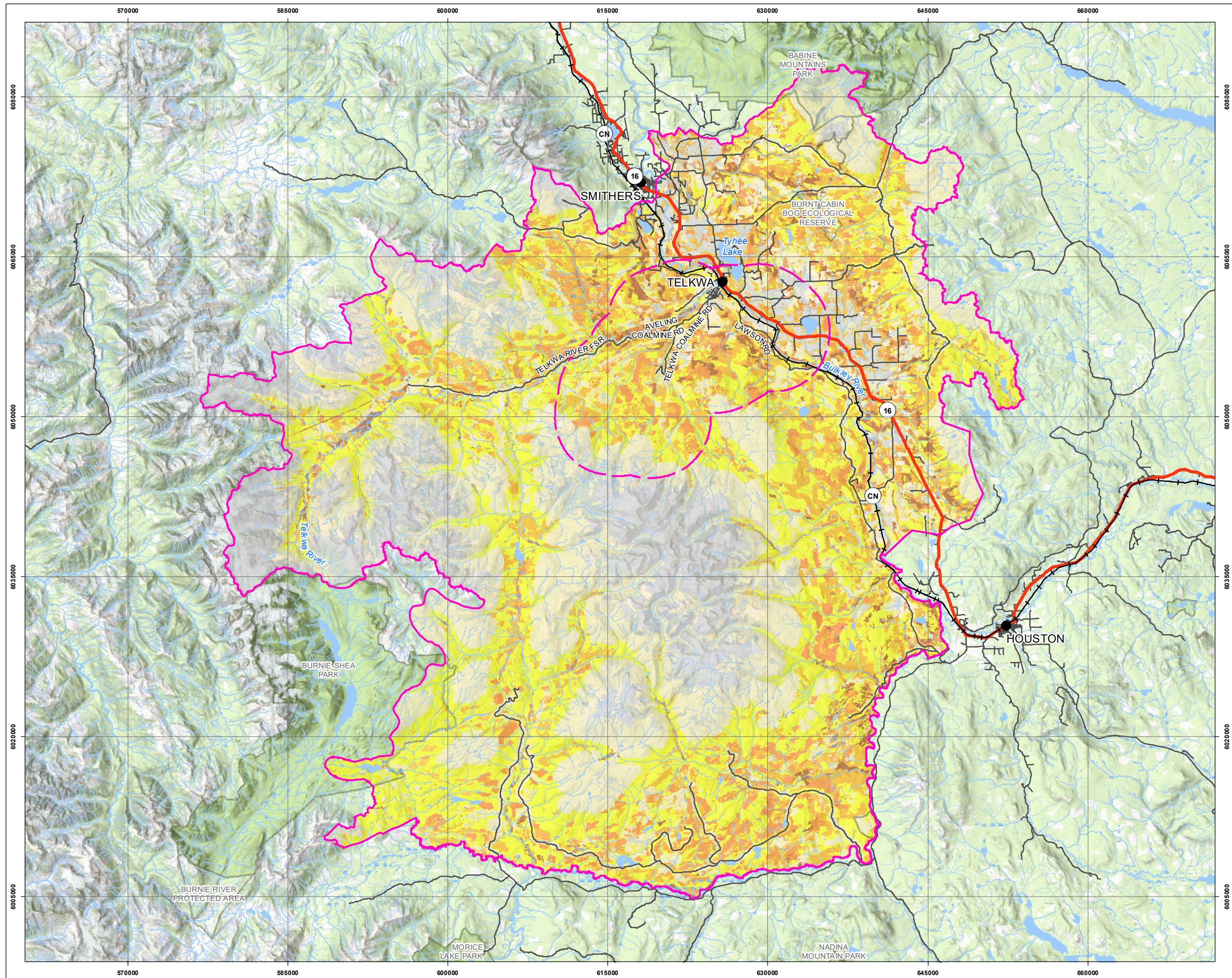


Path: L:\PROJECT\S2018\BP0421_Tenas_MinMap\map\REPORTING\TEA\Wildref\fig_2_3_MooseHabitat_202105.mxd



Tenas Project

Moose winter habitat suitability within the Wide-ranging Wildlife Regional Study Area

Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Wildlife Local Study Area
- Wilde-Ranging Wildlife Regional Study Area

Habitat Rating

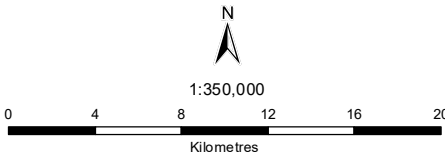
- High
- Moderately High
- Moderate
- Low
- Very Low
- Nil

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base



20P0172 Production Date: Aug 05, 2021 Figure 4.2-9

TELKWA COAL
LIMITED

EDI
ENVIRONMENTAL DESIGN INC.

4.2.5 Bats

4.2.5.1 Ultrasonic Monitoring

Bats were surveyed during the growing season (i.e., April through September) from 2017 to 2019 using Wildlife Acoustic's Song Meter 3Bat autonomous recording units (ARUs) to record bat calls. The ARUs were deployed at nine (9) locations within the WLSA that were chosen to include representative open, wetland, or other habitats (e.g., older forests, mixed forests) within the WLSA where potential feeding and roosting locations were expected to be available.

Kaleidoscope™ Pro version 5.1.6 (Wildlife Acoustics Inc.) was used to process ARU data using algorithms of bat species that may occur in the region. Each file was initially classified as a potential bat call, unknown recording, or noise, and each potential bat call classification was given a probabilistic identification to species. A manual review of the calls by biologists experienced in bat call identification was completed to confirm identifications.

Six (6) species of bats were identified through Kaleidoscope and manually confirmed, and an additional three (3) species were identified but not manually confirmed. Pallid bat (*Antrozous pallidus*) calls were identified but could not be confirmed during the baseline surveys. The closest confirmed population of this species occurs in the south Okanagan and typically occurs in arid habitats. Due to the distance from confirmed populations and the lack of suitable habitat, it is concluded that the potential detections were of vagrant individual(s) and that a population of pallid bat does not occur in the Project Area.

Little brown myotis was the most commonly detected species within the WLSA, and was detected in mature, mixed forest edge, young pine forest, and mature conifer forest edge habitats. Northern myotis was detected in all habitats surveyed. Most detections of long-eared myotis (*Myotis evotis*) occurred in mature conifer forest edge habitat. Hoary bat (*Lasiurus cinereus*) was detected in mature mixed forest edge and young pine forest. Almost all detections of silver haired bat (*Lasionycteris noctivagans*) and big brown bat (*Eptesicus fuscus*) were within mature mixed forest edge habitat.

Refer to **Appendix 4.8-A** for details on the methodologies and results for the ultrasonic bat surveys.

4.2.5.2 Forest Bat Habitat Suitability Modelling

Forest Bats (i.e., little brown myotis and northern myotis) habitat suitability models were developed for each of the life requisites of Foraging (Growing season), Security/Thermal (Growing season), Reproduction (Growing season), and Hibernation (Winter season). The Foraging and Reproduction models used a four (4)- class rating structure and the Security/Thermal and Hibernation models used a two (2)-class rating structure. A literature review of suitable habitat characteristics was used to create the initial models with mapped ecosystem data from the Vegetation Resource Inventory. Field ratings of Bat habitat suitability and Bat roost assessments were then used to test and adjust the habitat suitability models.

The Foraging habitat suitability model identified 30.9% of the WLSA and 21.2% of the WRSA as high and moderate rated habitat (i.e., suitable Bat habitat) (**Table 4.2- 4.2-9**). Most of the Foraging suitable habitat was in the lowlands of the Bulkley and Telkwa River valleys (**Figure 4.2-10**).

The Security/Thermal model identified 31.8% of the WLSA and 25.6% of the WRSA as suitable Bat habitat, potentially due to relatively older forest stands, dead standing trees, buildings, and urban areas in the WLSA than the WRSA (**Figure 4.2-11**).

The Reproduction habitat suitability model identified 12.3% of the WLSA and 10.8% of the WRSA as suitable Bat habitat. Most of the suitable habitat was located north of the Telkwa River and Tye Lake (Figure 4.2-12).

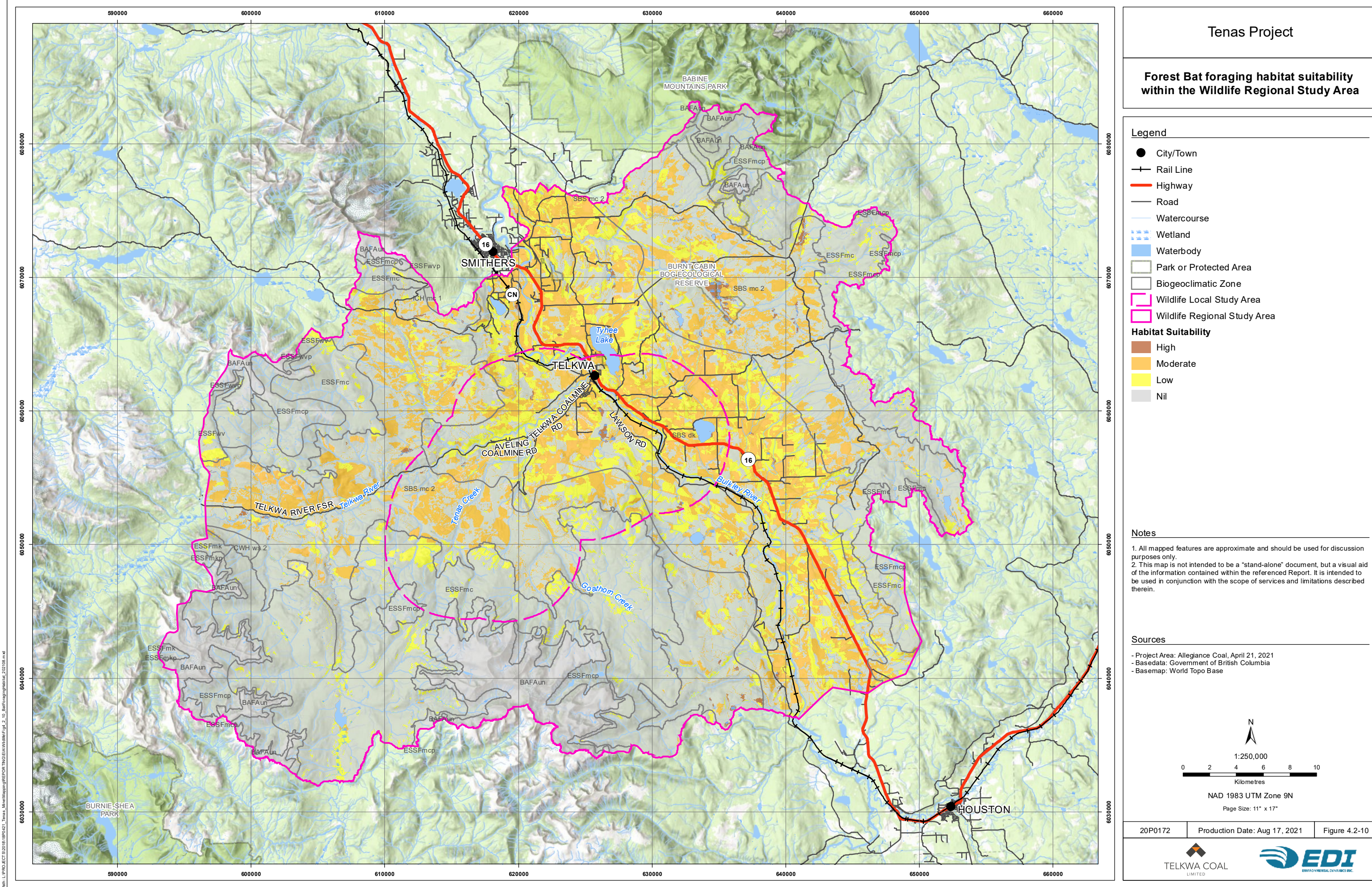
Suitable Hibernation habitat represented a small amount of both the WLSA (0.1%) and WRSA (0.2%), which included four abandoned underground mines in the WLSA (Figure 4.2-13).

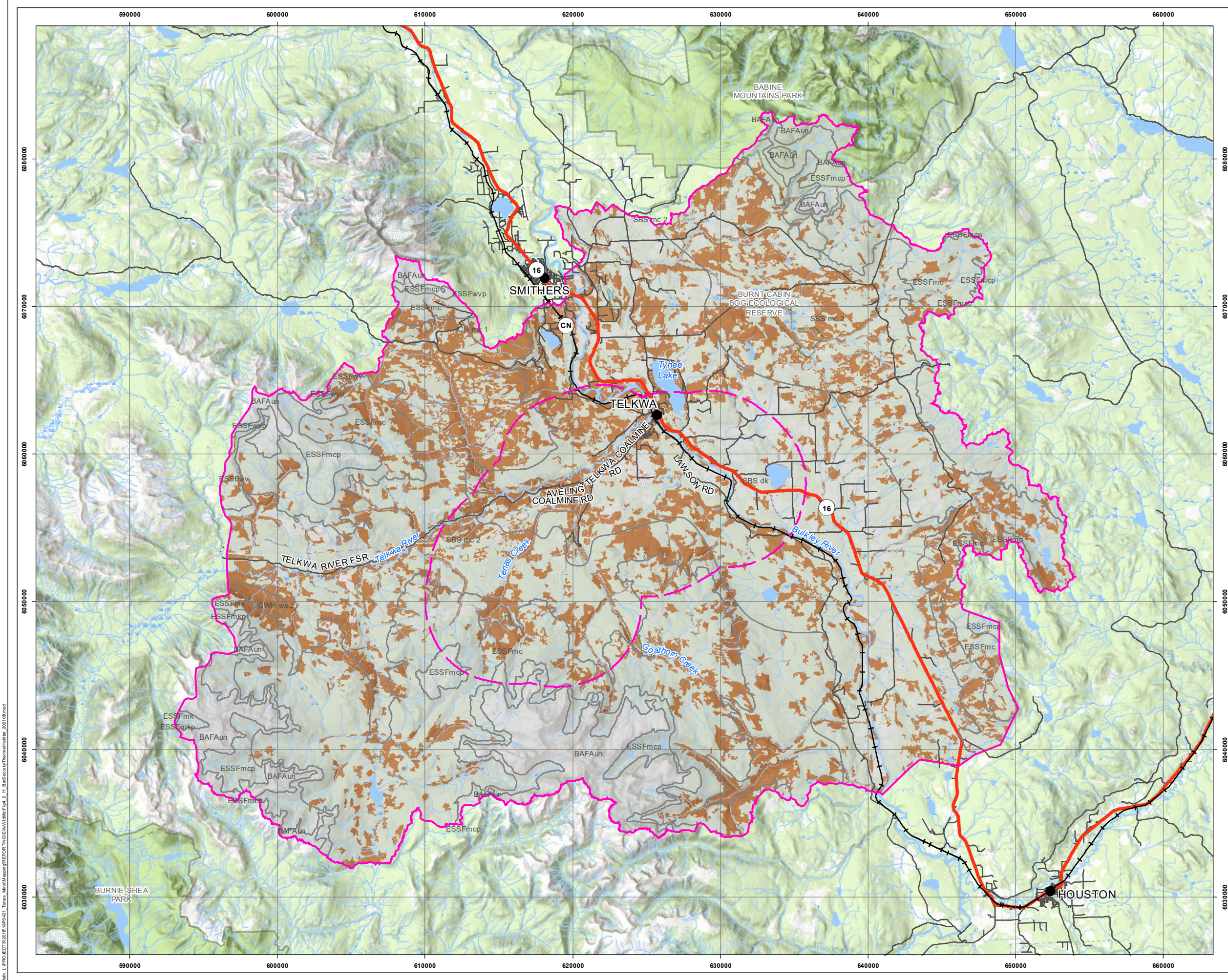
Refer to **Appendix 4.8-A** for details on the methodologies and results of the forest Bat habitat suitability model.

Table 4.2-9: Area and Percent of the Wildlife Local Study Area (WLSA) and Wildlife Regional Study Area (WRSA) for each Rating Class of the Forest Bat Foraging, Security/Thermal, Reproduction, and Hibernation Habitat Suitable Models

Model	Habitat Suitability Rating	WLSA (ha)	WLSA (%)	WRSA (ha)	WRSA (%)
Foraging	High	440.3	1.2	1,969.1	1.0
	Moderate	10,611.8	29.7	39,230.9	20.2
	Low	6,987.5	19.6	23,909.9	12.3
	Nil	17,686.3	49.5	129,540.6	66.6
	Total	35,725.9	100.0	194,650.5	100.0
Security/Thermal (Day/Night Roosting)	Suitable	11,350.2	31.8	49,796.4	25.6
	Unsuitable	24,375.7	68.2	144,854.0	74.4
	Total	35,725.9	100.0	194,650.5	100.0
Reproduction (Maternal Roosting)	High	2,350.0	6.6	9,866.9	5.1
	Moderate	2,052.4	5.7	11,021.2	5.7
	Low	2,534.5	7.1	10,668.1	5.5
	Nil	28,788.9	80.6	163,094.3	83.8
	Total	35,725.9	100.0	194,650.5	100.0
Hibernation	Suitable	23.4	0.1	414.4	0.2
	Unsuitable	35,702.5	99.9	194,236.1	99.8
	Total	35,725.9	100.0%	194,650.5	100.0

Notes: %=percent; ha=hectare; WLSA=Wildlife Local Study Area; WRSA=Wildlife Regional Study Area





Tenas Project

Forest Bat security/thermal habitat suitability within the Wildlife Regional Study Area

Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Biogeoclimatic Zone
- Wildlife Local Study Area
- Wildlife Regional Study Area
- Habitat Suitability**
 - Suitable
 - Not Suitable

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

1:250,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

20P0172

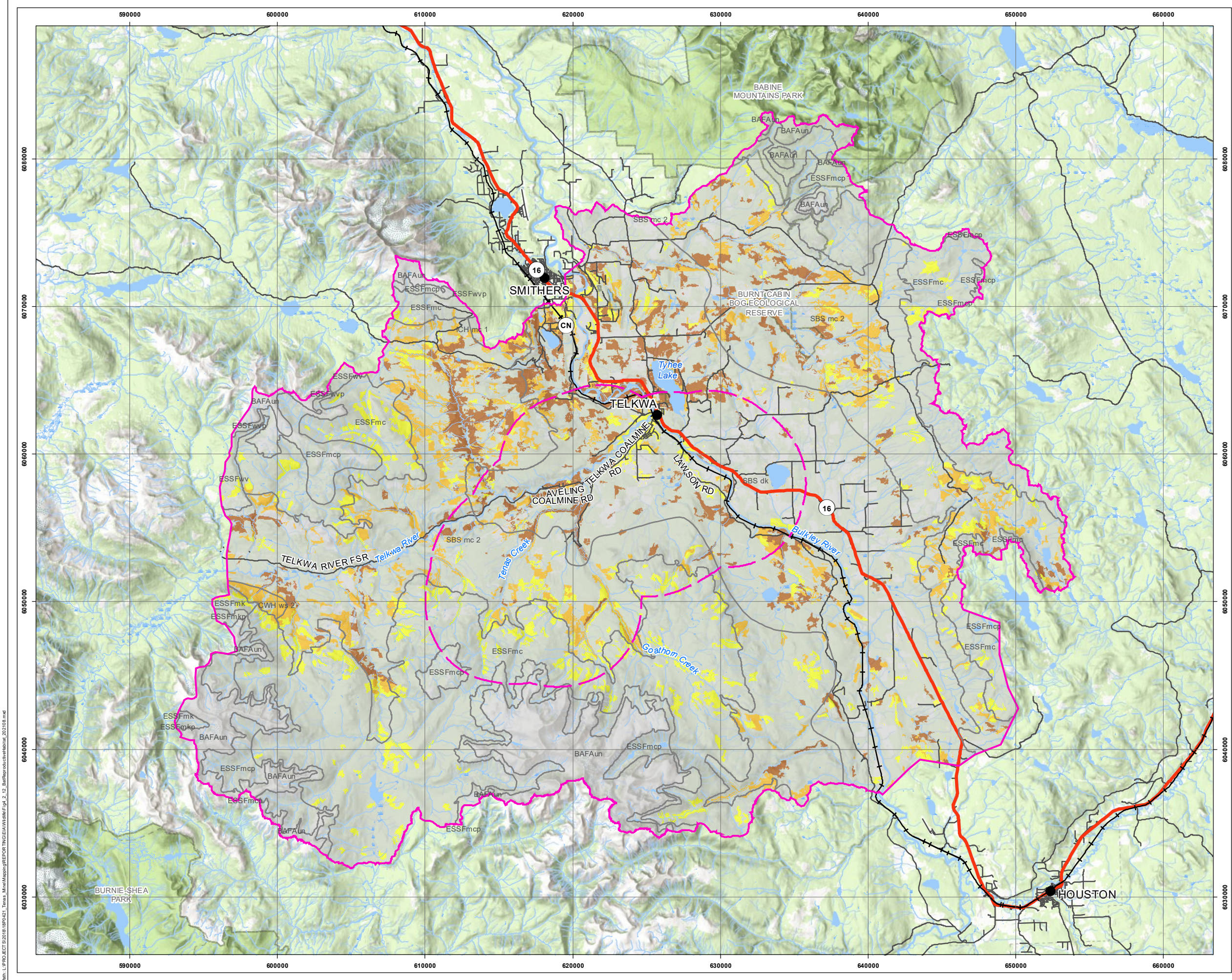
Production Date: Aug 17, 2021

Figure 4.2-11

TELKWA COAL LIMITED

EDI ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECT\2018\18P0172_Tenas_Mine\Map\REPORTING\EN\Wilder\fig_4.2-11_BatSecurityThermalHabitat.mxd, 2021-08-10



Tenas Project

Forest Bat reproductive habitat suitability within the Wildlife Regional Study Area

Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Biogeoclimatic Zone
- Wildlife Local Study Area
- Wildlife Regional Study Area

Habitat Suitability

- High
- Moderate
- Low
- Nil

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

1:250,000

Kilometres

NAD 1983 UTM Zone 9N

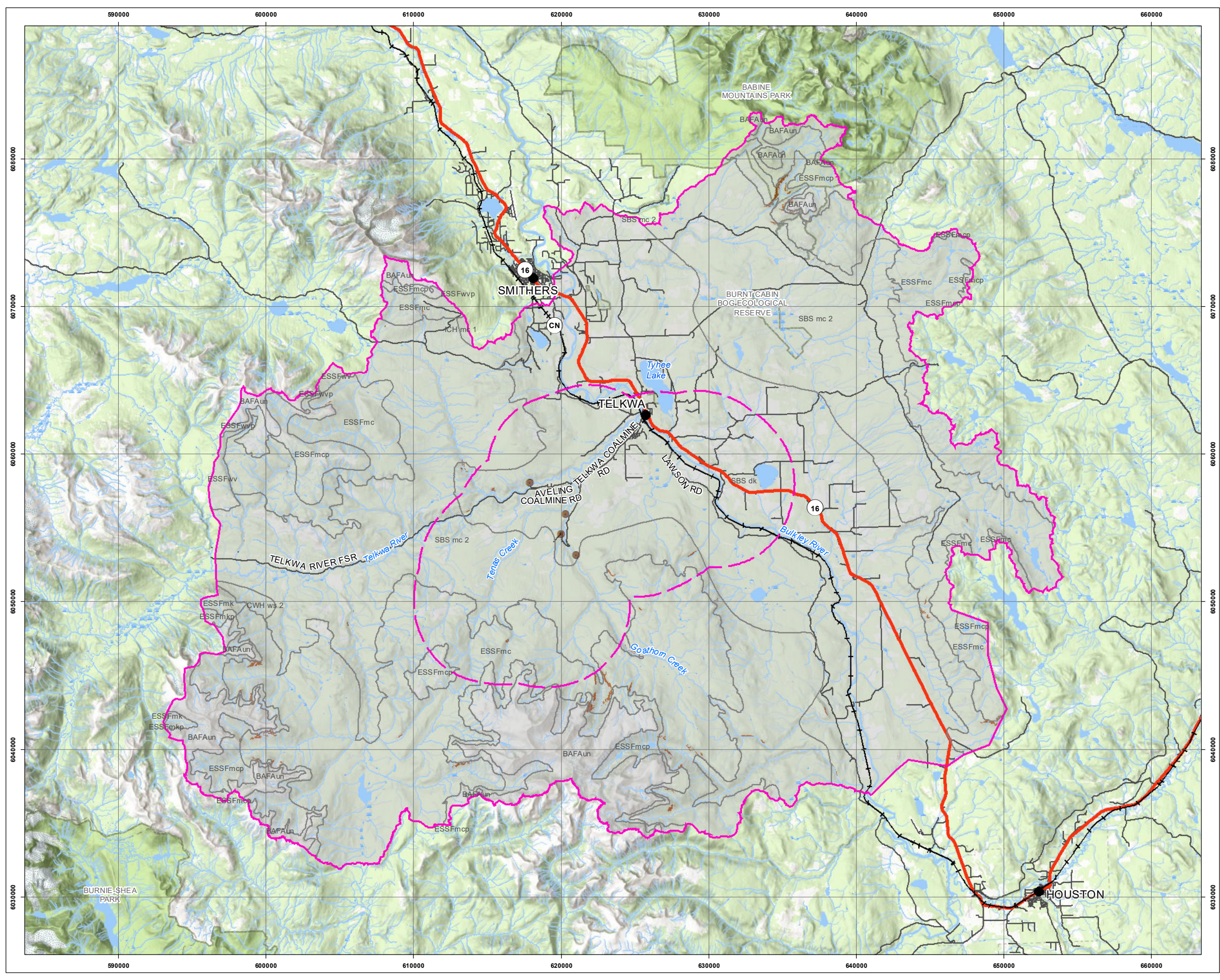
Page Size: 11" x 17"

20P0172

Production Date: Aug 17, 2021

Figure 4.2-12

Path: L:\PROJECTS\2018\18P0172_Tenas's Mine\Mapgen\REPORTING\ENVI\Wilder\fig_2_13_BatHibermatSuitability_202108.mxd



Tenas Project

Forest Bat hibernation habitat suitability within the Wildlife Regional Study Area

Legend

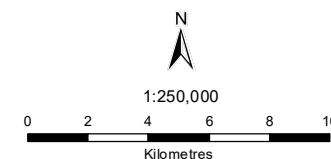
- City/Town
- +— Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Biogeoclimatic Zone
- Wildlife Local Study Area
- Wildlife Regional Study Area
- Habitat Suitability**
 - Suitable
 - Not Suitable
 - Abandoned Underground Mine

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base



NAD 1983 UTM Zone 9N
Page Size: 11" x 17"

20P0172

Production Date: Aug 17, 2021

Figure 4.2-13



4.2.6 Western Toad

4.2.6.1 *Amphibian Terrestrial and Aquatic Surveys*

Terrestrial and aquatic surveys were completed at 67 sites to assess for the presence, breeding status, and habitat use of amphibians. Aquatic surveys consisted of walking transects along the edges of the wetted portions of ponds and capturing amphibians with dipnets and traps for identification. Terrestrial surveys consisted of searching upland areas adjacent to wetlands and other waterbodies using transects and area-based searches in adjacent upland areas. Non-systematic visual searches for amphibians were also completed in both aquatic and terrestrial habitats.

Columbia spotted frog, long-toed salamander and Western Toad were detected during surveys and breeding was confirmed. Wood frogs were detected during surveys but breeding was not confirmed. Overall, 35% of the aquatic sites surveyed were found to have evidence of amphibian breeding.

Western Toads were the most frequently detected amphibian, being located at 35% of the amphibian survey sites. They were confirmed to breed at six (6) sites within the WLSA; two (2) within the Minesite; three (3) along the TAC; and one (1) within the Rail Infrastructure. Habitat used for breeding included ponds, wetlands, streams, and ditches. Two (2) potential movement paths were identified along the TAC.

Columbia spotted frogs were observed at 29% of the amphibian survey sites within the WLSA and breeding was confirmed at seven (7) sites and potentially at three (3) additional sites. Confirmed breeding was identified in wetlands, ponds, and ditches. Three (3) of the confirmed breeding sites were located within the Minesite, two (2) within the TAC and one (1) each in the Rail Infrastructure and Goathorn Creek areas.

Long-toed salamanders were detected at 24% of the amphibian survey sites, and breeding was documented at 16 sites within the WLSA. Most breeding sites were in ponds and wetlands, and a few were found in riparian areas, streams, and ditches.

Refer to **Appendix 4.8-A** for details on the methodologies and results of the baseline amphibian surveys.

4.2.6.2 *Amphibian Environmental Deoxyribonucleic Acid (eDNA) Sampling*

Water samples were collected from 42 potential amphibian aquatic habitats and analyzed for the presence of amphibian environmental deoxyribonucleic acid (eDNA) (Hobbs and Goldberg 2017). Samples obtained in 2017 were analyzed with known eDNA markers for coastal tailed frog and Western Toad, while samples in 2018 were analyzed for coastal tailed frog, Western Toad, Columbia spotted frog and wood frog.

The eDNA surveys detected three (3) amphibian species (i.e., Western Toad, Columbia spotted frog, and wood frog), and did not detect coastal tailed frogs (**Table 4.2-10**). A comparison between survey methods found that eDNA surveys detected amphibians at less than 50% of aquatic habitats where they had visually been confirmed. The eDNA surveys also suggested that amphibians were present at up to 35% of sites where no visual confirmations occurred. All three (3) species were detected using either method in or adjacent to Helps Creek, and western toads were detected in or adjacent to Tenas, Four, and Goathorn creeks.

Refer to **Appendix 4.8-A** for details on the methodologies and results of the baseline amphibian eDNA sampling.

Table 4.2-10: Results of Environmental Deoxyribonucleic Acid (eDNA) Sampling For Selected Amphibian Species within the Wildlife Local Study Area (WLSA)

Species Observed at Time of Sampling	Species Observed vs eDNA Species Test			No Species Observed vs eDNA Species Test		
	Positive	Negative	% Positive	Positive	Negative	% Positive
Coastal Tailed Frog1	-	-	-	0	6	0
Columbia Spotted Frog	2	6	25	3	14	18
Western Toad	8	9	47	8	15	35
Wood Frog	1	1	50	5	18	22

Notes: %=percent; eDNA=environmental deoxyribonucleic acid

1: No Coastal tailed frogs were observed within the WLSA during the 2017 to 2018 surveys. This supports other information and data that the Project Area is outside the extent of coastal tailed frogs, refer to **Appendix 4.8-A (Wildlife Baseline Report)**.

4.2.6.3 Reptile Hibernacula and Terrestrial Surveys

Terrestrial surveys were completed within the WLSA to survey for the presence of snakes and identify potential snake hibernacula sites. Surveys consisted of transects and spot searches looking into crevices and voids within potential habitat such as bedrock, boulder, talus slopes, and rocky outcroppings.

Adult common garter snakes were found at three (3) locations within the WLSA, including snakes at a known hibernaculum at the confluence of the Telkwa and Bulkley Rivers. A gravid common garter snake was found near the TAC.

Refer to **Appendix 4.8-A** for details on the methodologies and results of the baseline reptile surveys.

4.2.6.4 Western Toad Habitat Suitability Modelling

Western Toad habitat suitability models were developed for each of the life requisites of Living (Growing season), Reproduction (Growing season), and Hibernation (Winter season) using a four (4)-class rating structure. A literature review of suitable habitat characteristics was used to create the initial models with mapped ecosystem data from the Vegetation Resource Inventory. Field ratings of Western Toad habitat suitability and field surveys for Western Toad were then used to test and adjust the habitat suitability models.

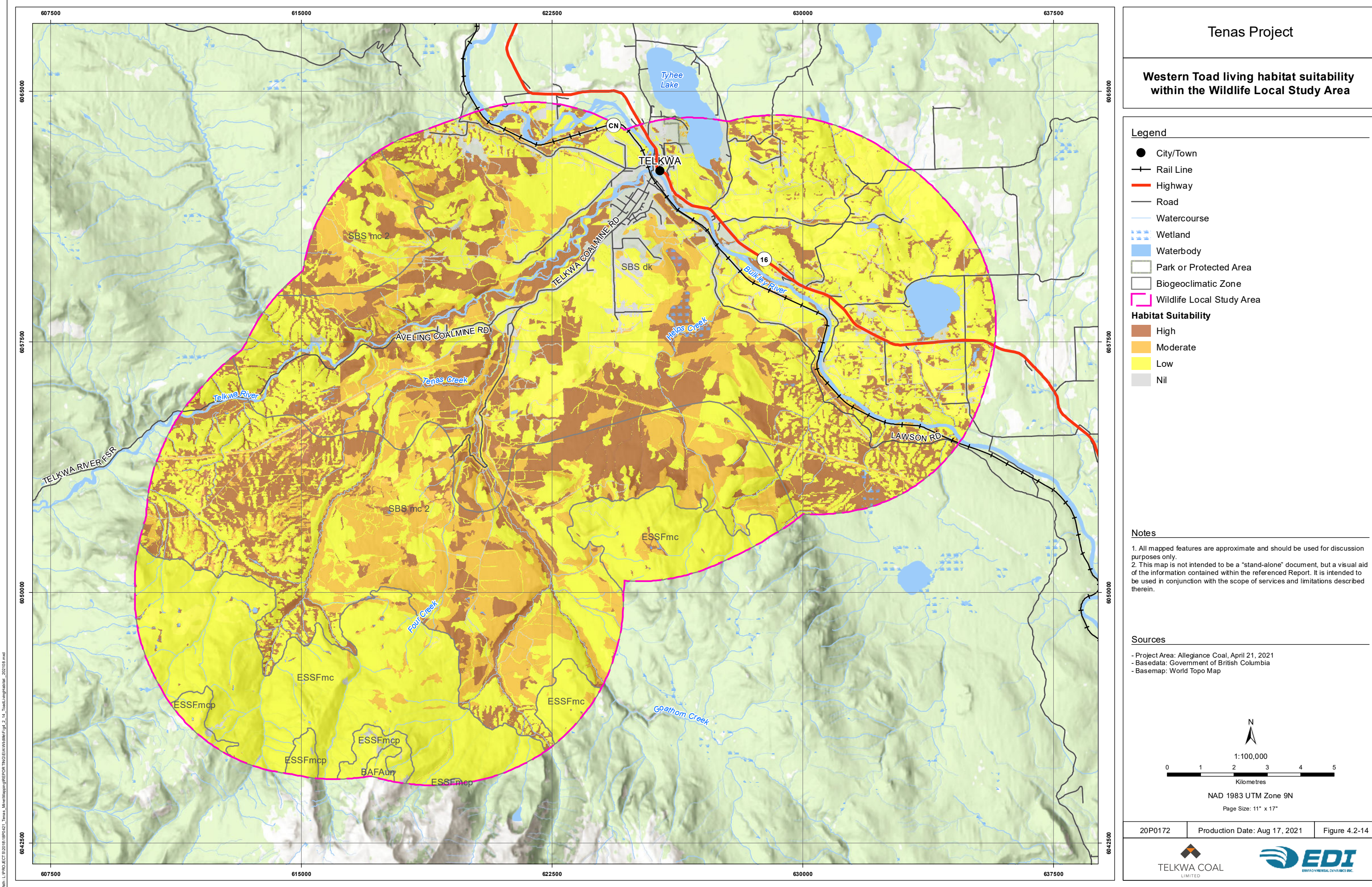
Model results for Living identified approximately 36.8% of the WLSA as suitable habitat (**Table 4.2- 4.2-11**), primarily within mature, moist coniferous forests within the SBSdk and SBSmc2 subzones (**Figure 4.2-14**). Suitable Reproduction habitat was limited within the WLSA, with only 1.8% identified as suitable (e.g., wetlands, ponds, and riparian habitat) (**Figure 4.2-15**). The Hibernation model identified 13.5% of the WLSA as suitable habitat, which was mostly within riparian areas and mature conifer habitats of the SBSmc2 and SBSdk subzones (**Figure 4.2-16**).

Refer to **Appendix 4.8-A** for details on the methodologies and results of the Western Toad habitat suitability model.

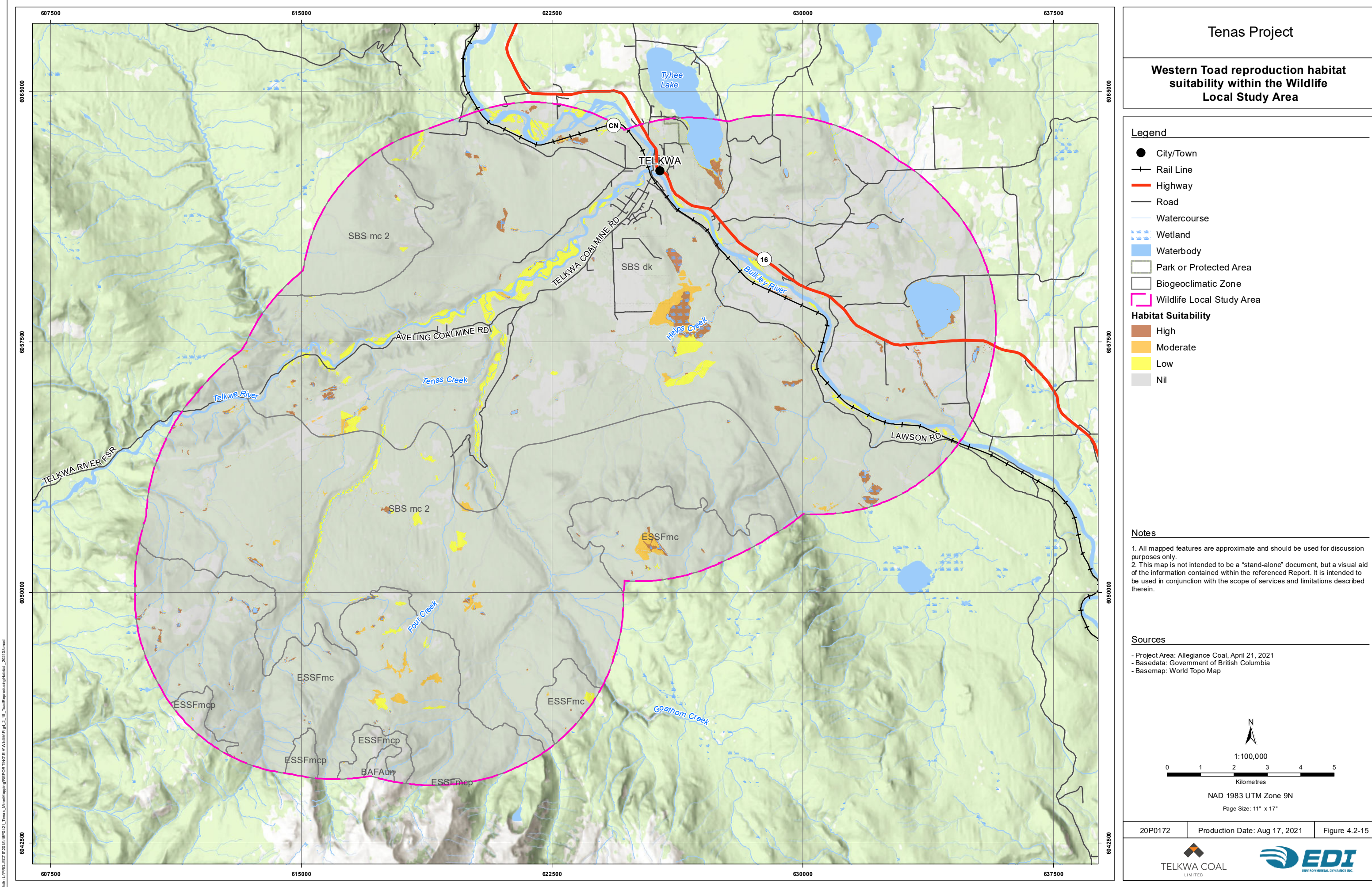
Table 4.2-11: Area and Percent of the Wildlife Local Study Area (WLSA) for Each Rating Class of the Western Toad Living, Reproduction, and Hibernation Habitat Suitable Models

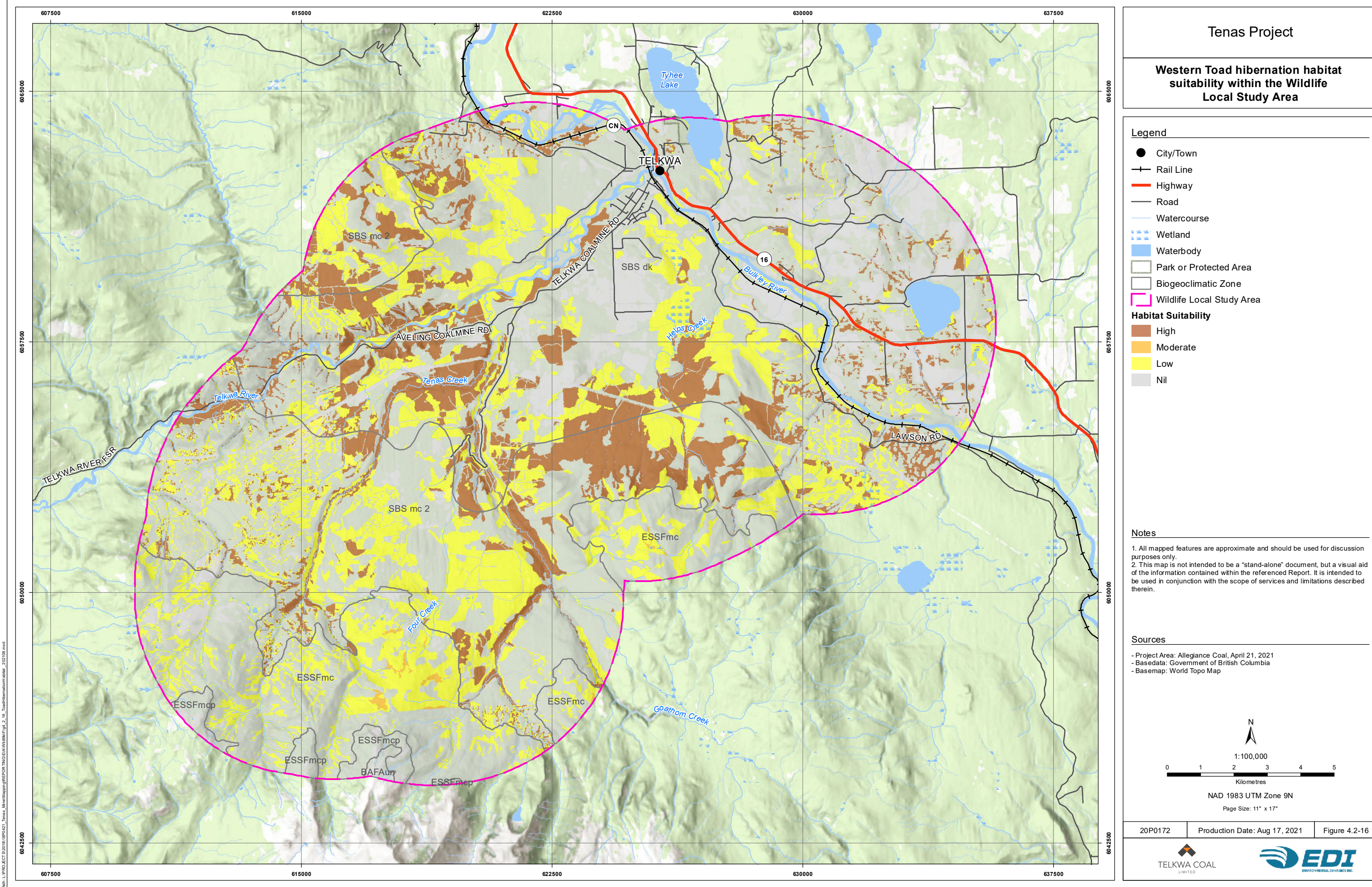
Life Requisites (Seasons)	Habitat Suitability Rating	WLSA (ha)	WLSA (%)
Living	High	7,704.7	21.6
	Moderate	5,431.4	15.2
	Low	20,055.6	56.1
	Nil	2,532.4	7.1
	Total	35,724.1	100.0
Reproduction	High	329.0	1.0
	Moderate	333.5	1.0
	Low	890.1	2.6
	Nil	34,171.4	95.7
	Total	35,724.1	100.0
Hibernation	High	4,703.4	13.2
	Moderate	58.2	0.2
	Low	8,115.7	22.7
	Nil	22,846.2	64.0
	Total	35,724.1	100.0

Notes: %=percent; ha=hectare; WLSA=Wildlife Local Study Area



Path: L:\PROJECT\2018\18P0172_Tenas's Mine\Map\REPORTING\ENR\Wetland\fig_2_14_Tenad_wetland_habitat_202108.mxd





5. ASSESSMENT OF PROJECT-RELATED EFFECTS

The information provided within this subsection includes:

- ▶ identification of potential interactions between the Project and the Wildlife VC;
- ▶ description of potential adverse Project effects on the Wildlife VC;
- ▶ identification of measures to avoid, manage or otherwise mitigate potential adverse effects on the Wildlife VC; and
- ▶ characterisation of Project residual effects and determination of their significance on the Wildlife VC.

5.1 Potential Project-related Interactions with the Wildlife Valued Component (VC)

This subsection focuses the assessment on those Project interactions with potential to adversely affect the Wildlife VC. Project-related interactions between the Wildlife VC and identified Project activities are considered. Project-related interactions and the likelihood of the interaction were determined with spatial analysis of the extent of the Project's potential effects and existing conditions of the Wildlife VC (see **S4.0 Environmental Effects Assessment**). Each potential interaction is rated using the terms provided in **Table 5.1-1**. Based on the evaluation, potential interactions between the Project and the Wildlife VC were carried forward into the assessment to determine the effects of the interaction.

Table 5.1-1: Potential for an Interaction between the Wildlife Valued Component (VC) and the Tenas Project (Project)

Term	Definition
No Interaction	Tenas Project (Project) activity will not interact with the Wildlife Valued Component (VC) and no adverse effect is expected; no additional consideration is warranted.
Interaction	Interaction between the Project activity and the Wildlife VC may have a substantive influence on the short- or long-term integrity of the VC (i.e., measurable, or detectable using the identified Indicator). The potential effect(s) of the interaction is considered further in the effects assessment.

Table 5.1-2 provides a summary of potential interactions between Project components or activities and Wildlife VC subcomponents. Interactions expected to result in potential effects on the Wildlife VC are discussed further in **5.2 Potential Project-related Effects**. When no interaction between the Project and a subcomponent is anticipated, or the interaction is considered Minor (i.e., not expected to have a substantive influence on the short- or long-term integrity of the subcomponent as the effect would not be measurable or detectable using the identified Indicator), the interaction is not considered further in the assessment.

Table 5.1-2: Potential for an Interaction between the Wildlife Subcomponents and the Project

Project Activities	Wildlife Subcomponents					
	Furbearers	Caribou	Grizzly Bear	Moose	Bats	Western Toad
Construction						
Transportation of equipment, materials, and personnel	X	X	X	X	X	X
Site clearing (surveying, clearing, grubbing, soil salvaging)	X	X	X	X	X	X
Construction of Surface Water Management Infrastructure, including channels and ponds (sedimentation, control, management, storage)	X	X	X	X	X	X
Construction of Bypass Road and quarries from the Minesite to the Rail Infrastructure	X	X	X	X	X	X
Improvements to existing private road and Forest Service Roads	X	X	X	X	X	X
Construction of haul roads and service roads within the Minesite	X	X	X	X	X	X
Construction of the permanent Goathorn Bridge Crossing over Goathorn Creek	X	X	X	X	X	X
Construction of the Coal Processing Plant	X	X	X	X	X	X
Construction of fuel and lubricant storage facilities and distribution network	X	X	X	X	X	X
Construction of administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, parking, and vehicle wash facilities)	X	X	X	X	X	X
Construction of a 25 kilovolt (kV) power line and a 600 volt (V) substation adjacent to the Coal Processing Plant	X	X	X	X	X	X
Construction of Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line	X	X	X	X	X	X
Installation of water supply wells, storage, and distribution system	X	X	X	X	X	X
Construction of the water discharge infrastructure	X	X	X	X	X	X
Construction of storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X	X	X	X	X	X
Construction of material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	X	X	X	X	X	X
Construction of solid waste management systems including recycling and composting facilities	X	X	X	X	X	X
Construction of Explosives Magazine (storage building)	X	X	X	X	X	X
Employment and labour						
Operation						
Mining the open Pit (soil salvaging, drilling and blasting, excavation of material, dewatering, loading, hauling, unloading)	X	X	X	X	X	X
Operation of Surface Water Management Infrastructure including channels and ponds (sedimentation, control, management, storage)	X	X	X	X		X
Maintain and use Bypass Road and quarries from the Minesite to the Rail Infrastructure	X	X	X	X	X	X
Maintain improved private and Forest Service Roads	X	X	X	X	X	X
Maintain haul roads within the Minesite, including service roads	X	X	X	X	X	X
Maintain permanent bridge over Goathorn Creek	X	X	X	X	X	X
Operate Coal Processing Plant	X	X	X	X	X	X
Maintain fuel and lubricant storage facilities	X	X	X	X		X
Maintain administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, and vehicle wash facilities)	X	X	X	X	X	X
Maintain 25 kV power line and a 600 V substation adjacent to the Coal Processing Plant	X	X	X	X		X
Transportation of equipment, materials, and personnel	X	X	X	X	X	X
Maintain and use Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line	X	X	X	X	X	X
Operate water supply wells, storage, and distribution system	X	X	X	X		X
Operate the spillway	X	X	X	X		X
Maintain storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X	X	X	X		

Project Activities	Wildlife Subcomponents					
	Furbearers	Caribou	Grizzly Bear	Moose	Bats	Western Toad
Operate material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	X	X	X	X		X
Operate solid waste management systems including recycling and composting facilities	X	X	X	X		
Maintain Explosives Magazine (storage building)	X	X	X	X		
Progressive reclamation	X	X	X	X	X	X
Employment and labour						
Decommissioning and Reclamation						
Dismantle and remove mining equipment and facilities (including powerline, Rail Infrastructure)	X	X	X	X	X	X
Transportation of equipment, materials, and personnel	X	X	X	X	X	X
Reclamation and closure activities at Minesite	X	X	X	X	X	X
Reclamation and closure of Bypass Road and haul roads, including borrow pits	X	X	X	X	X	X
Reclamation and closure of permanent bridge over Goathorn Creek	X	X	X	X	X	X
Reclamation and closure of powerlines	X	X	X	X	X	X
Reclamation and closure of Rail Infrastructure	X	X	X	X	X	X
Implement post-mining systems and monitoring	X	X	X	X	X	X
Employment and labour						
Post-closure						
Maintain post-mining systems and ongoing monitoring	X	X	X	X	X	X
Transportation of equipment, materials, and personnel	X	X	X	X	X	X
Employment and labour						

Notes:
Interaction (X): Interaction between the Project activity and the VC may have a substantive influence on the short- or long-term integrity of the VC (i.e., measurable or detectable using the identified indicator). The potential effect(s) of the interaction is considered further in the effects assessment.
No interaction (Blank): Project activity will not interact with the VC; no adverse effect is expected; no further consideration is warranted.

Project activity-VC interactions that are expected to result in potential effects on the Wildlife VC include those that are anticipated to result in direct habitat loss during the Construction Phase or indirect habitat alteration during the Construction, Operation, Decommissioning and Reclamation, and/or Post-closure phases. They also include those that are anticipated to result in changes in mortality or movement on the Wildlife VC during the Construction, Operation, Decommissioning and Reclamation, and/or Post-closure phases.

For the Wildlife VC, the only Project activity-VC interaction that was excluded from further assessment is Employment and labour during all Project phases. This Project activity-VC interaction was excluded because it is not expected to result in potential effects (e.g., direct habitat loss, indirect habitat alteration, or changes in mortality or movement) on the Wildlife VC.

5.2 Potential Project-related Effects

Based on the timing and nature of the interactions identified in **Table 5.1-2**, the following adverse effects have the potential to occur as predicted within the Project AIR (BC EAO 2022):

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns.

The potential effects are described in **5.2.1** as they relate to the Project phases. They are expected to affect Wildlife VC subcomponents through similar effect pathways (described in the following paragraphs); however, **5.2.2** through **5.2.7** describe how the three potential effects considered for the Wildlife VC subcomponents may affect each subcomponent specifically.

Mitigation measures for each potential effect and those specific to the Wildlife VC are described in **5.3**.

5.2.1 Wildlife Valued Component (VC)

5.2.1.1 *Alteration and/or Loss of Habitat*

Alteration and/or loss of habitat for wildlife species, as indicated by a change in habitat availability, includes both direct and indirect changes. Direct habitat loss occurs where suitable habitat is physically disturbed or removed to the extent that the area is rendered functionally unsuitable for wildlife use, e.g., when vegetation or other features (such as dens or wildlife trees) are cleared or affected during the lifetime of a project. Alteration of habitat is indirect habitat disturbance where suitable habitat remains physically intact, but its suitability is reduced or a minimum habitat size threshold is not met (Muhly et al. 2015, Crooks et al. 2017). Indirect effects that alter habitat can include edge effects, fragmentation, patch size alterations, and sensory disturbances (e.g., noise, light, dust deposition, or human presence).

As habitat is lost, a minimum patch size is often required for an individual to occupy or use an isolated patch on a landscape (Robbins et al. 1989, Askins 1994). When available suitable habitat is below a minimum patch threshold, a reduction in occupancy or use may occur despite the continued presence of suitable habitat. As a result, patch size, both on an individual and population level, may have a species-specific effect on use of suitable habitat (Reunanen and Nikula 2002, Homan et al. 2004).

Edge habitat is an area on either side of a border between vegetation communities. Edges between vegetation communities often result in altered microclimatic conditions that can modify habitat quality in habitat further away from the edge (Geiger 1957). Edge habitat can adversely affect wildlife that require interior forest conditions. Differences in vegetative communities and structure at forest edges often result

in altered microclimatic conditions relative to interior forest habitat (Geiger 1957). If changes to microclimatic conditions or vegetative structure at an edge exceed a species habitat preference or physiological tolerance, then edge habitat may result in lower occupancy or use, reduced survival, or lowered reproductive success (Donovan et al. 1997, Chen et al. 1995, Goosem 2000, Winter et al. 2000, Woodward et al. 2001, Moseley et al. 2009).

Sensory disturbances are anticipated to alter habitat; however, the extent of the alteration will vary by species, age, and sex. Caribou may avoid anthropogenic features with varying levels of human activity, Grizzly Bears may avoid roads with regular traffic, some Furbearer species (e.g., marten) may not be highly sensitive to sensory disturbances, and Moose may select areas with sensory disturbances to avoid predators (Stephens and Peterson 1984, Chapin et al. 1998, Weir et al. 2007, Beyer et al. 2013). Artificial lighting (e.g., area lighting, floodlights, illumination around buildings) can disrupt habitat use and alter habitat connectivity, affect the use of habitat for foraging and breeding in bats and amphibians, (Buchanan 2006, Bliss-Ketchum et al. 2012, Rich and Longcore 2013, Schirmer et al. 2019). Anthropogenic noise can cause short-term habitat avoidance when the noise sources are present and wildlife may return when noise levels decrease; however, loud noises (e.g., blasting) can cause long-term habitat avoidance (Bowles 1995). Vehicle and train traffic, which can cause both visual and auditory disturbances, can result in some wildlife avoiding areas with increasing traffic and disturbance intensity (Northrup et al. 2012, Leblond et al. 2013). Dust and trace metal deposition from traffic and coal handling processes are expected to contribute to habitat alteration for Wildlife VC subcomponents as they may affect palatability of vegetation (Chen et al. 2017).

5.2.1.1.1 Construction Phase

Alteration and/or loss of habitat for wildlife species is expected to occur during all Project phases; however, most of the Project effects are expected to occur during the Construction Phase. Vegetation clearing, soil movement, and surface water management may result in a loss of habitat or a reduction in habitat quality. Site clearing, soil salvaging, stockpiling, and grading will occur within the Project Area, resulting in the direct loss of vegetation, and potential wildlife habitat. Areas within the Project Area but outside of a Project component footprint are not expected to require soil disturbance and topsoil will remain in place (e.g., above-ground water distribution system, water discharge infrastructure, areas within the powerline ROW where structures are not planned).

The alteration of habitat, including sensory disturbances, are anticipated to begin during the Construction Phase and continue through to the Post-closure Phase; however, it is expected that the alteration of habitat due to sensory disturbances will decrease after the Operation Phase when Project-related activities decrease.

The effect of alteration and/or loss of habitat on wildlife species is anticipated to occur during the Construction Phase but will continue during the remaining Project phases and until Project activities decrease, Project components are removed, and disturbed habitat is revegetated and starts to provide suitable habitat for some Wildlife VC subcomponents.

5.2.1.1.2 Operation Phase

Direct habitat loss is expected to be limited during the Operation Phase; however, the alteration of habitat by sensory disturbances (e.g., vehicle / train traffic, artificial lighting, blasting, dust deposition, maintaining and operating site facilities, human presence), edge effects, fragmentation, patch size, changes to water quantity and quality, and dust deposition are expected to continue through the Operation Phase. Potential dust and trace metals deposition is expected to be highest during the Operation Phase as a result from drilling and blasting, operation and management and coal, and maintenance of material storage piles.

Maintenance will occur along the ROWs of existing roads, haul roads, Rail Infrastructure, and transmission lines that are expected to limit the progression of succession and the regeneration of forest habitat. Progressive reclamation is expected to be positive as revegetation is initiated in reclaimed areas.

5.2.1.1.3 *Decommissioning and Reclamation Phase*

Direct loss of wildlife habitat is not expected during the Decommissioning and Reclamation Phase; however, the alteration of habitat is expected to continue during the Decommissioning and Reclamation Phase. Progressive reclamation is expected to continue and result in positive effects as revegetation is continued in reclaimed areas.

5.2.1.1.4 *Post-closure Phase*

The overall effect of habitat alteration and/or loss on the Wildlife VC during the Post-closure Phase is expected to be positive as regeneration of vegetation is expected to continue within reclaimed areas. No direct loss of habitat is expected to occur during this phase; however, alteration may occur due to indirect effects such as sensory disturbances (e.g., vehicle traffic, dust deposition, or human presence).

5.2.1.2 *Change in Mortality*

Change in mortality, both direct and indirect, can alter population abundance and distribution of a Wildlife VC subcomponent. Mortality may result from collisions (i.e., with vehicles, trains, equipment, and Project components), changes in predator-prey dynamics, increased competition for food and other resources, increased hunter access, changes in animal health (e.g., higher stress levels and/or lower body condition), and increased human-wildlife encounters. Potential mortality from Project activities is anticipated to start during the Construction Phase and persist until Post-closure Phase.

5.2.1.2.1 *Construction Phase*

The effect of a change in mortality of wildlife species is expected to begin during the Construction Phase when initial Project-related activities begin and continue through to the Post-closure Phase. The potential effect of change in mortality is species-specific and based on the likelihood of a species encountering sources of potential direct or indirect mortality. Mortality may be caused directly by Project components and activities (e.g., vehicle/train-wildlife collisions; destruction of occupied den sites and hibernacula), or entrapment in Project facilities (such as buildings or Surface Water Management Infrastructure) (Knight and Gutzwiller 1995, Ashley and Robinson 1996, CBC et al. 2014) or indirectly when interactions with Project components and activities contribute to other sources of mortality (e.g., increased hunting, trapping, poaching, and management actions associated with the removal of nuisance animals) (Boer 1990, Beazley et al. 2004). Sensory disturbances from Project activities can result in chronic stress, which in turn may reduce body condition and increased predation risk in some species (Maier 1996, Barber et al. 2010, Ewacha 2016).

The activities expected to have the highest potential for mortality of wildlife species are likely related to site clearing during the Construction Phase when the Project Area is cleared of vegetation, and the transport of equipment, materials, and personnel, resulting in increased traffic during Construction, and Operation phases. Reductions in habitat, through decreased habitat effectiveness (i.e., alteration) or loss, may also contribute to indirect mortality due to increased intra-specific competition for available food and habitat (Buskirk 2000), as well as increased predation risk and hunting efficiency (Gehr et al. 2018, Viejou et al. 2018).

Ingestion of contaminants of potential concern (COPC) is a potential pathway that may result in effects on wildlife species. The predicted water quality data (**S4.0-C3 Surface Water VC** of the **EAC Application**) were used to screen parameters with an aim to establish COPC for ingestion exposure (consuming water) by wildlife species. The parameters were screened through a comparison of predicted (modelled) mean monthly concentrations to relevant Canadian benchmarks, specifically:

- ▶ British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS) water quality guidelines (WQGs) for the protection of aquatic life (to address concerns pertaining to amphibians¹);
- ▶ BC MECCS water quality guidelines (WQGs) for the protection of wildlife and livestock; and
- ▶ Canadian Council of Ministers of the Environment (CCME) WQG for the protection of agricultural water uses – livestock.

Exceedance factors of less than 1 indicated no risk to biota, while those greater than 1 required further evaluation. Exceedance factor is the maximum predicted value divided by the lowest guideline for that parameter or the Site Performance Objective (SPO) where one has been derived for this Project.

Table 5.2-1 presents the results of the COPC screening conducted. Given that Site Performance Objectives (SPOs) were derived for seven (7) of the site parameters (i.e., aluminum, cobalt, cadmium, nitrite, selenium, sulfate, and thallium) for this Project (by the Windward/Borealis team), COPC screening was conducted for the guidelines and the SPO values listed above. Additional detail is provided in the **S4.0-C3 Surface Water VC** on the context and baseline conditions for these seven (7) parameters.

Based on this screening exercise, one (1) of the parameters—aluminum—yielded an exceedance factor of >1 (i.e., concentration was above WQGs and its SPO). The predicted exceedance factor was 1.25. This required further assessment to evaluate potential risks to wildlife.

The predicted aluminum concentrations exceed aquatic life guideline, and an amphibian species was used to evaluate the context of risk. Aluminum toxicity data are generally rare, and, therefore, a wide range of appropriate toxicity reference values (TRV) are not available to use as benchmarks. Recently, ECCC derived and published a federal environmental quality guideline (FEQG) for aluminum (ECCC 2021). As part of the aquatic toxicity profile for aluminum (ECCC 2021; Table 4), a normalized² effect concentration of 0.421 milligram per litre (mg/L) (based on a 7-day no observed effect concentration (NOEC) endpoint for the common toad, *Bufo bufo*) is cited, based on data from Gardner et al. (2002). Using this benchmark for comparison to the predicted maximum mean monthly concentration for aluminum (i.e., 0.26 mg/L), the exceedance factor (i.e., the maximum mean monthly value over the aluminum TRV for amphibians = $0.26/0.421=0.62$), indicates an exceedance factor of < 1 and, therefore, poses limited risk to amphibians.

The COPC are not predicted to result in an adverse effect on the Wildlife Species VC and were scoped out of the assessment from this point forward due to this screening-level analysis.

¹Aquatic organisms other than amphibians are assessed in other sections of the environmental assessment (i.e., aquatic effects assessment).

²Normalized to pH=7.5, DOC=0.5 milligram per litre (mg/L), hardness=50 mg/L (ECCC 2021).

Table 5.2-1: Screening of Water Quality Parameters Against Aquatic Life, Wildlife, Livestock Guidelines, and Site Performance Objectives

Parameter	Maximum Modelled Mean Monthly (mg/L)	Location of Greatest Exceedance of WQG	Lowest BC or CCME WQG (Aquatic, Wildlife or Livestock) ¹	SPO	Exceedance Factor WQG (Maximum Modelled Mean/WQG)	Exceedance Factor SPO (Maximum Modelled Mean/SPO)
Aluminum, total	0.26	Telkwa R, S09	0.1	0.208	2.60	1.25
Arsenic, total	0.0016	Four Cr, S03_DS	0.005		0.32	-
Beryllium, total	0.000082	Four Cr, S03_DS	0.00013		0.63	-
Boron, total	0.21	Four Cr, S03_DS	1.2		0.18	-
Cadmium, dissolved	0.00026	Four Cr, S03_DS	0.00008	0.00026	3.25	1.00
Chloride	13	Four Cr, S03_DS	100		0.13	-
Chromium, total	0.0021	Four Cr, S03_DS	0.0049		0.43	-
Cobalt, total	0.0011	Four Cr, S03_DS	0.001	0.0174	1.10	0.06
Copper, total	0.0041	Four Cr, S03_DS	0.0047		0.87	-
Fluoride	0.095	Four Cr, S03_DS	0.12		0.79	-
Iron, total	0.47	Telkwa R, S09	1		0.47	-
Lead, total	0.0004	Four Cr, S03_DS	0.004		0.10	-
Manganese, total	0.057	Four Cr, S03_DS	0.1		0.57	-
Mercury, total	0.0000025	Four Cr, S03_DS	0.00001		0.25	-
Molybdenum, total	0.0036	Four Cr, S03_DS	0.01		0.36	-
Nickel, total	0.004	Four Cr, S03_DS	0.025		0.16	-
Nitrate	1.9	Tenas Cr, S04	3		0.63	-
Nitrite	0.045	Tenas Cr, S04	0.02	0.0524	2.25	0.86
Selenium, total	0.0058	Four Cr, S03_DS	0.002	0.008	2.90	0.73
Silver, total	0.000005	Four Cr, S03_DS	0.00005		0.10	-
Strontium	0.89	Four Cr, S03_DS	7		0.13	-
Sulfate	360	Four Cr, S03_DS	128	593	2.81	0.61
Thallium	0.00027	Four Cr, S03_DS	0.0008		0.34	
Uranium	0.0022	Four Cr, S03_DS	0.0085		0.26	-
Zinc	0.0074	Four Cr, S03_DS	0.023		0.32	-

Notes: BC=British Columbia; WQG = Water Quality Guidelines; CCME=Canadian Council of Ministers of the Environment; mg/L=milligram per litre; SPO = Site Performance Objective

1 = BC or CCME WQG for stream with highest modelled concentration

5.2.1.2.2 *Operation Phase*

Direct and indirect changes in mortality are expected to continue during the Operation Phase. Collisions with Project vehicles, trains, equipment, and components (e.g., buildings) may result in direct mortality of wildlife. Direct mortality may occur during Project-related activities (e.g., vegetation management, snow management, maintenance work) along the ROW of linear Project features (e.g., roads, Rail Infrastructure, powerline). Entrapment in Project components (e.g., buildings, pits, settling ponds) and due to Project activities (i.e., snow berms created during snow management) may also result in direct mortality of wildlife (e.g., drowning, vehicle collisions). Spills of fuels and other hazardous materials, malfunctions, and other accidents may result in contamination of wildlife habitat and indirectly affect a change in mortality. Exposure to hazardous materials (e.g., wildlife gaining access to settling ponds; individuals exposed to chemicals from herbicide spraying or trace metal depositions) could affect wildlife health and with that contribute to mortality. Indirect mortality may occur through increased and more efficient hunter, trapper, and predator access to the Project Area via ROWs, decreased wildlife health (e.g., increased stress, reduced body condition), and increased inter and intra-specific competition for resources.

5.2.1.2.3 *Decommissioning and Reclamation Phase*

Direct and indirect changes in mortality are expected during the Decommissioning and Reclamation Phase, but at a reduced level in concert with reductions in Project activity and removal of Project components. Collisions with Project vehicles, equipment, and components (e.g., buildings) may result in direct mortality of wildlife. Spills of fuels and other hazardous materials, malfunctions, and other accidents may result in contamination of wildlife habitat and indirectly affect a change in mortality. Indirect mortality may also occur through increased and more efficient hunter and predator access to the Project Area via ROWs, decreased wildlife health (e.g., increased stress, reduced body condition), and increased inter and intra-specific competition for resources. Overall, the potential for the effect of a change in mortality is expected to decrease as Project-related activities decrease, Project infrastructure is removed, and reclamation activities revegetate the Project Footprint.

5.2.1.2.4 *Post-closure Phase*

The effect of change in mortality on the Wildlife VC is expected to be limited during the Post-closure Phase. Project activities onsite during the Post-closure Phase will be limited and all Project components will be removed, resulting in a reduced risk of vehicle and/or train collisions with wildlife, exposure to hazardous materials (e.g., spills), and risk of entrapment.

5.2.1.3 *Change in Movement Patterns*

Change in movement patterns may affect the ability of wildlife to interact (e.g., breed, aggregate, access food, and escape predators) and may result in changes to population abundance and distribution. Project components and activities that may affect wildlife movement patterns are mostly associated with the creation of physical barriers and reducing the likelihood of wildlife crossing developments, such as infrastructure corridors. Potential changes in movement patterns resulting from Project activities are anticipated to start during the Construction Phase and persist until the Post-closure Phase.

5.2.1.3.1 *Construction Phase*

Project-related changes in movement patterns are expected to begin at the start of the Construction Phase and continue through to the Post-closure Phase. The potential effect includes the alteration (i.e., the reduction or facilitation of movement) and loss of movement between patches of suitable habitat or across the landscape. Wildlife movement in any environment, constrained or not, is species-specific, may be age

and sex specific, and varies with the ability of an animal to traverse the landscape (Mönkkönen and Reunanen 1999, Tischendorf and Fahrig 2000). Change to movement patterns due to an animal's reaction to a real or perceived barrier can affect a population's long-term viability, health, mortality, and individual habitat use (Beier 1993, Muhly et al. 2015, Edelsparre et al. 2018). Anthropogenic features (e.g., fencing or ROW infrastructure corridors) can restrict the movement of wildlife across a landscape (Clevenger et al. 2001, Ito et al. 2013), and wildlife may avoid traveling close to active anthropogenic features (e.g., roads, railways, and trails) to avoid encountering humans (Muhly et al. 2011, Leblond et al. 2013). However, not all species change their movement patterns close to anthropogenic features. Some species (e.g., Moose) may increase their use of areas with moderate to high human activity to avoid predators (Stephens and Peterson 1984, Berger 2007, Muhly et al. 2011, Rogala et al. 2011), and linear features with low human-use (e.g., trails) may be selected as easy travel routes by other species (e.g., grey wolf [*Canis lupus*], grizzly bear) (Northrup et al. 2012, Dickie et al. 2020).

5.2.1.3.2 *Operation Phase*

Change in movement patterns is anticipated in the Operation Phase as the alteration and loss of habitat will continue and influence the movement patterns of wildlife. Activities during the Operation Phase (e.g., mining the open pit, operation of the Coal Processing Plant (CPP), and vehicle/train traffic) may result in changes in movement patterns. Project components with the potential to influence movement patterns (i.e., Minesite, roads, or Rail Infrastructure) are expected to result in changes in movement patterns.

5.2.1.3.3 *Decommissioning and Reclamation Phase*

Change in movement patterns is anticipated in the Decommissioning and Reclamation Phase. The dismantling and removal of Project components is anticipated to create sensory disturbances that may alter wildlife movement patterns; however, as reclamation proceeds and Project-related activities decrease the effect of change in movement patterns is anticipated to diminish.

5.2.1.3.4 *Post-closure Phase*

The effect of change in movement patterns is anticipated to in the Post-closure Phase. Maintenance and monitoring activities are anticipated to result in sensory disturbances that can alter the movement patterns of wildlife; however, the effect is expected to diminish as Project-related activities decrease.

5.2.2 *Furbearers Subcomponent*

5.2.2.1 *Alteration and/or Loss of Habitat*

5.2.2.1.1 *Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases*

The alteration and loss of Furbearer habitat occurs when vegetation or other features (e.g., dens) are cleared or affected during the lifetime of a project. The alteration of habitat may occur through indirect effects such as sensory disturbances, edge effects, by a loss and/or reduction in use when a minimum habitat size threshold is not met (Chapin et al. 1998, Hargis et al. 1999, Krebs et al. 2007).

Sensory disturbances that may result in the alteration and/or loss of habitat include anthropogenic noises and human presence. Anthropogenic noises (e.g., aircraft, snowmobiles, humans) can cause habitat avoidance when the noise sources are present and return when they are not; however, loud noises can cause long-term habitat avoidance (i.e., functional habitat loss) (COSEWIC 2014b).

Edge habitat may be avoided by species that require interior forest conditions. Differences in vegetative communities and structure at forest edges often result in altered microclimatic conditions relative to interior forest habitat and can extend up greater than 240 m in some forests (Geiger 1957, Chen et al. 1995). Vegetative communities on either side of the edge can also influence the suitability of edge habitat and the avoidance of an edge (Buskirk and Powell 1994). Species that use or prefer forest interior habitats for predator avoidance, finding food, or gaining thermal shelter may be negatively affected by an increasing proportion of edge habitat relative to interior habitat (Hargis et al. 1999).

As habitat is lost, a minimum patch size is often required for an individual to occupy or use an isolated patch on a landscape (Chapin et al. 1998, Hargis et al. 1999). When available suitable habitat is below a minimum patch threshold, either for the individual patch or across a landscape, or when the distances between patches exceeds a threshold, a reduction in occupancy or use may occur despite the continued presence of suitable habitat (Chapin et al. 1998, Hargis et al. 1999, Olson et al. 2014). As a result, patch size, both on an individual and population level, may have a species-specific effect on use of suitable habitat (Chapin et al. 1998, Krebs and Lewis 1999, Olson et al. 2014).

5.2.2.2 Change in Mortality

5.2.2.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The effect of a change in mortality on Furbearers is expected to begin during the Construction Phase when initial Project-related activities begin and continue through to the Post-closure Phase. The potential effect of change in mortality is species-specific based on the likelihood of a species encountering sources of potential direct or indirect mortality. Mortality may be caused directly by Project components and activities (e.g., vehicle-wildlife collisions; destruction or abandonment of den sites and hibernacula, or entrapment in Project facilities, such as buildings or surface water management infrastructure (Knight and Gutzwiller 1995, Belant 2007, COSEWIC 2014b) or indirectly when interactions with Project components and activities contribute to other sources of mortality (e.g., hunting, trapping, poaching, and management actions associated with the removal of nuisance animals) (COSEWIC 2014b).

The activities expected to have the highest potential for mortality are likely related to site clearing during the Construction Phase when the Project Footprint is cleared of vegetation, and the transport of equipment, materials, and personnel during all phases. Reductions in habitat, through decreased habitat effectiveness (i.e., alteration) or loss, may also contribute to indirect mortality due to increased intra-specific competition for available food and habitat, increased predation risk and hunting efficiency, and abandonment of young (Hargis et al. 1999, COSEWIC 2014b).

Direct and indirect changes in mortality are expected in the Operation Phase. Collisions with Project vehicles, equipment, and components (e.g., buildings) may result in direct mortality of wildlife. Direct mortality may occur during Project-related activities (e.g., vegetation management, snow management, maintenance work) along the ROW of linear Project features (e.g., roads, Rail Infrastructure, powerline). Entrapment in Project components (e.g., buildings, pits, settling ponds) and due to Project activities (i.e., snow berms created during snow management) may also result in direct mortality of wildlife (e.g., drowning, vehicle collisions). Spills of fuels and other hazardous materials, malfunctions, and other accidents may result in contamination of wildlife habitat and indirectly affect a change in mortality. Exposure to hazardous materials (e.g., wildlife gaining access to contaminated settling ponds; individuals exposed to chemicals from herbicide spraying) could also indirectly influence wildlife mortality. Indirect mortality may also occur through increased and more efficient hunter, trapper, and predator access to the Project Area via ROWs,

decreased wildlife health (e.g., increased stress, reduced body condition), and increased inter and intra-specific competition for resources.

Direct and indirect changes in mortality are expected in the Decommissioning and Reclamation Phase but at a reduced level in concert with reductions in Project activity and removal of Project components. Collisions with Project vehicles, equipment, and components (e.g., buildings) may result in direct mortality of wildlife. Spills of fuels and other hazardous materials, malfunctions, and other accidents may result in contamination of wildlife habitat and indirectly affect a change in mortality. Indirect mortality may also occur through increased and more efficient hunter and predator access to the Project Area via ROWs, decreased wildlife health (e.g., increased stress, reduced body condition), and increased inter and intra-specific competition for resources. Overall, the potential for the effect of a change in mortality is expected to decrease as Project-related activities decrease, Project infrastructure is removed, and reclamation activities revegetate the Project Footprint.

The effect of change in mortality on Furbearers is expected to be limited during the Post-closure Phase. Project activities on site during the Post-closure Phase will be limited and all Project components will be removed, resulting in a reduced risk of vehicle collisions with wildlife, exposure to hazardous materials (e.g., spills), and risk of entrapment.

5.2.2.3 Change in Movement Patterns

5.2.2.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Change in movement patterns is considered a potential effect for the Furbearer (wolverine) subcomponent. Project-related effects related to change in movement patterns are expected to begin at the start of the Construction Phase and continue through to the Post-closure Phase. The potential effect of change to movement patterns includes the alteration (i.e., the reduction or facilitation of movement) and loss of movement between patches of suitable habitat or across the landscape. Wildlife movement in any environment, constrained or not, is species-specific, may be age and sex specific, and varies with the ability of an animal to traverse the landscape and the nature of the landscape (Hargis et al. 1999, Krebs et al. 2007, Woodford et al. 2013). Change to movement patterns due to an animal's reaction to a real or perceived barrier can affect a population's long-term viability, health, mortality, and individual habitat use (Rowland et al. 2003, Dawson et al. 2010). Wolverines are capable of long-distance dispersal and have large home ranges but are limited by suitable vegetation and anthropogenic features (Kyle and Strobeck 2001, COSEWIC 2014b).

Anthropogenic features (e.g., roads) can restrict movement from territory to landscape scales, and habitat with higher road density or active anthropogenic features may be avoided as these areas may be associated with a higher risk of mortality (Dawson et al. 2010, Bowman et al. 2010, COSEWIC 2014b). Not all anthropogenic features are avoided, some linear features with low human-use (e.g., seismic lines, cut blocks) may be selected as easy travel routes or for foraging opportunities (Scrafford et al. 2017). Sensory disturbances (e.g., snowmobiles, aircraft) can also result in habitat avoidance, increased activity, and young abandonment (COSEWIC 2014b).

Change in movement patterns is anticipated in the Operations Phase as the alteration and loss of habitat will continue and influence the movement patterns of wildlife. Activities during the Operation Phase (e.g., mining the open pit, operation of the CPP, vehicle traffic) will cause additional sensory disturbances to wildlife and result in changes in movement patterns. Project infrastructure with the potential to influence movement patterns (i.e., roads, Minesite) is expected to continue to result in changes in movement patterns.

Change in movement patterns is anticipated in the Decommissioning and Reclamation Phase. The dismantling and removal of Mine Infrastructure is anticipated to create sensory disturbances that may alter Furbearer movement patterns; however, as reclamation proceeds and Project-related activities decrease the effect on change in movement patterns is anticipated to diminish.

The effect of change in movement patterns is anticipated in the Post-closure Phase. Maintenance and monitoring activities are anticipated to result in sensory disturbances that can alter the movement patterns of wildlife; however, the effect is expected to diminish as Project-related activities decrease.

5.2.3 Caribou Subcomponent

5.2.3.1 *Alteration and/or Loss of Habitat*

5.2.3.1.1 *Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases*

Project-related disturbances that may result in the alteration and/or loss of habitat (i.e., the direct loss of habitat and the indirect alteration of habitat during all Project phases) in addition to the construction of Project components, may include anthropogenic noises, vehicle traffic, and human presence (COSEWIC 2014a). It is assumed that the Project Area will be completely altered during the Construction Phase and not be available as Caribou habitat. In addition, indirect alteration of Caribou habitat is caused by a change in the quality or availability of habitat in the area surrounding the Project due to sensory disturbances stemming from Project activities, including noise from mining, blasting and traffic; dust dispersal potentially affecting the palatability or quality of forage (Chen et al. 2017); and other sensory disturbances associated with visual, auditory, or olfactory stimuli. Vehicle traffic, which can cause both visual and auditory disturbances, can result in Caribou avoiding areas with increasing traffic and disturbance intensity (Leblond et al. 2013). Most mineral licks observed during the wildlife baseline studies will not be available to Caribou once the Construction Phase has started. A total of seven (7) mineral licks were observed with six (6) in the Project Area and one (1) adjacent to its eastern boundary in the WLSA (**Appendix 4.8-A**). No evidence was observed that Caribou ever used the mineral licks.

To describe the potential effect of habitat disturbance on Caribou, the 2014 Recovery Strategy (Environment Canada 2014) outlined a set of criteria to determine existing contributions to habitat disturbance by accounting for the actual development footprint and a 500 m buffer around it, as well as unbuffered natural disturbances (e.g., forest fires). The buffer used in the disturbance model is intended to reflect the alteration of Caribou habitat beyond the Project footprint due to sensory disturbance. The rationale for this approach to evaluate existing disturbed areas was based on observed Caribou population trends for herds across Canada showing that most Caribou subpopulations whose ranges were greater than 35% disturbed were reported to be declining (Environment Canada 2012). The results of the disturbance assessment (provided in **Appendix 4.8-A**) showed that most of the Project Caribou study areas were already disturbed, and the Project is expected to add to this existing disturbance through direct habitat loss and indirect habitat alteration. The **Wildlife Baseline Report (Appendix 4.8-A)** showed that Telkwa Caribou select alpine and subalpine habitats during the entire year indicating that the Caribou have used higher elevation habitat during all seasons and rarely used the Project Area.

As Project components and infrastructure are decommissioned and parts of the Project Area are revegetated, any habitat that was functional available to caribou in the baseline condition is expected to become available again to Caribou. However, the Project Area is already considered completely disturbed and is entirely outside of selected Caribou habitat, so any reclamation activities are likely to have limited benefit for Caribou as the habitat will return, over time, to a similar state as in pre-Project conditions.

5.2.3.2 Change in Mortality

5.2.3.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The potential effect of change in mortality on the Caribou subcomponent considers potential sources of mortality from direct Project interactions and potential effects stemming from landscape changes that could affect indirect mortality from predation. Direct mortality due to the Project could occur from vehicle or train collisions with Caribou, or Caribou getting injured when travelling through the Project Area. However, the Project Area does not overlap with habitat types selected by Caribou; it occurs entirely within the forested habitat type that is avoided by Telkwa Caribou (as described in **Appendix 4.8-A**).

Vehicle collisions with Caribou are a documented source of Caribou mortality in areas where Caribou ranges intersect transportation infrastructure and could add to Caribou mortality outside the Project Area where increased Project related traffic may occur. The effect of a change in direct mortality on Caribou is expected to begin during the Construction Phase when initial Project-related activities start and continue through to the Post-closure Phase when Project infrastructure is removed, and reclaimed areas begin to regenerate vegetation communities; however, activity levels will decrease after completion of the Operation Phase, potentially resulting in a reduced effect.

Describing indirect mortality, the **Wildlife Baseline Report** provides a description of Caribou mortality in relation to different habitat types (**Appendix 4.8-A**) and outlines the importance of predation on Caribou mortality. Results showed that Caribou are likely avoiding forested habitat types, such as the Project Area, as a way of separating themselves from predators. Indirect mortality of Caribou could occur through two (2) processes potentially affected by the Project: 1) apparent competition with more productive alternative prey species, and 2) facilitated predation by wolves. Apparent competition occurs when the density of an alternative prey species increases so that it supports a higher density of a shared predator(s) which increases predation on the other prey species. The increasing abundance of Moose and deer during the past century has likely increased the abundance of wolves, resulting in regional declines of Caribou due to wolf predation (Bergerud and Elliot 1986). Facilitated predation occurs with the development, maintenance, and/or use of roads and trails that provide easier movement for predators across the landscape. Predators, particularly wolves, use these linear features to move more quickly and consequently hunt more efficiently within their range (Dickie et al. 2017).

The potential for the Project to indirectly affect Caribou mortality through apparent competition and/or facilitated predation is limited during the Construction, and Operation phases when human activity is more likely to deter alternative prey and predators from the Project Area. However, during the Decommissioning and Reclamation and Post-closure phases, the Project Area will temporarily create habitat that could support higher densities of alternative prey species, potentially increasing predator density in the region.

5.2.3.3 Change in Movement Patterns

5.2.3.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Anthropogenic effects on Caribou movement are well documented (Reimers and Colman 2006) and are mostly associated with the creation of physical barriers and reducing the likelihood of Caribou crossing developments. The creation of most infrastructure is considered semi-permeable as use of the infrastructure (such as roadways and railways) reduces the likelihood of Caribou crossing these features (Dyer et al. 2002). The potential effect of change in Caribou movement patterns is based on the potential for the Project to cause barriers to Caribou movement within and between parts of the range and selected

habitat types of Caribou. The greatest potential for causing a change to Caribou movement patterns are the construction of Project infrastructure that could act as a barrier (e.g., fencing, snowbanks along the roads) and the use of infrastructure that could reduce the likelihood of Caribou moving across the feature (e.g., road and train traffic).

The **Wildlife Baseline Report** provides an analysis and discussion of Caribou annual and seasonal movements (**Appendix 4.8-A**). This analysis showed that Telkwa Caribou movement was mostly restricted to the alpine and subalpine habitat types and only one collared Caribou may have moved through the Project Area in approximately 10 years of data collection, representing 0.03% of all Caribou movement documented. Four (4) Caribou moved through the area south of the Project Area, representing 2.21% of documented Caribou movements. There is minimal overlap between the Project Area and recorded Caribou movements, and the Project is not located between different portions of the herd's current range, where it could act as a barrier to Caribou movement. However, Caribou may attempt to move through the Project Area at some point during the life of the Project and may encounter barriers to their movement.

Changes in movement patterns are anticipated to start during the Construction Phase and continue through the Operation Phase. Activities during the Operation Phase (e.g., mining the open pit, operation of the CPP, and additional vehicle/train traffic) may result in changes in movement patterns.

The dismantling and removal of Mine Infrastructure during the Decommissioning and Reclamation Phase is anticipated to create some traffic that may alter Caribou movement patterns; however, as reclamation proceeds and Project-related activities decrease, the effect on change in movement patterns is anticipated to diminish and decrease further during the Post-closure Phase where maintenance and monitoring activities are anticipated to be the only activities.

5.2.4 Grizzly Bear Subcomponent

5.2.4.1 Alteration and/or Loss of Habitat

5.2.4.1.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The alteration and loss of Grizzly Bear habitat occurs when vegetation or other features (e.g., dens) are cleared or affected by indirect effects (e.g., sensory disturbances) during the lifetime of a project (Gibeau et al. 2002). The direct removal of vegetation typically results in the loss of habitat, and the use of cleared areas may be dependent on the plant species that regrow (McLellan and Hovey 2001, Berland et al. 2008).

Areas of productive habitat (e.g., riparian areas, berry patches) may also be avoided if anthropogenic activity is high (COSEWIC 2012a). Roads can fragment habitat and associated human use can decrease habitat use. Increasing traffic volume can result in avoidance of areas around roads with 20-100 vehicles per day and strong avoidance of roads with greater than 100 vehicles per day; however, Grizzly Bears may respond by crossing at times when traffic volumes are lower (i.e., at night) (Northrup et al. 2012).

The spatial scale at which roads and associated human presence affect Grizzly Bear behavior and habitat use varies across studies but is a minimum 100 m and extends up to 1,000 m, although more frequently, the effects of roads are estimated to extend to 500 m (McLellan and Shackleton 1989, Kasworm and Manley 1990, Proctor et al. 2019). Road density can also affect habitat use, and a road density threshold of 0.6 km/km² to affect grizzly use has been observed in many areas (Proctor et al. 2019).

The type of road use may also affect habitat use, as bears may not avoid restricted roads (i.e., roads only open to natural resource industries) and surrounding habitats, whereas roads open to the forest industry

and the public are typically avoided (Wielgus et al. 2002, Cristescu et al. 2016). In addition, areas with road densities greater than 0.6 km/km² can sustain Grizzly Bear use if a proportion of roads are closed (or restricted) to the public (Lamb et al. 2018).

Most habitat loss is expected to occur during the Construction Phase and the alteration of habitat (i.e., sensory disturbances reducing habitat suitability) may occur through the life of the Project. As Project components and infrastructure are decommissioned and parts of the Project Area are revegetated, the habitat is expected to become available to Grizzly Bear. In addition, the reduction in human activity following the Operation Phase is expected to result in fewer sensory disturbances and less reductions in habitat suitability.

5.2.4.2 Change in Mortality

5.2.4.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Collisions with vehicles and trains can result in both direct mortality and indirect mortality (e.g., mortality of orphaned cubs). Grizzly Bear use of roadside habitat and crossing of roads (i.e., increase in vehicle collision risk) is strongly influenced by the amount of vehicle traffic (Northrup et al. 2012). Increasing traffic volume can result in the avoidance of roads with moderate use (20 to 100 vehicles per day) and strong avoidance of roads with high use (greater than 100 vehicles per day); however, Grizzly Bears may adjust their behaviour and cross roads when traffic volumes are lower (i.e., at night) (Northrup et al. 2012).

The risk of Grizzly Bear mortality from train collisions increases with train speed and track curvature, suggesting Grizzly Bears have problems detecting fast-moving trains (Clair et al. 2020). Train mortality in BC and Alberta mostly occurs when bears are typically active (i.e., April through October) and is highest in late spring (i.e., May and June) and during the day (Clair et al. 2020). Also, increased natural food resources (e.g., *Equisetum* sp., *Trifolium* sp., ants) along roadsides and anthropogenic food resources (e.g., spilled grain) along rail lines may attract Grizzly Bears and increase the risk of mortality from collisions (Roever et al. 2008, Gangadharan et al. 2017). Fencing along roads can be effective at reducing the risk of collisions; however, Grizzly Bears can breach fencing, reducing its effectiveness (Gilhooly et al. 2019).

Roads and ROWs into Grizzly Bear habitat can increase human access and bring people into potential conflict with Grizzly Bears through hunting, management mortality, and vehicle collision mortality (COSEWIC 2012a). Human access is an important predictor of Grizzly Bear mortality, and most Grizzly Bear deaths in BC and Alberta have occurred within 120 m of a road (Proctor et al. 2019). Managing motorized access (i.e., reducing public access) has been recognized as an important tool in managing human-bear conflicts (Proctor et al. 2019).

Licensed hunting ended in 2017 and was formerly responsible for most of the Grizzly Bear mortality; however, legal Indigenous harvest and illegal hunting may still occur (McLellan et al. 1999, BC FLNRD 2017). Mortality associated with the protection of life and property, often associated with hunters, garbage-habituated bears, or a lack of bear awareness, represent 14.7% of known Grizzly Bear deaths in BC (COSEWIC 2012a).

The activities expected to have the highest potential for mortality are likely related to site clearing during the Construction Phase when the Project Footprint is cleared of vegetation (i.e., mortality of bears in dens during clearing and grubbing), and the transport of equipment, materials, and personnel (i.e., mortality from vehicle collisions) during all phases. The potential for a change in mortality is expected to continue during the Operation Phase and during the Decommissioning and Reclamation Phase but at a reduced level in concert with reductions in Project activity and removal of Project components. Spills of fuels and other

hazardous materials, malfunctions, and other accidents may result in contamination of wildlife habitat and indirectly affect a change in mortality. Indirect mortality may also occur through increased and more efficient hunter access to the Project Area via ROWs, decreased wildlife health (e.g., increased stress, reduced body condition), and increased inter and intra-specific competition for resources. Overall, the potential for the effect of a change in mortality is expected to decrease as Project-related activities decrease, Project infrastructure is removed, and reclamation activities revegetate the Project Footprint.

The effect of change in mortality on the Wildlife VC is expected to be limited during the Post-closure Phase. Project activities onsite during this time will be limited and all Project components will be removed, resulting in a reduced risk of vehicle collisions with Grizzly Bears.

5.2.4.3 Change in Movement Patterns

5.2.4.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Grizzly Bears are typically solitary with large home ranges (i.e., 100 to 300 km² on average in BC) with adult bears typically using higher quality habitats and sub-adults forced into more marginal habitats (Flynn et al. 2007, COSEWIC 2012a). Their movement patterns average 2.4 km per day in mountainous regions and are primarily influenced by finding food and avoiding human activity, and to a lesser extent, intraspecific interactions, and the availability of thermal and security cover (BC MWLAP 2004, COSEWIC 2012a, Proctor et al. 2012). Food resources are often highly seasonal, and Grizzly Bear movements typically follow the timing of plant emergence and berries, spring ungulate calving, and salmon runs (COSEWIC 2012a). Annual elevational migrations also typically occur in mountain regions, where following emergence from high elevation denning sites occurs in the spring, Grizzly Bears descend to low elevations to forage (e.g., emergent vegetation, ungulate carrion) (LeFranc et al. 1987, Proctor et al. 2012, Hamilton et al. 2018). Grizzly Bears may then make use of food resources (e.g., berry patches, ungulate calving areas, subalpine/alpine meadows) throughout their home range during the summer, and typically use high elevation berry patches or low elevation salmon runs in the fall (COSEWIC 2012a).

Dispersal movements by young bears in mountainous areas are initially relatively short and sex based (i.e., males generally disperse three (3) times further than females), and may take several years to disperse away from the core of their natal home range (McLellan and Hovey 2001, Proctor et al. 2004). Roads have been identified as the primary route that increases anthropogenic mortality, typically via hunting, and may disrupt bear movements or form barriers to dispersal (Gibeau et al. 2002, Proctor et al. 2012). Major transportation routes, such as Highway 1 (Gibeau et al. 2002) and Highway 3 (Proctor et al. 2012) in south-eastern BC have been found to act as complete (Highway 1) or almost complete (Highway 3) barriers to adult female movement, but not males, resulting in genetic fragmentation of Grizzly Bear sub-populations. Barriers to dispersal typically involve high traffic volumes (i.e., 1,000s to 10,000s of vehicles per day) and high speeds; however, no effects of population fragmentation have been found for secondary or resource roads (Gibeau et al. 2002, Proctor et al. 2012, Proctor et al. 2019).

Different sensory disturbances can affect differing responses in Grizzly Bears. Noise disturbances may result in a flight response, freezing, or a strong startle response, and can affect denning bears; bears may habituate to noises depending on the intensity and consistency (Craighead et al. 1982, Harding, and Nagy 1980, Jope 1985, Schoen et al. 1987, Mancini et al. 1988, Cristescu et al. 2016). Smells associated with poor waste management practices (e.g., improperly stored human food and food waste, oils, aerosols) can attract bears in search of food (Herrero 1985).

Any changes in movement patterns are anticipated to start in the Construction Phase and continue through Operation as the alteration and loss of habitat and Project activities may influence Grizzly Bear movement

patterns. Activities during the Operation Phase (e.g., mining the open pit, operation of the CPP, vehicle traffic) can cause additional sensory disturbances and result in changes in movement patterns. Project infrastructure with the potential to influence movement patterns (i.e., roads, Minesite) is expected to continue to result in changes in movement patterns. Change in movement patterns is anticipated to continue through the Decommissioning and Reclamation Phase; however, as reclamation proceeds and Project-related activities decrease the effect on change in movement patterns is anticipated to diminish. The effect of change in movement patterns is anticipated to continue through to the Post-closure Phase. Maintenance and monitoring activities are anticipated to result in sensory disturbances (e.g., vehicle traffic, human presence) that can alter the movement patterns of Grizzly Bears; however, the effect is expected to diminish as Project-related activities decrease.

5.2.5 Moose Subcomponent

5.2.5.1 Alteration and/or Loss of Habitat

5.2.5.1.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Project-related activities may result in the alteration and/or loss of habitat (i.e., the direct loss of habitat and the indirect alteration of habitat during all Project phases). Vegetation clearing associated with the construction of Project components will result in direct habitat loss and the Project Area is anticipated to be completely disturbed during Construction and it will not be available as Moose habitat. In addition, most mineral licks observed during the wildlife baseline studies, will not be available to Moose any longer once Construction has started. A total of seven (7) mineral licks were observed with six (6) in the Project Area and one (1) adjacent to its eastern boundary in the WLSA (**Appendix 4.8-A**). Evidence of Moose use was observed at two (2) mineral licks.

The alteration of habitat is associated with sensory disturbances that may include anthropogenic noises, vehicle traffic, human presence, and increased predator access (Dussault et al. 2006, Lykkja et al. 2009, Neilson and Boutin 2017).

Vehicle traffic and associated roads can influence habitat use by Moose. Roads and vehicle traffic can affect Moose habitat selection in the areas surrounding roads up to 1,000 m, although most effects occur within 250 m of a road (Colescott and Gillingham 1998, Yost and Wright 2001, Laurian et al. 2008, 2012, Shanley and Pyare 2011).

Vehicle mortality associated with roads can also result in the areas surrounding roads becoming a habitat sink due to increased mortality risk (Rea 2012, Welch et al. 2015, Mumma and Gillingham 2019). Road densities as low as 0.16 km/km² can influence Moose habitat selection and a threshold of 0.6 km/km², above which Moose populations may decline due to habitat degradation has been observed (Beazley et al. 2004, Laurian et al. 2012).

Moose may also be attracted to roads due to the presence of road salt in winter, although any nutritional benefit may be offset by an increase in risk of mortality from vehicle collisions (Dussault et al. 2006). Moose may avoid areas around buildings during times of high human activity, although females with calves may avoid areas around buildings even during low human activity (Lykkja et al. 2009). Moose cows, particularly those with calves, strongly avoid areas with a high intensity of wolf use, which may include linear features associated with surrounding natural resource developments (Neilson and Boutin 2017).

Direct habitat loss for Moose is expected to primarily occur during the Construction Phase and will be limited during the Operation Phase; however, the alteration of habitat by sensory disturbances (e.g., vehicle traffic,

artificial lighting, mine blasting, maintaining and operating site facilities, human presence) is expected to continue through the Operation Phase. The direct loss of habitat is not expected during the Decommissioning and Reclamation and Post-Closure Phases. The alteration of habitat is expected to continue during this time as sensory disturbances (e.g., vehicle traffic, human presence) may result in the alteration of habitat, although at a reduced level. Progressive reclamation is expected to be a positive effect as revegetation continues in reclaimed areas.

5.2.5.2 Change in Mortality

5.2.5.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Primary sources of anthropogenic mortality for Moose typically include vehicle and train collisions, increased or easier hunter access, and increased or easier predator access. Additional sources of anthropogenic mortality may include exposure to contaminated sites, entrapment within pits or waterbodies (e.g., settling ponds), or within snowbanks along roads resulting in an increased risk of vehicle collision.

Provincial estimates for Moose vehicle collisions (MVCs) are only available for numbered highways and an unknown number of mortalities occur along resource roads (Child et al. 1991, Sielecki 2010). Annual MVC estimates typically range from 300 to 500, but are not corrected to traffic volumes due to a lack of data for specific highway sections for the seasons in which most MVCs occur (Child et al. 1991, Sielecki 2010). The MVCs in northern BC are more common in the winter (i.e., December to February) and often coincide with high snowfall events when Moose may select roads cleared of snow to facilitate travel (Child et al. 1991, Sielecki 2010). Other factors that may influence the risk of MVC are increased Moose use of areas with roads (i.e., valley bottoms), poor light conditions, traffic speed exceeding 80 kilometres per hour (km/hr) and amount of vehicle traffic (Stuart 1984, Child et al. 1991, Joyce and Mahoney 2001, Dussault et al. 2006, Danks 2007, O'Keefe and Rea 2012).

Train collisions are known to result in direct Moose mortality across Canada (Kerr and Dillon 2018, Hamr et al. 2019). Annual mortality in a region may vary year to year and are typically not evenly distributed along a length of track (Kerr and Pollard 2016, 2017, Kerr and Dillon 2018). Collision risk may be influenced by snowfall events or total amount of snow, where Moose may take advantage of cleared railway lines to facilitate travel (Kerr and Pollard 2016, 2017, Kerr and Dillon 2018). Exclusion fences can decrease collision risk, although not eliminate it completely (Kerr and Pollard 2016).

Anthropogenic features can facilitate the ease of hunter and predator travel, increasing the accessibility into areas and resulting in indirect sources of mortality (Beazley et al. 2004, Ewacha 2016, Mumma and Gilligham 2019a, b). Other indirect anthropogenic sources of mortality may include sensory disturbances that can result in reduced body condition or increased stress (Barber et al. 2010).

Changes in mortality of Moose are expected to start during the Construction Phase and continue during the Operation Phase, but the risk of any mortality is anticipated to decline with decreasing Project activity over the life of the Project. Collisions with Project vehicles and equipment are anticipated to be the main activities associated with Moose mortality.

5.2.5.3 Change in Movement Patterns

5.2.5.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The effect of anthropogenic features on Moose movement is variable. Moose may reduce their movements as human encroachment into Moose habitat increases and are more likely to avoid areas with higher densities of anthropogenic features or they may avoid areas around linear features with low human-use (e.g., seismic lines) that may be selected as easy travel routes by predators (e.g., grey wolf [*Canis lupus*], grizzly bear) (Lykkja et al. 2009, Northrup et al. 2012, Dickie et al. 2020). Conversely, Moose may increase their use of areas with moderate to high human activity if it allows them to avoid predators or relief from biting insects (Stephens and Peterson 1984, Berger 2007, Muhly et al. 2011, Rogala et al. 2011).

Linear features (e.g., roads, plowed snowbanks) may result in barriers to Moose movement and result in deflected movement patterns, creating a corridor effect as Moose move along it; however, transmission lines typically are not avoided, potentially due to low human use, a lack of a physical barrier, and the presence of abundant browse (Laurian et al. 2008, Bartzke et al. 2015). Combinations of some barriers (e.g., roads with powerlines or rivers) may also increase changes to movement patterns (Bartzke et al. 2015).

The loss or fragmentation of habitat and sensory disturbances may result in changes to Moose movement patterns. Seasonal Moose movements may be reduced in reactions to reductions in the spatial diversity or forest cover present in their summer home range (Borowik et al. 2020). The fragmentation of forest, especially by roads, once densities reach a threshold of 0.6 km/km², may result in Moose avoidance of suitable habitat (Beazley et al. 2004, Laurian et al. 2012). Moose may be attracted to roads in winter due to the presence of road salt (Dussault et al. 2006).

Moose may perceive traffic and other human activity as analogous to predation risk and change their movement patterns accordingly (e.g., avoidance of higher traffic roads over lower traffic roads, crossing and using areas closer to roads at night when traffic volumes are lower, the avoidance of areas near buildings during periods of high-human activity) (Laurian et al. 2008, Lykkja et al. 2009, Eldegard et al. 2012). Moose may also alter their movement patterns in response to varying levels of human activity and density of buildings, although this can vary by sex (Lykkja et al. 2009).

Project-related activities and infrastructure have the potential to result in changes to Moose movement patterns, potentially both positive and negative. Any changes to movement patterns are expected to start during the Construction Phase and continue through the life of the Project, but any changes are anticipated to decline with decreasing Project activity. Vehicle traffic, Project components, and human presence are anticipated to be the main activities associated with changes to Moose movement patterns.

5.2.6 Bats Subcomponent

5.2.6.1 Alteration and/or Loss of Habitat

5.2.6.1.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The direct and indirect effects of habitat loss and alteration (i.e., the degradation and fragmentation of habitat) due to the Project may result in a change in habitat for Bats. The main habitat requirements for Bats are roosting and foraging habitat. Roosting sites for hibernation and maternal roosting are the most limiting habitat factors, due to specific microclimate (e.g., temperature, humidity) and disturbance

requirements based on species-specific physiological needs (ECCC 2018). Hibernation sites (hibernacula) are typically in caves, rock crevices, or abandoned mines, but buildings may be used if they contain the specific requirements (Barclay and Brigham 1995, Norquay et al. 2013).

Activities (e.g., mining exploration and development, site clearing) can result in the direct loss of hibernacula or result in the degradation of microclimatic conditions to render the site unsuitable (ECCC 2018). Mine and cave entrances can collapse due to heavy equipment use near weak areas of the hibernaculum, resulting in the blockage of use or degradation of microhabitat conditions (McAlpine 1983). Activities that require the removal of trees, snags, or forested landscapes (e.g., site clearing) have the potential to destroy or degrade maternity or other roosts. The effects of tree removal or degradation may depend on the availability of other suitable habitat, timing, bat species, sex, and other factors (ECCC 2018). Bats may use alternate sites (i.e., other trees) for roosting, depending on availability, if a previous roosting tree is removed outside the breeding season (Silvis et al. 2015).

The effects of natural resource activities can result in the removal, degradation, or fragmentation of foraging habitat for Bats (e.g., forests, wetlands, and riparian areas). The effects of foraging habitat loss and alteration may vary in relation to species, amount of available habitat, cause of forest degradation, spatial scale examined, and food availability (Grindal and Brigham 1999, Henderson and Broders 2008, Pauli et al. 2015). In general, Bats may avoid large clearcuts and open areas, but forested and vegetated edges may provide foraging opportunities for some Bats (Krusic et al. 1996, Grindal and Brigham 1999, Henderson et al. 2008). In addition, the use of linear vegetated elements caused by forest fragmentation may vary based on species, location, and available habitat (Broders and Forbes 2004, Broders et al. 2006).

Most direct loss of habitat for Bats is expected to occur during the Construction Phase and be limited during other phases. The alteration of habitat (e.g., fragmentation, edge effects, sensory disturbances) are expected to first occur during the Construction Phase and are expected to continue through to the Post-closure Phase. Maintenance will occur along the ROWs of existing roads, haul roads, rail infrastructure, and transmission lines and is expected to limit the progression of succession and the regeneration of suitable habitat. Progressive reclamation is expected to be positive as revegetation is initiated in reclaimed areas.

5.2.6.2 Change in Mortality

5.2.6.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The potential Project-related effect of a change in mortality of Bats is expected to begin during the Construction Phase and continue through to the Post-closure Phase. The potential effect of change in mortality is species-specific based on the likelihood of a species encountering sources of potential direct or indirect mortality. Anthropogenic mortality may be caused by a variety of activities; however, potential Project-related sources may include the destruction of hibernacula or roosting sites while Bats are still present, vehicle mortality, and exposure to hazardous materials (ECCC 2018).

Hibernacula sites include caves, mines, and buildings and are considered a limiting habitat feature due to the specific temperature, humidity, and disturbance requirements (COSEWIC 2013). Few hibernacula have been documented in BC and as a result little is known about the potential risks associated with natural resource development (BC MOE 2016). During hibernation Bats awaken slowly and may not be able to avoid disturbance or if awoken they may metabolize too much of their fat stores and may not survive through the winter (ECCC 2018). In addition, if conditions in a hibernacula change to be less suitable or unsuitable, Bats may experience mortality prior to spring. It is expected that clearing activities during the Construction

Phase will have the highest potential for Bat mortality through potential roost or hibernacula destruction or disturbance.

The extent of vehicle Bat mortality in Canada is unknown, but collisions with vehicles, equipment, recreational vehicles, and watercraft can result in direct mortality (ECCC 2018). The level of vehicle traffic and noise, surrounding habitat, Bat use of an area, species, and seasonality can affect the number of vehicle collisions (Lesiński et al. 2011, Medinas et al. 2013). Forest-adapted species (e.g., northern myotis) that are known to fly low and slow may be at higher risk (Abbott et al. 2015).

Spills of fuels and other hazardous materials, malfunctions, and other accidents, exposure to materials in contaminated waterbodies, or exposure to herbicide spraying may affect a change in Bat mortality (ECCC 2018). Exposure to hazardous materials (e.g., wildlife gaining access to contaminated settling ponds; individuals exposed to chemicals from herbicide spraying) could also indirectly influence wildlife mortality. It is expected that the potential for mortality from vehicle mortality or exposure to hazardous materials will be highest during the Construction, and Operation phases.

The potential for the effect of a change in Bat mortality is expected to decrease as Project-related activities decrease, Project components are removed, and activities diminish. During the Decommissioning and Reclamation Phase the removal of buildings could result in Bat mortality if occupied by Bats for roosting or hibernation. The potential for vehicle mortality to occur is expected to continue until all Project-related vehicle movement has ceased. The effect of change in Bat mortality is expected to be limited during the Post-closure Phase, as Project activities will be limited, and all Project components will be removed.

5.2.6.3 Change in Movement Patterns

5.2.6.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Anthropogenic factors (e.g., vehicle presence, traffic noise, traffic volume, habitat fragmentation) may influence Bat movement patterns. Current data on factors that may influence seasonal movements are limited; however, data collected during monitoring at wind farms suggests that Bats migrate at relatively low heights (i.e., less than 40 m), but above natural obstacles (Reynolds 2006, Environment Canada 2015). This suggests that Bats may fly at higher altitudes during seasonal movements than daily movements; however, it is unknown whether factors that influence daily movement patterns influence seasonal movement patterns.

The effect roads have on daily movement patterns vary by habitat type and can extend up to 300 m in woodlands and 500 m in open fields (Zurcher et al. 2010, Bennett and Zurcher 2012, Medinas et al. 2013, Bennett et al. 2013). Vehicle traffic and noise can reduce the permeability of roads to crossing. The crossing of all roads may be avoided when vehicle noise exceeds 88 decibels (dB) or when traffic volumes exceed 2,400 vehicles/hour, and movement patterns may change when vehicle noise exceeds 66 dB or 120 vehicles/hour (Zurcher et al. 2010, Bennett and Zurcher 2012, Bennett et al. 2013). Gaps in the vegetation or forest cover caused by roads can alter Bat movement patterns when gaps in movement corridors exceed 2.5 m (Bennett and Zurcher 2012). If tree canopies cover the road ROW, this may reduce changes to Bat movement patterns by creating connected movement corridors and dampening the noise from traffic (Bennett and Zurcher 2012).

The foraging behaviour of Bats can be affected by light pollution. Aerial hawking species (e.g., little brown myotis) may be attracted to lit areas by an increase in prey; however, gleaning and slow flying species (e.g., northern myotis) may avoid lit areas due to an increase in predation risk (Environment Canada 2015).

Differences in the spectra of anthropogenic light may also influence Bat movements, where white and green light is avoided by slow-flying species and red-light has no effect (Spoelstra et al. 2017).

Project-related activities and infrastructure have the potential to result in changes to Bat movement patterns. Any changes to movement patterns are expected to start during the Construction Phase and continue through the life of the Project, but any changes are anticipated to decline with decreasing Project activity and the revegetation of the Project Area.

5.2.7 Western Toad Subcomponent

5.2.7.1 Alteration and/or Loss of Habitat

5.2.7.1.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

The direct and indirect effects of habitat loss and alteration (i.e., the degradation and fragmentation of habitat) due to the Project may result in a change in habitat for Western Toad. The main habitat requirements are aquatic habitats for reproduction, and terrestrial habitats for foraging and hibernation (ECCC 2016).

Toads require aquatic habitats (e.g., beaver ponds, lakes, ditches, river backwaters) for reproduction (COSEWIC 2012b). Pollution from chemical contaminants (e.g., herbicides, fertilizers, agricultural runoff) can degrade amphibian aquatic habitat in general, but the effects of specific contaminants on Western Toads are poorly known. Foraging habitats include upland habitats (e.g., forests, burns, clearcuts) that provide overhead cover (e.g., shrubs, herbs, coarse woody debris) and aquatic habitats (e.g., wetlands, riparian areas). Habitat loss and alteration for toads can occur through the removal of natural habitats and the fragmentation of existing habitats by roads. Hibernation habitats are not well known, but sites must occur below the frost line. Site clearing that requires grubbing and soil movement can disturb areas below the frost line, and, as a result, has the potential to disturb hibernation habitats. In addition, toads require habitats to provide connectivity between seasonal habitats and mass movements may occur as adults move towards breeding locations and newly transformed toads move away into surrounding terrestrial habitats (Davis 2000, ECCC 2016). Roads can fragment natural habitats, limiting the connectivity between seasonal habitats, and alter wetland hydrology and potentially degrade breeding habitats.

Vegetation clearing during the Construction Phase is anticipated to result in most of the direct habitat loss associated with the Project and habitat loss during other phases is expected to be minimal. Habitat alteration (e.g., fragmentation, edge effects, sensory disturbances) is expected to first occur during the Construction Phase and continue through to the Post-closure Phase. The maintenance of vegetation along the ROWs of roads and transmission lines will limit the progression of succession and progressive reclamation is expected to be positive as revegetation is initiated in reclaimed areas.

5.2.7.2 Change in Mortality

5.2.7.2.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Potential changes in Western Toad mortality are expected to begin during the Construction Phase and continue through to the Post-closure Phase. Many potential sources of anthropogenic mortality have been identified as threats to Western Toad; however, it is anticipated that vehicle collisions and exposure to hazardous materials may result in Project-related mortality.

Vehicle collisions, both on road and off-road, are a threat to Western Toads particularly near breeding, foraging and hibernation sites (ECCC 2016). Mass mortality events have been reported at several areas in BC for both toadlets and adults as they arrive and depart breeding sites (Carr and Fahrig 2001, Clegg 2011, Dulisse et al. 2012). The mass mortality of toadlets may result in a higher amount of mortality; however, the mortality of mature females may have a larger affect on the population (ECCC 2016). Western Toads are considered more susceptible to road mortality than more sedentary amphibians as they often move relatively long distances between foraging, hibernating, and breeding sites (Carr and Fahrig 2001). The nocturnal behaviour of Western Toads may result in more road crossings at night when driver visibility is more limited and increase their susceptibility to vehicle collisions (Dulisse et al. 2016).

Little research is available on the effects of specific contaminants on Western Toad; however, in general, amphibians are known to be sensitive to hazardous materials (e.g., industrial wastes, herbicides) (ECCC 2016). Heavy metals, pesticides, road salts, and other hazardous material contamination may be a source of lethal and sublethal effects, including developmental abnormalities and increased mortality of amphibian embryos and tadpoles (Vertucci and Corn 1996, Harfenist et al. 2007, Govindarajulu 2008, Skaar et al. 2017). Hazardous materials may act together with other environmental stressors and depress the immune system of Western Toads, making them vulnerable to pathogens (Carey 1993). Fertilizers and nutrients can also cause the eutrophication of water through algal blooms that can lower dissolved oxygen levels and reduce survival (Rouse et al. 1999).

Project-related mortality to Western Toads may occur through to the Post-closure Phase, but at a reduced level together with reductions in Project activity and the removal of Project components. Project activities during the Post-closure Phase will be limited and all Project components will be removed, resulting in a reduced risk of vehicle collisions and exposure to hazardous materials.

5.2.7.3 Change in Movement Patterns

5.2.7.3.1 Construction, Operation, Decommissioning and Reclamation, and Post-closure Phases

Project-related effects Western Toad movement patterns are anticipated to begin at the start of the Construction Phase and continue through to the Post-closure Phase. The potential effect includes the alteration (i.e., the reduction or facilitation of movement) and loss of movement between patches of suitable habitat across the landscape. Potential barriers to Western Toads may include features that act as physical barriers (e.g., cement barriers, culverts) and activities that be perceived as barriers (e.g., sensory disturbances). Barriers, real or perceived, that result in changes to movement patterns may also affect population viability, mortality, and habitat use (Beier 1993, Edelsparre et al. 2018).

Project components that Western Toad are unable to cross or climb over can act as barriers to movements, although not all barriers to movement are negative (e.g., fencing along roadsides) and can be used to reduce mortality. Higher densities of Western Toads are often detected near breeding habitats, and large numbers of emerging toadlets may use creeks and riparian areas as movement corridors. The presence of physical barriers (e.g., roads, buildings) in migration corridors may magnify the effect of the barrier to movement.

Roads can act as a barrier to Western Toad movement due to the loss of suitable habitat between patches, sensory disturbances due to traffic, and a higher risk of mortality can magnify the effects of these barriers (Dulisse et al. 2012, ECCC 2016). Roads with more traffic and a wider ROW may act as a more effective barrier due to the increased travel distance across unsuitable habitat and higher risk of mortality. Culverts and other types of road underpasses have been used to reduce the barrier effects of roads; however, not all underpasses or locations are effective, and in some cases can increase the barrier effect (Dulisse et al.

2012). Changes to movement patterns are anticipated to continue through to the Post-closure Phase; however, as reclamation proceeds and Project-related activities decrease the effect is anticipated to diminish.

5.3 Mitigation Measures

This subsection describes the mitigation measures to address the potential adverse effects of the Project on the Wildlife VC, as described in **5.2 Potential Project-Related Effects**. These mitigation measures are consistent with the mitigation definition provided by the BC EAO (2013). Mitigation measures may include applicable standards, guidelines, and BMPs supported by specific guidance documents.

TCL has incorporated several mitigation measures in the Project's design and/or operational procedures to reduce the magnitude, duration, and extent of effects due to the Project. These Project mitigation measures are outlined in **S1.0 Overview of Project Proponent Description** of the **EAC Application**; those measures relevant to minimizing potential Project-related effects on the Wildlife VC are described in **5.3.1 to 5.3-12**. Additional mitigation measures specific to the Wildlife VC are described in **5.3.13 to 5.3.19**. These mitigation measures are based on proven and accepted mitigation used on other similar approved projects in BC (e.g., Red Mountain Underground Gold, Blackwater Gold) that had comparable potential adverse effects on wildlife species, as well as standard industry guidelines and BMPs such as A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (BC MFLNRO 2014), Best Management Practices for Amphibian and Reptile Salvages in British Columbia (BC MFLNRO 2016), and Best Management Practices for Bats in British Columbia (BC MOE 2016). As such, these additional mitigation measures are expected to be feasible and effective in a timely manner following implementation. No uncertainties have been identified at this time.

Refer to the **Wildlife Management Plan (S13.0-C25) (WMP)** for details on mitigation measures for the Wildlife VC. The environmental and socio-economic management plans for the Project are provided in **S13.0 Management Plans** of the **EAC Application**.

Mitigation measures tailored to Project features that are applicable to the Wildlife VC will be incorporated into the various management plans for the Project, such as the following:

- ▶ **Air Quality Management Plan (S13.0-C2) (AQMP);**
- ▶ **Chemicals and Materials Storage, Transfer, and Handling Plan (S13.0-C3) (CMSTHP);**
- ▶ **Construction Environmental Management Plan (S13.0-C4) (CEMP);**
- ▶ **Discharge Management Plan (S13.0-C5) (DMP);**
- ▶ **Explosives Management Plan (S13.0-C6) (EMP);**
- ▶ **Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP);**
- ▶ **Mine Emergency Response Plan (S13.0-C9) (MERP);**
- ▶ **Minesite Traffic Control Plan (S13.0-C10) (MTCP);**
- ▶ **Minesite Water Management Plan (S13.0-C11) (MWMP);**
- ▶ **Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12) (ML/ARDMP);**
- ▶ **Public Access Management Plan (S13.0-C14) (PAMP);**
- ▶ **Reclamation and Closure Plan (S13.0-C15) (RCP);**
- ▶ **Surface Erosion Protection and Sediment Control Plan (S13.0-C17) (SEPSCP);**

- ▶ **Vegetation Management Plan (S13.0-C18) (VMP); and**
- ▶ **Waste Management Plan for Refuse and Emissions (S13.0-C20) (WMPRE).**

The management plans provide guidance as per the current practices for minimizing changes to environmental and socio-economic values, including the Wildlife VC. The management plans provide direction on sequencing, monitoring, and adaptive management and the mitigation measures outlined in each plan are expected to be timely and effective following implementation.

Mitigation measures are commitments that TCL has applied through mine design and to the operating principles through the life cycle of the Project. All mitigation measures for the Wildlife VC are described in detail below and summarized in **Table 5.3-1**.

5.3.1 Avoid Sensitive Environments

The Project has been designed to:

- ▶ avoid known wetlands and sensitive ecosystems (such as riparian areas); and
- ▶ avoid activities within watercourses.

5.3.2 Limit Project Footprint and Project Area

To limit the Project footprint and Project Area the Project has been designed to:

- ▶ Cluster Project components, including the open pit, stockpiles for run-of-mine (ROM) coal, processed coal and processed rock, Coal Processing Plant (CPP), management ponds, and ancillary facilities such as the Maintenance Facility and Administration Building;
- ▶ Align linear Project features (such as powerlines, roads, water distribution) into a common ROW;
- ▶ Place Project features within existing or planned Project component footprints to limit the clearing of vegetation and the salvage of reclamation materials (surface soil, woody debris, and overburden). For example, the Minesite buildings will be built in areas previously cleared by forestry activity;
- ▶ Minimize the length of haul roads, access roads, and rail line where possible. Use or improve existing roads where practical;
- ▶ Utilize a loop design configuration for the rail that requires half the space and subsequent footprint compared to the standard teardrop shape seen at other operating or proposed coal mines in western Canada;
- ▶ Place reclamation material (surface soil and woody debris) stockpiles within development areas such as the open pit and haul roads to avoid disturbance, while overburden is directly placed on Project components for future reclamation activities;
- ▶ Limit the TAC to a single lane width for long distances and utilize existing Forest Service Roads (FSRs) or private roads where appropriate;
- ▶ Backfill approximately 50 percent (%) of non-coal material back into the open pit; and
- ▶ Place processed rock from the CPP within the management ponds versus a separate permanent pile to avoid any potential acid rock drainage (ARD) from this material and reduce Project Footprint.

5.3.3 Reclamation Measures

The following reclamation measures have been incorporated into the mine design:

- ▶ Use progressive reclamation techniques including to limit the amount of disturbance at any given time by sequencing the open pit and stockpiles to the extent feasible, backfilling of open pit where possible, directly placing reclamation materials, and placing excavated materials on previously disturbed areas;
- ▶ Salvage reclamation materials (surface soil, woody debris, and overburden), for later use in accordance with the **RCP**;
- ▶ Vegetate all temporary surface soil and overburden stockpiles to minimize the potential for erosion and sediment generation, to prevent subsequent potential effects on water quality, and to prevent losses of surface soils;
- ▶ Implement progressive reclamation on embankments, buttresses, backfills, TAC cut and fill slopes, and other Project components where possible to minimize fugitive dust emissions and reduce erosion and sediment generation;
- ▶ The reclaimed landscape will be shaped and contoured to achieve variations of slope steepness, slope length, aspect, and form to assist in creating landform diversity suitable for the establishment of varied plant communities and to reduce visual effects;
- ▶ PAG material deposited in the management ponds will be flooded to prevent acid mine drainage but will also be covered with an engineered cover consisting of non-PAG rock, overburden, and surface soils to allow for terrestrial revegetation;
- ▶ Majority of open pit features (e.g., highwalls and footwalls) are covered/resurfaced/recontoured with non-potentially acid generating (non-PAG) rock and overburden; and
- ▶ Revegetate with native plant species appropriate for the target ecosystems, which will include species for merchantable timber, subsistence foods, and ceremonial purposes in consultation with the Wet'suwet'en.

5.3.4 Project Footprint Boundaries

The following apply to Project footprint boundaries:

- ▶ Implement no activity buffers for identified features such as riparian areas and watercourses that were previously documented or identified by methodologies provided in the related management plans (e.g., **CEMP**, **WMP**, **VMP**);
- ▶ Clearly delineate the boundaries of no activity buffers for sensitive features in the proximity of planned disturbances to facilitate avoidance during all phases of the Project, where possible; and
- ▶ Clearly delineate Project Footprint boundaries, adhering to construction plans, and restricting identified machine use to defined areas within the Project footprint.

5.3.5 Transport Measures

The following mitigations refer to transport measures:

- ▶ Build, maintain, and use the TAC for hauling processed coal to the Rail Infrastructure for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Build, maintain, and use the TAC for transport of personnel, goods, and services for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;

- ▶ Build, maintain, and use the TAC for transport of personnel, goods, and services for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Repair and/or replace and/or upgrade existing FSRs or private roads that will be used as part of the TAC;
- ▶ Repair and replace new and existing culverts as required for all Project related transport corridors including the TAC;
- ▶ Design and build a permanent clear span bridge over Goathorn Creek and Helps Creek and its related tributaries to provide vehicular access to the Project that will be controlled by TCL;
- ▶ Use buses and/or vans for employees and contractors as much as practical to reduce the risk of traffic incidents, and to reduce noise and fugitive dust emissions generated by the Project. Bussing options to Witset and/or Houston to be provided (if requested and based on sufficient employees in these locations) to facilitate potential employees accessing employment opportunities with the Project;
- ▶ Use dust suppression agents on the rail cars to reduce fugitive dust emissions;
- ▶ Cover super B-train trucks when hauling processed coal from the CPP to Rail Infrastructure to reduce fugitive dust emissions from trucks;
- ▶ Use water and chemical agents on the TAC to reduce fugitive dust emissions, where and when appropriate;
- ▶ Use water and chemical agents, as required, on processed coal and ROM coal stockpiles to reduce fugitive dust emissions resulting from storage and handling;
- ▶ Use privately controlled Rail Infrastructure so that there are no train whistles generated from Rail Infrastructure;
- ▶ Utilize low train speeds (10 kilometres/hour [km/hr] within the Rail Infrastructure, and up to 20 km/hr while entering and exiting the Rail Infrastructure) to mitigate vibration and noise;
- ▶ Post a speed limit of 50 km/hr on the TAC, 70 km/hr on Minesite haul roads, and 30 km/hr on Project service roads. Mine haul trucks within the Minesite portion of the Project Footprint will have a maximum operating speed of approximately 35 km/hr, given their size and weight; and
- ▶ Investigate implementing a no train whistle requirement at the existing level rail crossing in the Village of Telkwa based on consultation with and approval of the Canadian National Railway (CNR).

5.3.6 Project Component Design

The following apply to Project component design:

- ▶ Manage light effects using acceptable best management practices (BMPs) and engineering design.
- ▶ TCL will also incorporate the following mitigation measures associated with effects from lighting:
 - ▶ For areas visible to the public from sensitive viewpoints investigate eliminating night lighting of buildings and structures and block light from windows where possible considering safety requirements;
 - ▶ Direct lighting shall be directed towards the ground and have appropriate covers to avoid fugitive light emissions; and

- ▶ Lighting should be sensitive to environmental conditions and automatically shut off during daylight hours.

5.3.7 Blasting Measures

The following mitigation measures apply to blasting:

- ▶ Use best management stemming techniques (e.g., type of material, size consistency, loading method, and thickness) that will minimize effects of noise and fugitive dust from blast patterns and assist in the complete detonation of drill holes to reduce the introduction of nitrogen species into the surrounding rock per the **EMP**;
- ▶ Correctly time blasts to minimize effects of noise, vibration, and fugitive dust from blast patterns;
- ▶ Keep blast patterns small to minimize effects of noise, vibration, and fugitive dust and to reduce the time that patterns need to sleep or wait until they are blasted which reduces the introduction of nitrogen species into the surrounding rock;
- ▶ Monitor actual blast results and implement improvements as required as per the adaptive management process to reduce effects of noise, vibration, fugitive dust and reduce the introduction of nitrogen species into the surrounding rock;
- ▶ Use electronic detonators to minimize effects of noise, vibration, and fugitive dust from blast patterns and manage misfires to reduce the introduction of nitrogen into the surrounding environment; and
- ▶ Use noiseless lead lines on the surface to minimize the effects of noise from blasts.

5.3.8 Coal Processing Measures

The following mitigation measures apply to process design:

- ▶ Use centrifuges for processed coal dewatering versus coal and/or natural gas fuelled coal dryers to minimize greenhouse gas (GHG) and dust emissions;
- ▶ Use BMPs in flowsheet design to maximize the reuse of process water by the CPP and allow the recirculation of grey water from Project equipment wash bays in the Maintenance Facility by the CPP; and
- ▶ Use belt filter presses to dewater fine processed rock material versus conventional slurry fine processed rock to reduced water consumption by the CPP.

5.3.9 Seepage Management Measures

the following mitigation measures are associated with seepage management:

- ▶ Use overburden bentonite liners for management ponds to reduce the amount of groundwater seepage and potential effects on surface water and groundwater quality;
- ▶ Use liners in the Tenas Control Pond, Wastewater Storage Pond, Soil Treatment Facility, Potable Water Storage Pond, and sedimentation pond at the CPP site to minimize the risk of seepage to groundwater and potential effects on surface water and groundwater quality;
- ▶ Monitor seepage, groundwater, and surface water levels, and quality/quantity downstream and upstream of the Project as per the monitoring programs set up in the **MWMP**; and

- ▶ Establish trigger levels that require the implementation of contingency mitigation measures described in **DMP** to protect surface water and groundwater quality and maintain minimum flow levels downstream of the Project.

5.3.10 Water Capture Measures

The designs of the management ponds, sedimentation ponds, collection and diversion channels, and all other water management structures are documented in **S1.0-1.22 Management Ponds (Tailings Storage Facility) and Control Pond Aspects, Appendix 1.0-G Tenas Project Water Management Technical Design Report**, and the **MWMP**. The following mitigation measures apply to water capture:

- ▶ Construct diversion channels, where practical, to prevent non-contact water from entering the Project Area and remain as non-contact water;
- ▶ Sedimentation and control ponds will have sufficient storage capacity to allow fine sediments to settle out for 1 in 10-year storm events and will be designed to structurally withstand a 1 in 200-year storm event; total suspended solids (TSS) and/or turbidity will be monitored prior to release;
- ▶ Establish flocculent addition systems for sedimentation and/or control ponds that will discharge directly to surface waters to provide additional sedimentation control to reduce potential effects on surface water quality;
- ▶ If monitoring indicates, construct wetlands within or downstream of sedimentation and/or control ponds to reduce potential effects on surface water quality;
- ▶ Include a control structure on the outflow from the C02 diversion channel south of the East Management Pond to control high flow events discharging into the upstream portion of Four Creek by enabling overflow to the East Management Pond directly in the Post-closure phase or to a channel going into the Tenas Control Pond in the Operation, and Decommissioning and Reclamation phases;
- ▶ Maintain sufficient capacity in the Tenas Control Pond to store up to a 1 in 10-year storm event to control discharge;
- ▶ Monitor and control water discharges from Tenas Control Pond to a tributary of Goathorn Creek based on downstream water flow rates and water quality to meet in-stream guidelines and flow requirements during the Operation, and Decommissioning and Reclamation phases; and
- ▶ Develop the open pit in a manner that will allow it to collect water in Decommissioning and Reclamation, Post-closure Phases to provide additional sedimentation control.

5.3.11 Management of Metal Leaching/Acid Rock Drainage (ML/ARD)

The following mitigation measures apply to preventing potential ARD:

- ▶ Identify and segregate PAG material while mining the open pit, and place PAG material in management ponds and submerge PAG material under a minimum of 1.0 metre (m) of water within an average of six (6) months after excavation but no longer than 12 months and under at least two (2) m of water once the management pond has met its PAG material storage requirements (North Management Pond is completed first, followed by the East Management Pond and finally the West Management Pond) to prevent potential ARD and subsequent effects on surface water quality;
- ▶ Place approximately a one (1) to two (2) m layer of non-PAG rock on top of the submerged PAG material below the active water level of the respective management pond, followed by

approximately one (1) to three (3) m layer of overburden to create a dry landform above water, followed by an approximately 30 centimetre (cm) layer of reclamation materials (surface soil) to reduce evaporative losses from the management ponds and provide a landscape more similar to pre-Project development;

- ▶ No PAG material will be used in construction of any external piles, pads, roads, embankments, buttresses, or for backfilling the open pit to prevent potential ARD and subsequent effects on surface water quality; and
- ▶ Open pit walls will be covered by non-PAG material to limit oxygen and water ingress into the open pit walls and provide a neutralizing effect on the open pit wall material below;
- ▶ Some of the open pit walls will be flooded with water to further reduce the likelihood of ARD from the covered open pit walls;
- ▶ Establish a material geochemical testing program for future Project exploration drillholes and Operation phase blast holes as part of the blasting program to verify PAG versus non-PAG materials. Maintain a PAG geological model while the open pit is being mined to reflect any changes observed;
- ▶ Maintain a database of geochemical testing results and material placement to avoid the incorrect placement of PAG material and potential ARD with subsequent effects on surface water quality;
- ▶ Establish a material tracking system to document the location and type of material being excavated and hauled to avoid misplacement of material and/or remediate any misplacement that may occur;
- ▶ Controlled open pit wall blasting will be conducted on both the highwall and footwall to limit the amount of damage to the open pit wall to minimize the potential for particle size reduction and provide pathways for water and oxygen to enter the open walls prior to them being covered;
- ▶ Majority of material near the open pit footwall will not be blasted again to minimize the potential of water and oxygen accessing this material;
- ▶ Progressive reclamation will be undertaken to reduce the infiltration of water and oxygen into the open pit walls by placing non-PAG rock and overburden on the open pit walls once mining is completed for an open pit wall section in question and people operating equipment have moved at least 100 m away from proposed backfilling operation. Furthermore, this non-PAG material is expected to provide a permanent high neutralization potential (NP) water source to prevent ARD generation from PAG material present in the open pit walls; and
- ▶ Provide annual reports to British Columbia Ministry of Energy, Mines and Low Carbon Innovation (BC MEMLI) and BC MECCS and designated Indigenous groups summarizing the results of geochemical testing.

The following mitigation measures for minimizing potential ML:

- ▶ Progressive reclamation will be undertaken to reduce the infiltration of water and oxygen into the non-PAG backfills, buttresses, and embankments;
- ▶ Non-PAG rock will be covered with overburden as much as material constraints allow to reduce the infiltration of water and oxygen;
- ▶ Place some non-PAG rock into management ponds that are characterised as PAG because of the mine planning process using a neutralization potential ratio (NPR) value of 2NP (neutralizing potential):1AP (acid potential [AP]) to classify non-PAG material from PAG material versus the geochemistry NPR value of 1.2NP:1AP used for classifying non-PAG material from PAG material; and

- ▶ In the Post-closure Phase, approximately half of non-PAG material will be flooded with water in the open pit to prevent oxygen ingress and further oxidization of this material resulting in a reduction of metal leaching once this occurs.

5.3.12 People, Employees, Contractors, and Onsite Policies

The following mitigation measures apply to people, employees, contractors, and onsite policies:

- ▶ Establish and implement an onsite policy prohibiting shooting, hunting, and fishing within the Project Area.

5.3.13 Project Design and Siting

- ▶ Buildings and other Project infrastructure will be designed and maintained to exclude wildlife. Deterrents will be used, as appropriate, to discourage use of Project infrastructure for refuge or shelter by wildlife and to prevent wildlife from potentially becoming entrapped;
- ▶ Ditches and culverts will be designed along the Project roads to minimize pooling of water. Roadside pools that form and remain for an extended period will be monitored for amphibian breeding activities, and appropriate buffers used for breeding sites;
- ▶ Amphibian surveys will be completed to determine locations for seasonal movements and crossing structures will be installed at specific locations based on likely areas for movements, with emphasis on Western Toad; and
- ▶ New trails and roads will be designed to minimize sightlines for predators wherever practicable while still maintaining general road safety.

5.3.14 Minimize Habitat Disturbance

- ▶ The Project footprint boundaries, sensitive habitats and identified wildlife features will be clearly delineated by flagging and/or fencing to limit the potential for mortality, inadvertent loss of wildlife habitat, and development within sensitive habitats. This includes identified wildlife features (e.g., dens) outside the Project footprint;
- ▶ Directed lighting or light shielding will be implemented, rather than broad lighting, and lighting will be focused on work sites and not on surrounding areas. Appropriate lamps will be used, or lamps will be fitted with ultraviolet (UV) filters, and dusk/night use will be limited between May and September, whenever practicable; and
- ▶ Vegetation mitigation measures will be implemented, including seeding and vegetating exposed surface soils as soon as practicable with regionally appropriate, certified weed-free seed mixtures. Stockpiles might be revegetated with an agronomic weed free legume mixture as this is a temporary measure and not final reclamation.

5.3.15 Timing Considerations

- ▶ Least-risk timing windows for wildlife (refer to **WMP**) will be used to avoid Project activities during sensitive time periods (e.g., during certain times of the day or during certain periods of the year), for works that involve the clearing of vegetation and/or surface soils. If activity must occur during sensitive time periods or in sensitive habitats, a QP will conduct pre-clearing surveys focused on areas of suitable habitat (e.g., for fisher or other dens, bat roosting sites) and/or will conduct salvages (e.g., Western Toad);

- ▶ Pre-construction surveys will be used to determine the occurrence of wildlife habitat features that may be used annually by wildlife. Features that are re-used annually by wildlife species include raptor stick nests, mineral licks, wildlife dens, bat roosts and hibernacula. Surveys conducted by the QP will be completed with focus on suitable habitat and species at risk (see **WMP**) and where applicable, will be followed by specific mitigation measures which could include installing crossing structures, providing alternate denning/roosting sites, or establishing setbacks; and
- ▶ Blasting activities will be managed (i.e., daytime only) to minimize effects on wildlife especially during sensitive time periods or in sensitive habitats (e.g., alter blasting patterns or delay blasting if wildlife is present within the blast personnel clearing radius).

5.3.16 Wildlife Education Program

- ▶ A Wildlife Education Program will be implemented for employees, visitors, and contractors in accordance with the **WMP**;
- ▶ Employees and contractors will be educated through a formal induction process about potential wildlife issues, awareness (including bear awareness), wildlife mitigation measures, waste management policies that limit human-wildlife interactions, to not harass wildlife or use vehicles to entice wildlife to move off the road, and about wildlife crossing and habitat corridor signage;
- ▶ Mandatory reporting of wildlife observations and interactions to TCL staff by employees and contractors. Wildlife observations and interactions will be tracked in a logbook with daily logs stored in a digital data storage system that will be maintained by the Environmental Coordinator Logbooks and reports will be available to employees and contractor;
- ▶ If caribou are observed within the Project Area, the BC MFLNRORD Regional Wildlife Biologist for the Skeena area will be notified; and
- ▶ Employees and contractors will be trained in appropriate wildlife deterrent techniques.

5.3.17 Wildlife Protection Protocols

- ▶ Wildlife Protection Protocols will be implemented in accordance with the **WMP** to avoid or minimize wildlife habitat interactions that may result in the mortality, morbidity, or injury to wildlife or employees/contractors;
- ▶ Traffic and access control measures including reducing traffic volume by scheduling truck convoys, using high-volume haul trucks, transporting workers to site by bus, and closing Project roads to the public (e.g., private vehicles, snowmobiles, all-terrain vehicles, hikers) will be implemented;
- ▶ Appropriate traffic signage (e.g., speed limits, wildlife crossing) will be installed along Project haul roads, services roads and the TAC;
- ▶ Wildlife will be allowed to move away or off the road, by slowing down and/or stopping equipment before resuming normal road speeds for the area;
- ▶ Personal firearms will be prohibited within the Project Area;
- ▶ Policies prohibiting workers from feeding or harassing wildlife within the Project Area/Footprint will be implemented;
- ▶ A "no domestic pet policy" will be implemented within the Project Area/footprint; and
- ▶ Appropriately sized gaps will be maintained in roadside snowbanks to facilitate wildlife crossing and escape.

5.3.18 Manage Hazardous Materials

- ▶ The use of harmful and hazardous substances will be limited to the extent practical; and
- ▶ Hazardous materials will be handled and stored using measures, such as those in the **FMSCP** and **WMPRE**, to avoid attracting wildlife (e.g., wildlife proof containers or exclusion fencing).

5.3.19 Manage Potential Wildlife Attractants

- ▶ The use of road salts within the Project Area will be minimized to reduce attractants to wildlife;
- ▶ Vegetation management will be incorporated along Project roads and adjacent to management, sedimentation, and control ponds to minimize site attractiveness to wildlife;
- ▶ Visual and auditory deterrents will be used to deter wildlife from using potentially contaminated areas such as the Soil Treatment Facility;
- ▶ Any wildlife carcasses found within the Project Area will be reported to the BC Conservation Officer Service; carcasses will be disposed of as directed to prevent scavenging;
- ▶ A "no littering" policy within the Project Area will be implemented;
- ▶ Any materials that could act as wildlife attractants (e.g., oils, chemicals, garbage) will be placed, stored, and stockpiled in either animal proof containers or in a manner that minimizes their potential to attract wildlife. If evidence of wildlife presence or access to waste disposal facilities or a waste disposal compliance problem is detected, use of modified systems and/or increase of offsite waste disposal frequencies will be implemented; and
- ▶ Management of waste and/or wildlife attractants will be included in the Wildlife Education Program (refer to **WMP**).

5.3.20 Summary of Mitigation Measures

A summary of the mitigation measures applicable to the Wildlife VC, organized by potential effect and contributing activities, is provided in **Table 5.3-1**. An indication of whether a residual effect is anticipated for each potential effect following implementation of the listed mitigation measures is provided in the table. Each potential effect applies to all Wildlife VC subcomponents, and all potential effects are predicted to be residual effects and are carried forward in the assessment.

Table 5.3-1: Summary of Potential Effects and Mitigation Measures for the Wildlife Valued Component (VC) and Subcomponents

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Applicable Valued Component (VC) Subcomponent	Residual Effect (Yes/No)
Alteration and/or Loss of Habitat	- Site clearing (clearing, grubbing, soil stripping and salvaging) (C) - Transportation of equipment, materials, and personnel (C, O, D, P) - Construction and installation of all Project components (C) - Improvements to existing private road and Forest Service Roads (C) - Mining the open pit (O) - Operation of surface water management systems; Coal Processing Plant (CPP); water discharge infrastructure; material handling systems; and solid waste management systems (O) - Maintenance of Project roads; bridge over Goathorn Creek; powerline and substation; Rail Infrastructure; Project buildings and storage facilities; and material storage piles (O) - Progressive reclamation of completed mine areas (O) - Dismantling and removing all mining equipment and facilities (D) - Reclamation and closure of Minesite activities, Project roads, bridge over Goathorn Creek, Powerlines, and Rail Infrastructure (D) - Implementation of post-mining systems and monitoring (D) - Maintenance of post-mining systems and ongoing monitoring (P)	- Avoid sensitive environments - Limit Project footprint and Project Area - Reclamation measures (Refer to RCP) - Project footprint boundaries - Transport measures - Project component design - Blasting measures (Refer to EMP) - Coal processing measures - Seepage management measures - Water capture measures - Management of ML/ARD (Refer to ML/ARDMP) - Project design and siting - Minimize habitat disturbance - Timing considerations (Refer to WMP) - Wildlife education program (Refer to WMP) - Wildlife protection protocols (Refer to WMP) - Manage potential wildlife attractants (Refer to WMP)	- Furbearers - Caribou - Grizzly Bear - Moose - Bats - Western Toad	Yes

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Applicable Valued Component (VC) Subcomponent	Residual Effect (Yes/No)
Change in Mortality	- Site clearing (clearing, grubbing, soil stripping and salvaging) (C) - Transportation of equipment, materials, and personnel (C, O, D, P) - Construction and installation of all Project components (C) - Improvements to existing private road and Forest Service Roads (FSR) (C) - Mining the open pit (O) - Operation of surface water management systems; CPP; water discharge infrastructure; material handling systems; and solid waste management systems (O) - Maintenance of Project roads; bridge over Goathorn Creek; powerline and substation; Rail Infrastructure; Project buildings and storage facilities; and material storage piles (O) - Progressive reclamation of completed mine areas (O) - Dismantling and removing all mining equipment and facilities (D) - Reclamation and closure of Minesite activities, Project roads, bridge over Goathorn Creek, powerlines, and Rail Infrastructure (D) - Implementation of post-mining systems and monitoring (D) - Maintenance of post-mining systems and ongoing monitoring (P)	- Avoid sensitive environments - Limit Project footprint and Project Area - Project footprint boundaries - Transport measures - Project component design - Blasting measures (refer to EMP) - Coal processing measures - Seepage management measures - Water capture measures - Management of ML/ARD (Refer to ML/ARDMP) - People, employees, contractors, and onsite policies - Project design and siting - Minimize habitat disturbance - Timing considerations (Refer to WMP) - Wildlife education program (Refer to WMP) - Wildlife protection protocols (Refer to WMP) - Manage hazardous material (Refer to FMSCP and WMPRE) - Manage potential wildlife attractants (Refer to WMP)	- Furbearers - Caribou - Grizzly Bear - Moose - Bats - Western Toad	Yes
Change in Movement Patterns	- Site clearing (clearing, grubbing, soil stripping and salvaging) (C) - Transportation of equipment, materials, and personnel (C, O, D, P)	- Avoid sensitive environments - Limit Project footprint and Project Area - Project footprint boundaries	- Furbearers - Caribou - Grizzly Bear	Yes

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Applicable Valued Component (VC) Subcomponent	Residual Effect (Yes/No)
	- Construction and installation of all Project components (C) - Improvements to existing private road and FSR (C) - Mining the open pit (O) - Operation of surface water management systems; CPP; water discharge infrastructure; material handling systems; and solid waste management systems (O) - Maintenance of Project roads; bridge over Goathorn Creek; powerline and substation; Rail Infrastructure; Project buildings and storage facilities; and material storage piles (O) - Progressive reclamation of completed mine areas (O) - Dismantling and removing all mining equipment and facilities (D) - Reclamation and closure of Minesite activities, Project roads, bridge over Goathorn Creek, Powerlines, and Rail Infrastructure (D) - Implementation of post-mining systems and monitoring (D) - Maintenance of post-mining systems and ongoing monitoring (P)	- Transport measures - Project component design - Blasting measures (Refer to EMP) - Coal processing measures - Seepage management measures - Water capture measures - Management of ML/ARD (Refer to ML/ARDMP) - People, employees, contractors, and onsite policies - Project design and siting - Minimize habitat disturbance - Timing considerations (Refer to WMP) - Wildlife education program (Refer to WMP) - Wildlife protection protocols (Refer to WMP) - Manage hazardous materials (Refer to FMSCP and WMPRE) - Manage potential wildlife attractants (Refer to WMP)	- Moose - Bats - Western Toad	

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

EMP=Explosives Management Plan (S13.0-C6); FMSCP=Fuel Management and Spill Control Plan (S13.0-C7); ML/ARD=metal leaching/acid rock drainage; ML/ARDMP=Metal Leaching/Acid Rock Drainage Management Plan; Project=Tenas Project; RCP=Reclamation and Closure Plan (S13.0-C15); WMP=Wildlife Management Plan (S13.0-C21); WMPRE=Waste Management Plan for Refuse and Emissions (S13.0-C20)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table.

5.4 Residual Effects and Significance of Residual Effects

This subsection describes the likely residual adverse effects of the Project on the Wildlife VC. Residual effects are effects that remain after the implementation of all mitigation measures and management strategies and are the expected consequences of the Project for the Wildlife VC.

The approach to assessing residual Project effects on the Wildlife VC follows the methodology outlined in **S3.0 Assessment Methodology** of the **EAC Application**. For each subcomponent of the Wildlife VC, each residual effect is assessed in the context of the Project activities that will occur within each Project phase. Each residual effect is then characterised based on the combined predicted residual effect for all phases, including an evaluation of Likelihood, Significance, and Level of Confidence.

5.4.1 Description of Evaluation Criteria

5.4.1.1 Residual Effects Characteristics

Residual effects on the Wildlife VC subcomponents have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of effect. Definitions and ratings for each residual effect characteristic are provided in **Table 5.4-1**.

Table 5.4-1: Effect Characteristics Considered When Determining the Significance of Residual Effects on the Wildlife Valued Component (VC)

Residual Effect Characteristic	Definition	Rating
Magnitude	The intensity of the residual effect, or a measure of the degree of change from existing (baseline) conditions.	Effect: Alteration and/or Loss of Habitat Low: Effect occurs that might be detectable but is expected to be within the range of baseline or guideline values, or within the range of natural variability (0-5%) Moderate: Effect is expected to be at or to slightly exceed the limits of baseline or guideline values (6-15%) – clearly an effect and may become a management concern. High: Effect is expected to exceed the limits of baseline or guideline values (>15%) – can pose a serious risk and represents a management concern.
		Effect: Change in Mortality and Change in Movement Patterns Low: Effect occurs that might be detectable but is expected to be within the range of baseline or guideline values, or within the range of natural variability. Moderate: Effect is expected to be at or to slightly exceed the limits of baseline or guideline values – clearly an effect and may become a management concern. High: Effect is expected to exceed the limits of baseline or guideline values – can pose a serious risk and represents a management concern.
Geographic Extent	The geographic area within which the residual effect is expected to occur.	Project Area: Effect is limited to the Project Area. Local: Effect is limited to the WLSA. Regional: Effect extends beyond the WLSA into the WRSA, CRSA1, CRSA2, or WR-WRSA.

Residual Effect Characteristic	Definition	Rating
Duration	Length of time over which the residual effect is expected to persist.	Short-term: Less than two (2) years (i.e., effect happens during the Construction Phase only). Medium-term: two (2) years to 52 years (i.e., effect happens from the Construction Phase through to the end of the Post-closure Phase). Long-term: More than 52 years (i.e., effect extends beyond the Post-closure Phase).
Frequency	How often the residual effect is expected to occur.	Infrequent: Effect occurs several times at sporadic intervals. Frequent: Effect occurs many times on a regular basis. Continuous: Effect occurs continuously.
Reversibility	Whether or not the residual effect can be reversed once the activity causing the residual effect ceases.	Fully reversible: A residual effect that diminishes to baseline conditions. Partially reversible: A residual effect that partially diminishes to baseline conditions. Irreversible: A residual effect that will not diminish to baseline conditions.
Context	The extent to which the Wildlife VC has been affected by past and present environmental and socio-economic processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience).	Low: Subcomponent has high resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and / or a lack of historic and ongoing anthropogenic or natural disturbance. No listed species present. Moderate: Subcomponent has moderate resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or an intermediate level of historic or ongoing anthropogenic or natural disturbance with the capacity to assimilate more change. Presence of blue-listed species. High: Subcomponent has weak resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a high level of historic or ongoing anthropogenic or natural disturbance. Presence of red-listed or SARA-listed species.

Notes: %=percent; CRS A1=Caribou Regional Study Area; CRS A2=Caribou Regional Study Area 2; WLSA=Wildlife Local Study Area; WR-WRSA=Wide-ranging Wildlife Regional Study Area; WRSA=Wildlife Regional Study Area; SARA=Species At Risk Act, SC 2002, c. 29 (GovCan 2002) (SARA)

Magnitude is assessed quantitatively by assigning thresholds to express the relative percentage of habitat loss or alteration relative to the total habitat available in the respective RSAs. Evidence suggests that, below certain thresholds of habitat cover, species may decline more rapidly than would be expected from habitat loss alone. When remaining functional habitat is greater than 10% to 30% in a region, species are still affected by habitat loss (Andrén 1994; Swift and Hannon 2010) but are not necessarily at risk of regional extirpation. Some taxa, ecosystems, and landscapes are more susceptible than others and habitat thresholds ranging from 10% to 60% may be required to avoid rapid population declines (Bennett and Ford 1997; Villard et al. 1999; Swift and Hannon 2010).

A conservative approach is used in this assessment and precautionary thresholds have been identified for species for which specific thresholds are not known. A precautionary threshold is defined as the point before a resource would be expected to undergo an unacceptable change, either from an ecological, regulatory,

or social perspective. This definition allows for adaptive mitigation measures to be enacted with sufficient time to prevent the resource (i.e., subcomponent) from reaching or exceeding the true ecological threshold.

The precautionary thresholds used in this assessment for the alteration and/or loss of habitat identified a Loss 0–5% of suitable habitat as a Low Magnitude, 6–15% as a Moderate Magnitude, and a >15% loss of suitable habitat as a High Magnitude. For the change in mortality and change in movement pattern effects the precautionary thresholds identified the following ratings: Low, as an effect that occurs that might be detectable but is expected to be within the range of baseline or guideline values, or within the range of natural variability; Moderate, as an effect that is expected to be at or to slightly exceed the limits of baseline or guideline values – clearly an effect and may become a management concern; and High, an effect is expected to exceed the limits of baseline or guideline values – can pose a serious risk and represents a management concern

5.4.1.2 *Likelihood*

Likelihood refers to the probability that the predicted residual effect will occur while considering that the mitigation will be successful. Likelihood is defined as Likely or Unlikely:

- ▶ **Unlikely:** Low probability of an effect; or
- ▶ **Likely:** Moderate-to-High probability of an effect.

5.4.1.3 *Significance Determination*

The characterisation of residual effects is based on the review of existing conditions (**4. Existing Conditions**), the assessment of Project-related effects, other relevant scientific information, and professional judgement. All residual effects (independent of their Significance rating) are carried forward to the CEA.

The Significance of the residual effect is rated as **Not Significant** or **Significant**, based on the following:

- | | |
|------------------------|---|
| Not Significant | A residual effect that is not expected to result in a change to a Wildlife VC subcomponent and is not expected to alter its population viability or persistence within their respective RSA beyond an acceptable level is considered Not Significant ; or |
| Significant | A residual effect that is expected to result in a change to a Wildlife VC subcomponent and is expected to alter its population viability and persistence within their respective RSA beyond an acceptable level (e.g., where it is not sustainable or is unavailable to contribute to biodiversity and ecosystem function) is considered Significant . |

Limitations of existing data and uncertainty associated with the assessment were also characterised by assigning a level of confidence for each residual effect. Confidence levels were considered in relation to:

- ▶ scientific certainty relative to the quantification of the effect, including the quality and or quantity of data and the understanding of effect mechanisms;
- ▶ scientific certainty relative to the effectiveness of the proposed mitigation; and
- ▶ professional judgment based on prior experience in predicting effects and the known effectiveness of proven mitigation measures.

Confidence estimates allows the decision-maker to evaluate risk associated with the residual effects of the Project. In the determination of confidence, the following is considered:

- ▶ **Low Confidence:** is assigned when the VC, subcomponent and/or Project interaction is not well understood, and/or the mitigation has not been proven effective;
- ▶ **Moderate Confidence:** is assigned where the VC is understood in similar ecosystems and effects have been documented in the larger regional area or in the literature, and/or the mitigation has been proven effective elsewhere; or
- ▶ **High Confidence:** is assigned when the VC, subcomponent, and Project interactions are well understood, and the mitigation has been proven effective.

Based on these criteria, it was determined that an additional risk analysis was not required.

5.4.2 Furbearers Subcomponent

5.4.2.1 Alteration and/or Loss of Habitat

The assessment of the alteration and/or loss of habitat residual effect considers the direct loss of habitat and the indirect alteration (e.g., sensory disturbances, edge effects, perceived barriers) of habitat for American marten (i.e., the representative species for Furbearers) during all Project phases. The American marten habitat suitability model (**Appendix 4.8-A**) characterises and quantifies suitable habitat within the WRSA using a habitat suitability index (HSI) as baseline information to inform the assessment of the Project. The characterisation of the alteration and/or habitat loss residual effect considers the Project effects on Moderate to High suitable American marten winter living habitat (suitable Furbearer habitat), within the WRSA.

Alteration and habitat loss is quantified by calculating the area of suitable Furbearer habitat altered or lost within the Project Area. Progressive revegetation is anticipated to begin during the Construction Phase and habitat that is altered/lost will become available as suitable Furbearer habitat following the Post-closure Phase (i.e., after the regeneration of vegetation following reclamation. However, a conservative approach is used, in that habitat within the Project Area is considered unavailable to Furbearers for the duration of the Project.

Direct habitat loss will be mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, suitable Furbearer habitat will be cleared during the Construction Phase. Up to 1,578 ha (1%) of suitable Furbearer habitat within the WRSA is anticipated to be removed or altered during site clearing in the Construction Phase (**Table 5.4-2**). In this analysis it was assumed that all suitable habitat in the Project Area would be lost, which is an overestimate of the habitat loss and alteration that will occur. Mitigation measures outlined in **5.3** are anticipated to reduce the effects.

Mitigation measures are expected to maintain important identified habitat features (e.g., no-disturbance buffers around sensitive or important habitat features [e.g., dens]), and reduce the loss or alteration of habitat (e.g., minimize Project Area, common corridors for linear Project components).

Table 5.4-2: Summary of Change in Suitable Habitat for Marten

Habitat	Predicted Total Change in Suitable Habitat (ha)¹	Total Suitable Habitat (ha) in the WRSA	Predicted Total Change in Suitable Habitat (%)²
Marten – High suitability	39.0	31,249.0	0.5
Marten – Moderate suitability	1,539.0	121,852.0	1.3
Total	1,578.0	153,101.0	1.0

Notes: %=percent ; ha=hectare; WRSA= Wildlife Regional Study Area

¹ Predicted total change in suitable habitat (ha) in the Project Area and LSA.

² Predicted total change in suitable habitat (%) in the Wildlife RSA.

5.4.2.1.1 Residual Effects Characterisation

The residual effects characterisation for the alteration and/or loss of suitable Furbearer habitat is provided in **Table 5.4-3**.

The Magnitude of the alteration and/or loss of suitable Furbearer habitat is predicted to be Low. It is anticipated that up to 1% of suitable Furbearer habitat within the WRSA will be lost due to clearing within the Project Area during the Construction Phase. The residual effect is predicted to be Local in Geographic Extent. While the direct loss of suitable Furbearer habitat is expected to be limited to the Project Area during Construction, Indirect effects are expected to occur within the WLSA along the periphery of the Project Area during all Project phases.

The Frequency of the alteration and/or loss of suitable Furbearer habitat is predicted to be Frequent. While loss of suitable Furbearer habitat due to clearing during Construction will occur once, alteration of suitable Furbearer habitat within the WLSA by Indirect effects is anticipated to be Frequent throughout the Construction, Operation, Decommissioning and Reclamation phases, and Infrequent during the Post-closure Phase.

The alteration and/or loss of suitable Furbearer habitat is predicted to occur over the Long-term (>52 years) because of the length of time required for suitable Furbearer habitat to regenerate following disturbance. SBS BGC zone forests, which represents 61% of the WRSA, do not provide suitable Furbearer habitat until they are 50 years old (Lofroth 1984). Progressive reclamation is anticipated to begin in some parts of the Project Area following the Construction Phase; however, the revegetation within most of the Project Area will occur as part of reclamation activities during the Decommissioning and Reclamation Phase, up to 27 years after clearing during the Construction Phase.

The alteration and/or loss of suitable Furbearer habitat is predicted to be Fully Reversible. Progressive and final reclamation will revegetate disturbed areas within the Project Area with a focus on an end land use of forested ecosystems. American marten will use regenerating stands following forest harvesting once the forest has reached a suitable age, typically after 50 years (Lofroth 1984). Thus, suitable Furbearer habitat lost within the Project Area has the potential to regenerate over a short timeframe. Progressive revegetation may occur in some parts of the Project Area prior to the Post-closure Phase; however, most revegetation is anticipated to occur following the end of the Operation Phase and become suitable Furbearer habitat following the Post-closure Phase. In addition, the alteration of suitable Furbearer habitat is expected to be reduced within a similar time frame as sensory disturbances diminish and the vegetation regenerates.

The Context of the residual effect for the alteration and/or loss of suitable Furbearer habitat is predicted to be Moderate. Suitable Furbearer habitat that is altered or cleared due the Project will remain so until the

Decommissioning and Reclamation Phase when revegetation will occur. Revegetated areas are expected to become suitable Furbearer habitat after approximately 50 years following the revegetation of the Project Area (Lofroth 1984). The outbreaks of mountain pine beetle (*Dendroctonus ponderosa*) and spruce beetle (*Dendroctonus rufipennis*) and subsequent salvage logging in central BC have likely affected suitable Furbearer habitat in the WRSA. In 2019, forestry losses in the Bulkley TSA totalled 1,979 ha due to the mountain pine beetle outbreak and were estimated at less than 600 ha due to the spruce beetle outbreak (Westfall et al. 2019). Projected forest losses due to the mountain pine beetle outbreak are expected to continue to increase through to 2024 (BC MFLNRO 2015a). Forest may initially continue to provide suitable habitat following the beetle outbreaks; however, it is anticipated that suitability will decline following the loss and fragmentation of mature forest stands (Chan-McLeod 2006). American marten is susceptible to forest fragmentation and has low dispersal capabilities (Ruggiero et al. 1994). Prey species such as seed-eating wildlife (e.g., red squirrel [*Tamiasciurus hudsonicus*]) populations are anticipated to decline following beetle outbreaks and likely reduce the habitat suitability for American marten (Chan-McLeod 2006). Overall, variability resulting from natural disturbance to suitable Furbearer habitat is expected to increase over the near future. Therefore, a Moderate rating is predicted for Context.

Table 5.4-3: Summary of the Characteristics Ratings for the Alteration and/or Loss of Habitat for Furbearers

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	<1% of suitable Furbearer habitat is predicted to be altered or lost.
Geographic Extent	Local	The effect is limited to the WLSA.
Duration	Long-term	The loss of habitat will only occur during Construction Phase; however, the alteration of habitat will continue through all phases. The reclamation of the Project Area will not be complete until the end of the Decommissioning and Reclamation Phase (i.e., 27 years after clearing). Reclaimed areas are predicted to become suitable Furbearer habitat 50 years after replanting.
Frequency	Frequent	The effect occurs continuously due to the potential for the alteration of habitat to occur until the end of Decommissioning and Reclamation Phase
Reversibility	Fully Reversible	The alteration of habitat is anticipated to end following Decommissioning and Reclamation Phase and the revegetation of the Project Area is expected reverse the loss of habitat
Context	Low	A reduction in forest due to mountain pine and spruce beetle outbreaks has affected suitable habitat; however, Furbearers can be resilient to disturbance to suitable habitat.

Notes: <=less than; %=percent; Project=Tenas Project; WLSA=Wildlife Local Study Area; WRSA=Wildlife Regional Study Area

5.4.2.1.2 Likelihood

The Likelihood of the residual effect for the alteration and/or loss of suitable Furbearer habitat is predicted to be Likely. Suitable Furbearer habitat within the Project Area is expected to be cleared during Construction, and habitat outside the Project Area is expected to be indirectly affected during all Project Phases.

5.4.2.1.3 *Significance Determination*

The residual effect of the alteration and/or loss of suitable Furbearer habitat due to the Project is not expected to result in a change in suitable Furbearer habitat that will alter its integrity within the WRSA to the point where it is not able to sustain the regional population. The anticipated Long-term Duration of the alteration and loss of habitat is anticipated to affect a minimal amount of suitable habitat (i.e., <1%) and alter the integrity of suitable habitat for Furbearers. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The effects of habitat loss and alteration are well known, and mitigation measures have been proven effective on past projects; however, uncertainty is present with long-term habitat suitability due to natural changes from the mountain pine beetle and spruce beetle outbreaks. Uncertainty also exists in relation to the accuracy of the mapping products used to identify suitable Furbearer habitat.

5.4.2.2 *Change in Mortality*

The assessment of the change in mortality residual effect on Furbearers considers Project-related effects within the WRSA. The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Furbearer population estimates and mortality within the WRSA. The assessment includes consideration of direct mortality from Project activities and interactions with Project components, and indirect mortality due to the Project (e.g., reduced fitness). Most of the mortality risk and potential for a change in Furbearer mortality is anticipated to occur during the Construction, and Operation phases; however, mortality may occur during all Project phases.

Most American marten mortality is caused by predation and fur trapping (Poole et al. 2004, Erb et al. 2008). The mean annual non-harvest marten mortality rate is variable ranging from 7 to 48% (Bull and Heater 2001, Belant 2007, Erb et al. 2008). Sources of anthropogenic mortality for marten, such as vehicle collisions and exposure to contaminants, contribute minimally to overall anthropogenic mortality rate compared to trapping (Belant 2007, Environment Canada 2013, U.S. Fish and Wildlife Service 2018). Project roads and ROWs will be closed to the public, which is expected to reduce the potential for vehicle collision mortality. Two (2) registered trap lines overlap with the Project Area and access provided by roads and ROW may increase ease of trapping access and logistics within the WLSA and potentially increase the amount of trapping pressure; however, additional trapping mortality is expected to be minimal and sustainable trapping regulations are developed and administered by MFLNRORD (BC MFLNRORD 2003, BC MFLNRORD 2020). Traffic related mitigation (e.g., bus carpooling, reduced speed limits) are anticipated to minimize vehicle collision risk. Mitigation to reduce the potential exposure to environmental contaminants (e.g., waste storage in wildlife-proof containers, limit the use of hazardous materials) are expected to further limit the potential for mortality. It is, therefore, anticipated that any increase in risk of marten mortality will be within natural variability.

For fisher, natural mortality (e.g., predation, starvation, disease) rates (18 to 22%) are higher than mortality rates associated with other sources, which vary between 2 to 7%, excluding trapping (Koen et al. 2007, Erb et al. 2008, Sweitzer et al. 2016). Fisher trapping accounts for up to one-third of all mortalities, and the harvest rate of 9% for a population around the Williston reservoir was considered sustainable, although trapping regulations in central BC are under review following the population's change in status to red-listed in 2020 (Koen et al. 2007, Erb et al. 2008, BC Conservation Data Centre [BC CDC] 2015a). The Project Area overlaps with two (2) registered trap lines. Trapping regulations developed and administered by BC MFLNRORD are expected to maintain trapping mortality within management guidelines (BC MFLNRORD 2003, BC MFLNRORD 2020). New and improved Project roads and ROWs can increase the risk of vehicle collisions (Koen et al. 2007, Gabriel et al. 2015). However, the access and traffic related mitigation are expected to limit the risk for any additional mortality to occur due to access and vehicle

collisions. Exposure to chemicals can also increase the risk of mortality (Sweitzer et al. 2016). Mitigation to reduce the potential exposure to chemicals of potential concern are expected to further limit the potential for harm or mortality. The **WMP** also includes provision to conduct pre-clearing surveys in suitable habitat that may contain fisher dens to identify and avoid disturbance to any active dens. It is anticipated that any change in fisher mortality due to the Project's effect on mortality will be within the rates of mortality in the existing conditions.

Wolverine have low fecundity and are sensitive to changes to mortality rates due to the additive nature of anthropogenic and natural mortality rates (COSEWIC 2014b). Annual natural mortality varies from 4 to 20% and anthropogenic-related mortality rates are almost entirely from regulated harvest, as other anthropogenic sources of mortality are minimal (Krebs et al. 2004, Mowat et al. 2019). The annual harvest rate of 8.4% in southeastern BC was thought to exceed the maximum regional harvest rate of 8.0%, and a 4% harvest rate was suggested to account for uncertainties (Mowat et al. 2019). Wolverine home ranges are large, can range across several trap lines, and require the regional management of hunting and trapping regulations (BC MFLNRORD 2020). An analysis of the sustainability of BC's harvest (1985 to 2004) reported a sustainable annual harvest rate of 3.3% in the Babine region and an unsustainable annual harvest rate of 6.8% in the Bulkley-Lakes region, which was reported as overharvested by 115% (Lofroth and Ott 2007). Increases in resource roads and road density can provide hunting and trapping access to remote areas and result in increasing risk of anthropogenic-related mortality (Mowat et al. 2019). The access and traffic related mitigation for the Project are expected to limit the risk for any additional mortality to occur due to access and vehicle collisions. Data from the compulsory reporting and inspection of all harvested wolverines is used so that seasons are properly set by BC MFLNRORD and the population is sustainably managed. It is anticipated that any changes in mortality due to an increase in access will remain within the allowable harvest limits established and monitored by BC MFLNRORD. As a result, it is anticipated that any change in mortality for wolverine will be within the natural variability and management guidelines.

The residual effect of change in mortality for Furbearers is expected to be minimized by Project design mitigation measures identified in **5.3.1 to 5.3.12** that are anticipated to limit interactions between Furbearers and potential sources of mortality. The implementation of additional mitigation measures, as identified in **5.3.13 to 5.3.198**, are expected to further limit interactions between Furbearers and potential sources of direct and indirect mortality. Although Project activities may result in direct and/or indirect mortality of Furbearers within the WRSA, with the implementation of Project design measures and mitigation measures, the residual effect of change in mortality is not expected to result in a change to the long-term persistence and viability of Furbearers within the WRSA.

5.4.2.2.1 *Residual Effects Characterization*

The residual effects characterization for the change in mortality for Furbearers is provided in **Table 5.4-3**.

The Magnitude of the effect is assessed as Low, as the mitigation measures are anticipated to be effective at maintaining mortality of Furbearers within the range of natural variability.

The Geographic Extend is predicted to be Regional. Direct effects are expected to only occur within the Project Area and indirect mortality is expected to affect Furbearers with home ranges that overlap with the WLSA. The mean home ranges of Furbearers in BC vary from 17.9 km² for American marten, 219 km² for fisher, to 1,366 km² for wolverine (Stordeur 1985, Lofroth 2001, Weir and Corbould 2010). Consequently, Furbearer home ranges that overlap with the Project Area and WLSA may extend into the WRSA, resulting in a Regional Geographic Extent.

The Duration of the effect is predicted to be Medium-term. The potential for direct mortality is expected to be highest during Construction, and Operation when the Project Area will be cleared and vehicle traffic is

most frequent, and it is predicted that mortality risk will continue through to the end of the Post-Closure Phase. The potential for indirect mortality is expected to be highest during the Operation Phase, when Project components may result in indirect mortality. The potential for indirect mortality is anticipated to subside in the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and be limited during the Post-closure Phase.

The Frequency is assessed as Infrequent. Mitigation measures are anticipated to limit the potential for Furbearer mortality; however, direct and indirect mortality could occur sporadically through all Project phases.

It is predicted that the residual effect on Furbearer mortality will be Fully Reversible. The risks of direct or indirect mortality are anticipated to decrease during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities, and to diminish to baseline conditions following Post-closure.

The residual effect of change in mortality is expected to have a Moderate Context, considering the stability, abundance, and resiliency of each representative Furbearer species. Provincially, the American marten is yellow-listed, the Columbian fisher population is red-listed, and wolverine is blue-listed and only the wolverine is listed as Special Concern under SARA. American marten populations are widespread, abundant, and secure in BC, and with the resiliency to support trapping (BC CDC 1994). The Columbian fisher population was recently red-listed due to low population numbers and habitat loss (BC CDC 2015a). Wolverine populations are mostly stable in BC, although population trends are unknown, but with limited potential for population growth or additional mortality due to low reproductive rates and densities (Lofroth and Ott 2007, BC CDC 2010).

Table 5.4-4: Summary of Effect Characteristics Ratings for Change in Mortality

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	The risk of mortality is expected to be within the range of natural variability.
Geographic Extent	Regional	Direct mortality is expected to occur only within the Project Area; however, home ranges overlap with the WRSA and indirect mortality may extend into the WRSA.
Duration	Medium-term	Furbearer mortality may occur during all phases of the Project.
Frequency	Infrequent	It is expected that the effect may occur sporadically through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that Project-related Furbearer mortality is expected to end following Post-closure.
Context	Moderate	American marten is yellow-listed, fisher is red-listed, and wolverine is blue-listed in BC. Wolverine is also listed as Special Concern under SARA.

Notes: BC=British Columbia; Project=Tenas Project; SARA=Species At Risk Act, SC 2002, c. 29 (Government of Canada [GovCan] 2002); WRSA=Wildlife Regional Study Area

5.4.2.2.2 Likelihood

The Likelihood of the residual effect of the change in Furbearer mortality is Likely. Mitigation measures are expected to reduce, but not eliminate changes to Furbearer mortality.

5.4.2.2.3 *Significance Determination*

The change in mortality for Furbearers due to the Project is not expected to alter the integrity of the populations within the WRSA to the point where they are not sustainable. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence in this prediction is Moderate. The direct effects of change in mortality are well known and direct and indirect mortality is expected to remain within the range of natural variability; however, the effectiveness of mitigation measures have not been proven on past projects.

5.4.2.3 *Change in Movement Patterns*

As the widest ranging of the three (3) Furbearer focal species, wolverine has the potential to interact with all Project components. Its distribution and abundance are strongly influenced by food availability (Krebs et al. 2007), particularly ungulate carrion, so it also has the potential to display interaction effects with other Wildlife VCs that may be affected by the Project (e.g., Caribou, Moose). Wolverines are adversely affected by human activity, including roads, infrastructure, and backcountry recreation (May et al. 2006, Krebs et al. 2007). For these reasons, wolverine was selected to inform the assessment of the effects of the Project on Furbearer movement patterns. With home ranges in the order of 300 to 400 km² for females and 1,000 to 1,400 km² for males (Krebs and Lewis 1999, Lofroth 2001), the potential for change in movement patterns was assessed at the scale of the WR-WRSA. Changes to wolverine movement patterns are expected to occur primarily during the Construction, and Operations phases; however, the effect could occur during all Project phases.

Although wolverine habitat use is most likely defined by the seasonal distribution and abundance of food and the availability of suitable denning habitat (BC MWLAP 2004), it does display some broad trends (Krebs et al. 2007). In mountainous areas of British Columbia, such as in the WR-WRSA, females tend to use ESSF biogeoclimatic zones during winter, move to higher-elevation environments around treeline for denning and rearing kits, and then to Alpine Tundra zones to continue rearing throughout the summer. It is believed that females may select these higher-elevation environments to decrease predation risk and avoid human disturbance during rearing (Lofroth and Krebs 2007). The timing of this process has been noted to coincide with the movement of Caribou to high elevation areas in late winter (BC MWLAP 2004). Males, on the other hand, tend to use lower elevation zones during winter and switch to ESSF zones during the summer (Krebs and Lewis 1999, Lofroth 2001). Subadult males typically occur at the lowest elevations. These patterns of habitat use indicate that most wolverine activity in the WR-WRSA will be concentrated throughout the year at higher elevations than those of the Project Area, whose highest point occurs near the transition from the SBS to the ESSF zone at approximately 1,000 m above sea level. As such, the possibility of interactions between wolverines and Project components is expected to be limited to foraging males in winter and dispersing sub-adults.

Daily movements for wolverines can be up to 65 km (Wilson 1982) and, like seasonal movements, are most strongly influenced by food availability and distribution rather than any specific habitat or vegetation type, although they have been found to spend substantial time moving through mature and old forest structural stages (BC MWLAP 2004). Wolverines in the northern Columbia Mountains seem to prefer moving about the landscape by following watercourses and using low elevation passes between valleys.

Young disperse from their natal home ranges in their second spring. Subadult female wolverines typically disperse short distances away from their natal home ranges and males disperse 30 to 100 km (Magoun 1985), although dispersals of up to 378 km have been documented (Gardner et al. 1986). Subadults travel widely prior to establishment of a permanent home range, with their movements often characterised by

periods of concentrated use of a relatively small area, interspersed by large-scale movements (Lofroth 2001).

Human activity (e.g., log hauling, logging, mining, backcountry recreation) may alter movement paths of wolverines (Lofroth 2001) and they will often avoid entering young cutblocks (i.e., <25 years) while travelling (BC MWLAP 2004). Transportation corridors can interrupt or alter daily movements (Austin et al. 2000) and potentially limit dispersal among metapopulations (Kyle and Strobeck 2001), and it has been suggested that a movement barrier threshold exists between 300 and 500 vehicles per day (Alexander et al. 2005).

Given the propensity for wolverines to avoid areas of human disturbance, the siting of the Project in a relatively disturbed portion of the landscape is expected to lower the probability of interactions between foraging or dispersing wolverines and the Project. Much of the Project Area (44%) has been previously subjected to timber harvesting and is now dominated by 10 to 40 year-old regenerating forest stands and an extensive network of resource roads, some of which continues to be used for recreational activities. The Project Area also appears to offer limited prey availability to wolverines, with indications of relatively low densities of ungulates, except for Moose (**Appendix 4.8-A**), further reducing the probability of wolverine interactions with Project components. The limited habitat value to wolverine of the Project Area in its current condition was reflected in the single detection of a wolverine track in mature forest in the southern (highest elevation) portion of the open pit area from 31.5 km of baseline snow track surveys (**Appendix 4.8-A**). No wolverines were detected in camera studies nor are there any records of wolverine captures in 20 years of trapping data for traplines that intersect the Project Area.

Other Project design measures identified in **5.3** are expected to reduce the opportunity for effects on movement patterns of wolverine, such as the use of existing resource roads during Construction and aligning linear features into a common ROW where possible. It is expected that measures taken to minimize the Project-related increase in traffic and human disturbance, such as the use of carpooling/bussing, truck convoys, and high-volume haul trucks, enforcing speed limits on Project roads, and training programs for workers will further limit the potential for Project effects on wolverine movement. In addition, the use of a dedicated Bypass Road during the Operation Phase will avoid increased traffic volumes on existing roads. Planned processed coal super B-train truck movements of 4 to 8 trucks/hour are below the suggested barrier threshold for wolverine. Similarly, the relatively small increase in rail traffic associated with the Project is unlikely to result in a barrier to wolverine dispersal.

The implementation of additional mitigation measures, as identified in **5.3**, are expected to further limit interactions between wolverine and potential sources of sensory disturbance and functional habitat loss (in the form of reduced prey availability). Although Project activities may result in some disruption of wolverine foraging and dispersal movements within the WR-WRSA, with the implementation of Project design and other mitigation measures, the residual effect of change in movement patterns is not expected to result in a change to the long-term persistence and viability of wolverine within the WR-WRSA.

5.4.2.3.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in movement patterns is provided in **Table 5.4-5**.

The Magnitude of the effect is assessed as Low due to the small size of the Project relative to adult wolverine home ranges, the preference of the species for higher-elevation habitats than those that occur in the Project Area, and the human-disturbed condition in much of the Project Area that limits its current value to foraging males or dispersing wolverines. Mitigation measures are expected to limit the potential of the Project forming a complete barrier to wolverine movement.

The Geographic Extent is predicted to be Regional due to the size of wolverine home ranges (300 to 1,400 km²), their ability to cover distances of up to 65 km in their daily movements and dispersal distances that often exceed 100 km. It is expected that the home ranges of some wolverine will overlap with the WR-WRSA and some foraging or dispersal movements will overlap with the Project Area.

It is estimated that the Duration of the effect will be Medium-term. The potential for the effect is expected to be greatest during Construction, and Operations when sensory disturbances (e.g., vehicle traffic, rail activity, human presence) are likely to be highest and prior to revegetation of the site during Reclamation. As Project components are removed and Project activities are reduced it is predicted that the effect will diminish through to the end of Post-closure (i.e., within 50 years) when wolverine movement patterns are anticipated to return to pre-Project conditions.

The Frequency is assessed as Frequent. Measures to mitigate sensory disturbances (e.g., low speed limits, minimizing increases in traffic by convoys and carpooling, preventing public access to Project components) and minimize the size of the Project Area are anticipated to limit the potential for changes in the effect; however, sensory disturbances and previously cleared habitat may influence wolverine movement patterns until Post-closure.

It is predicted that the effect will be Fully Reversible. Any changes to wolverine movement patterns are anticipated to diminish during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and diminish further following Post-closure.

The residual effect of change in movement patterns is expected to have a Moderate context. Wolverine is a blue-listed species in BC, with the primary threat to population persistence identified as trapping and hunting (BC MWLAP 2004, COSEWIC 2014). While trapline records from the region indicate 22 wolverines killed over three (3) traplines and a total of 38 trapping years, only one (1) of the three (3) trapline licence areas displayed a minor overlap with the WLSA and no wolverines have been reported as trapped in the Project Area over the 20-year period of record examined (**Appendix 4.8-A**). Few high traffic volume roads (e.g., Highway 16) and rail lines (e.g., Telkwa Subdivision – Canadian National Railway [CNR]) exist within the WR-WRSA that may restrict the movement of wolverines. FSRs are prevalent across the WR-WRSA at lower elevations. While they are anticipated to have relatively low traffic volumes, increased density of roads has been associated with avoidance or reduced use by wolverines relative to large roadless areas (Rowland et al. 2003, May et al. 2006, Scrafford et al. 2018). Loss or changes in habitat used by prey species and other predators can adversely affect scavenging opportunities. The mountain pine beetle and spruce beetle in central BC and salvage logging have reduced the amount of forest cover in the WR-WRSA (Kuzyk and Heard 2014, Kuzyk et al. 2018). Losses in forest cover due to the outbreaks are thought to result in deeper snow and a higher density of downed pine and spruce trees, which increases the energetics and difficulty in movement of ungulates and their predators across the landscape (Heard 2012). As a generalist predator/scavenger, wolverine can switch between prey species relative to availability, such that declines in Caribou in the region have likely resulted in an increase in scavenged Moose in the diet of wolverines. Wolverines have also likely been advantaged by the general bias of protected areas to higher elevations and industrial disturbance to valley bottoms such that large areas of relatively undisturbed sub-alpine and alpine habitats are available to wolverine in the WR-WRSA. For these reasons, in the absence of significant trapping and hunting pressure, wolverines are considered to have moderate resilience to historic and ongoing natural and anthropogenic changes in the WR-WRSA.

Table 5.4-5: Summary of Effect Characteristics Ratings for Change in Wolverine Movement Patterns

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Elevation and current condition of the Project Area limits its value to foraging males or dispersing sub-adults.
Geographic Extent	Regional	Changes to movement patterns are expected to promulgate outside the WLSA into the WR-WRSA due to the large home range sizes of wolverines.
Duration	Medium-term	Changes to wolverine movement patterns may occur during all phases of the Project but are anticipated to end following the Post-closure Phase.
Frequency	Frequent	It is expected that the effect may occur continuously through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that potential Project-related changes to wolverine movement patterns will end following the Post-closure Phase.
Context	Moderate	Blue-listed species. Low incidence of trapping or hunting pressure. Existing disturbance in the form of roads and cutblocks may have reduced availability of traditional ungulate prey source but wide range of prey species present. Most disturbance restricted to lower elevations of WR-WRSA.

Notes: Project=Tenas Project; WR-WRSA=Wide-ranging Wildlife Regional Study Area; WLSA=Wildlife Local Study Area

5.4.2.3.2 Likelihood

The residual effect of change in wolverine movement patterns is Likely. A single detection of a wolverine on the outskirts of the Project Area was made during baseline studies. Mitigation measures are expected to reduce, but not eliminate any changes in movement patterns.

5.4.2.3.3 Significance Determination

The residual effect of change in wolverine movement due to the Project is expected to result in a minor disruption of wolverine movement patterns within the WR-WRSA such that it will not alter the integrity of the population within the WR-WRSA to the point where it is not sustainable. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The effects of human activity on changes in wolverine movement patterns are reasonably well understood. The proposed mitigation measures have proven effective on past projects for other wide-ranging, disturbance-sensitive species. However, despite recent attention in the literature, the cumulative effects of habitat alterations, forest harvesting and increases in transportation activities remain poorly understood.

5.4.3 Caribou Subcomponent

5.4.3.1 Alteration and/or Loss of Habitat

The assessment of the alteration and/or loss of habitat residual effect on Caribou considers the direct loss of habitat and the indirect alteration of habitat during all Project phases at the scales of the WLSA, CRSA1,

CRSA2 Core, and CRSA2 Matrix. Indirect alteration of Caribou habitat is caused by a change in the quality or availability of habitat in the area surrounding the Project and is based on Project activities. Alteration of habitat for Caribou is assumed to be related to sensory disturbance, including Project-related noise, dust dispersal that may affect the palatability or quality of forage (Chen et al. 2017) and other sensory disturbances associated with visual, auditory, or olfactory stimuli (Reimers and Colman 2006).

To quantify the potential effects of alteration and/or loss of potential Caribou habitat, the assessment used a Caribou habitat disturbance model and the analysis of Caribou habitat selection based on locations of collared Caribou (as described in the **Wildlife Baseline Report** in **Appendix 4.8-A**). These two (2) assessments characterise and quantify Caribou habitat and describe habitat use within the WLSA, CRSA1, CRSA2 Core, and CRSA2 Matrix.

The basis for the Caribou habitat disturbance assessment followed criteria outlined the 2014 Recovery Strategy (Environment Canada 2014). The rationale for the approach using an evaluation of disturbed areas to assess Caribou habitat was based on observed Caribou population trends for herds across Canada showing that most Caribou subpopulations whose ranges were >35% disturbed were reported to be declining (Environment Canada 2012). The results of the disturbance assessment showed that the CRSA1, CRSA2 Core, and CRSA2 Matrix are areas where different extents of disturbance have occurred during the previous decades. The WLSA is almost entirely disturbed by existing human development and activities and only includes a limited amount of potential Caribou habitat.

Habitat selection by Caribou was analyzed using BEC variant groups for classification of habitat and locations of collared Caribou to indicate habitat selection. As described in the Wildlife Baseline Report (**Appendix 4.8-A**), Telkwa Caribou have been documented to select alpine and subalpine habitats during the entire year and the analysis of recent collar data indicated that Caribou are selecting almost exclusively alpine and subalpine habitats. The results show that Caribou are using the higher elevation habitat during all seasons. Use of higher elevation terrain is even more pronounced during the winter and spring seasons.

The habitat disturbance model provided in the **Wildlife Baseline Report (Appendix 4.8-A)** considered the combined direct loss and indirect alteration of habitat (collectively referred to as habitat disturbance) within each Caribou study area by using the actual footprint and a 500 m buffer around the existing human disturbance. It also included unbuffered natural disturbances (e.g., forest fires). The buffer used in the disturbance model is intended to reflect the alteration of Caribou habitat beyond the footprint of the features due to sensory disturbance. The 500 m buffer is supported by a meta-analysis of Caribou population viability modelling that indicates using the buffer is reasonable and is the suggested method in the Recovery Strategy (Environment Canada 2014). Population viability modelling found that the Caribou subpopulations had a greater probability of growth in areas that were less than 35% disturbed (footprint and 500 m buffer). The existing condition of the Caribou study areas based on the disturbance model (provided in the **Appendix 4.8-A Wildlife Baseline Report**) indicates that disturbance already exceeds the 35% threshold recommended in the 2014 Recovery Strategy (Environment Canada 2014) for the WLSA, CRSA1, and CRSA2 Matrix, but remains below the threshold at the scale of the CRSA2 Core (**Table 5.4-6**).

Following the criteria described in the habitat disturbance model, the current condition of the Project Area is already entirely disturbed by human infrastructure or activity; consequently, the addition of the Project is not predicted to add any new disturbance (i.e., habitat loss and alteration of habitat) within the Project Area, even though an 1,852.95 ha disturbance footprint will occur with the Construction Phase of the Project. The Project will be constructed entirely on previously disturbed habitat (including 500 m buffers) caused by forestry cutblocks, infrastructure and agricultural land use. For that reason, **Table 5.4-6** does not show the addition of the Project disturbance footprint to the Project Area. Outside the Project Area, the additional predicted disturbance (in this case caused by habitat alteration) created by a 500 m buffer around the Project Area will occur in the SBSmc-Babine and SBSdk BEC variant groups where the Project results in

an additional disturbance of 15.10 ha of potential Caribou habitat in each of the Caribou study areas, with exception of the CRSA2 Core. However, based on Caribou habitat selection described in the **Wildlife Baseline Report (Appendix 4.8-A)**, these variant groups are the forested habitat types that are strongly avoided by Caribou of the Telkwa herd.

At the scale of the WLSA, the disturbance model indicates that this study area is currently approximately 90.11% disturbed, exceeding the 35% threshold recommended in the 2014 Recovery Strategy (Environment Canada 2014). The addition of the Project is predicted to increase the disturbance within the WLSA by 0.05% (**Table 5.4-6**) and will occur within the SBSmc-Babine and SBSdk BEC variant groups, currently not used by the Caribou, as explained above.

At the scale of the CRSA1, the Caribou range used in the 2014 Recovery Strategy (Environment Canada 2014), the Project is predicted to result in a 0.01% disturbance increase in addition to the existing disturbance which was modelled to be 48.34% (**Table 5.4-6**) without the Project. Similar to the WLSA, the new disturbance is associated with the habitat alteration created by the buffer around the Project Area and will occur within the SBSmc-Babine and SBSdk BEC variant groups, currently not used by the Caribou, as explained above. The 48.34% current disturbance exceeds the recommended 35% threshold suggested in the 2014 Recovery Strategy (Environment Canada 2014).

As described earlier, the CRSA1 is not a good approximation of Caribou habitat or range currently used by Caribou. The CRSA2 Core and Matrix habitat delineations provide better accuracy of the habitat used by the Telkwa Caribou Herd (Dodd and Carswell 2019). At the scale of the CRSA2 Core, the Project is predicted to result in no additional disturbance of Caribou habitat. The CRSA2 Core is currently 22.89% disturbed and the addition of the Project is predicted to not add disturbance (in the form of habitat alteration) in this study area (**Table 5.4-6**). The currently disturbed area within the CRSA2 Core does not exceed the recommended 35% total disturbance (Environment Canada 2014), and the addition of the Project will not result in exceedance. The difference between the modelled disturbed areas within the CRSA1 and CRSA2 Core is due to the inclusion of lower elevation forested habitats into the CRSA1, with forestry activity and most human infrastructure and settlements concentrated in these lower elevation habitat types.

At the scale of the CRSA2 Matrix, the addition of the Project is predicted to result in an additional disturbance of 0.01% within the SBSmc-Babine and SBSdk BEC variant groups created by the buffer around the Project Area (**Table 5.4-6**). The CRSA2 Matrix is currently 58.65% disturbed and the addition of the Project is predicted to result in a small increase in total disturbance. As with most of the other Caribou study areas, the 58.65% current disturbance exceeds the recommended 35% threshold suggested in the 2014 Recovery Strategy (Environment Canada 2014).

Figure 5.4-1 depicts the existing disturbance (i.e., development footprint and 500 m buffer) and Project-related disturbance (i.e., Project Area and 500 m buffer) in relation to Caribou study areas, corresponding with **Table 5.4-6**.

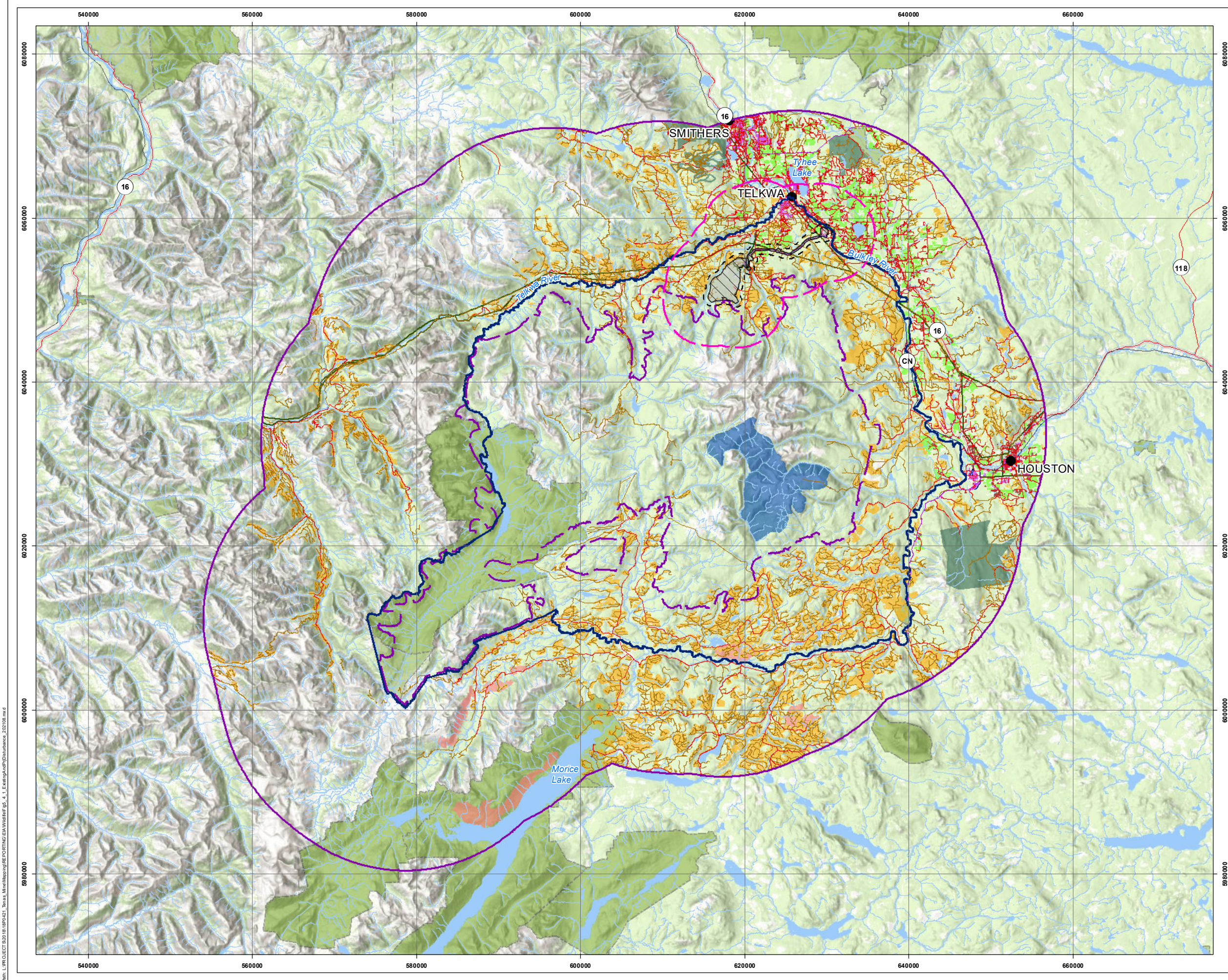
Table 5.4-6: Alteration and/or Loss of Caribou Habitat, Based on Disturbance Modelling, Due to the Tenas Project for each Biogeoclimatic Ecosystem Classification (BEC) Variant Group at the Scale of the Project Area, Wildlife Local Study Area (WLSA), Caribou Regional Study Area (CRSA) 1, CRSA2 Core, and CRSA2 Matrix

Study Area	BEC Variant Group	Total Area	Existing Disturbance*		Existing and Project-related Disturbance*		Change	
		ha	ha	%	ha	%	ha	%
Project Area	Alpine	0.00	-	-	-	-	-	-
	ESSF–parkland	0.00	-	-	-	-	-	-
	ESSF	7.37	7.37	100	7.37	100	0.00	0.000
	SBS–moist cold–Babine	1,363.04	1,363.04	100	1,363.04	100	0.00	0.000
	SBS–dry cool	482.53	482.53	100	482.53	100	0.00	0.000
	Coastal BEC	0.00	-	-	-	-	-	-
	Total	1,852.95	1,852.95	100	1,952.95	100	0.00	0.000
WLSA	Alpine	60.13	13.64	22.68	13.64	22.68	0.00	0.000
	ESSF–parkland	447.57	17.00	3.80	17.00	3.80	0.00	0.000
	ESSF	5,685.40	3,199.96	56.28	3,199.96	56.28	0.00	0.000
	SBS–moist cold–Babine	10,765.34	10,336.62	96.02	10,347.18	96.12	-10.56	-0.102
	SBS–dry cool	18,423.64	18,316.09	99.42	18,319.61	99.44	-4.54	--0.025
	Coastal BEC	-	-	-	-	-	-	-
	Total	35,382.08	31,883.31	90.11	31,898.40	90.15	-15.10	--0.047
CRSA1	Alpine	25,340.67	4,177.43	16.49	4,177.43	16.49	0.00	0.000
	ESSF–parkland	34,938.79	8,280.94	23.70	8,280.94	23.70	0.00	0.000
	ESSF	93,354.84	22,405.12	24.00	22,405.12	24.00	0.00	0.000
	SBS–moist cold–Babine	79,228.19	66,665.46	84.14	66,676.02	84.16	-10.56	-0.0160
	SBS–dry cool	25,595.34	24,341.54	95.10	24,345.06	95.12	-4.54	-0.019
	Coastal BEC	2,164.97	126.24	5.83	126.24	5.83	0.00	0.000
	Total	260,622.79	125,996.72	48.34	126,011.82	48.35	-15.10	-0.012
CRSA2 Core	Alpine	24,228.97	4,177.43	17.24	4,177.43	17.24	0.00	0.000
	ESSF–parkland	36,508.81	8,280.94	22.68	8,280.94	22.68	0.00	0.000
	ESSF	94,759.94	22,397.44	23.64	22,397.44	23.64	0.00	0.000

Study Area	BEC Variant Group	Total Area	Existing Disturbance*		Existing and Project-related Disturbance*		Change	
		ha	ha	%	ha	%	ha	%
	SBS–moist cold–Babine	3,779.12	1,831.16	48.45	1,831.16	48.45	0.00	0.000
	SBS–dry cool	0.00	-	-	-	-	-	-
	Coastal BEC	995.55	0.02	0.00	0.02	0.00	0.00	0.000
	Total	160,272.39	36,686.99	22.89	36,686.99	22.89	0.00	0.000
CRSA2 Matrix	Alpine	68,153.00	1,628.73	2.39	1,628.73	2.39	0.00	0.000
	ESSF–parkland	25,464.73	3,136.40	12.32	3,136.40	12.32	0.00	0.000
	ESSF	75,042.33	26,197.83	34.91	26,197.83	34.91	0.00	0.000
	SBS–moist cold–Babine	179,882.26	159,890.13	88.89	159,900.71	88.89	-10.56	-0.007
	SBS–dry cool	85,299.87	83,294.18	97.65	83,298.73	97.65	-4.54	-0.005
	Coastal BEC	100,324.12	39,140.41	39.01	39,140.41	39.01	0.00	0.000
	Total	534,166.31	313,287.68	58.65	313,302.84	58.65	-15.10	-0.005

Notes: BEC=Biogeoclimatic Ecosystem Classification; CRSA=Caribou Regional Study Area; ESSF=Engelmann Spruce-Subalpine Fir; ha=hectare Project; SBS=Sub-Boreal Spruce; WLSA=Wildlife Local Study Area

* Disturbance is the combined result from direct loss and indirect alteration of habitat.



Tenas Project

Existing and project-related disturbance

Legend

● City/Town	Disturbance Class
— Watercourse	— Road-Primary/Secondary
■ Waterbody	— Road-Haul
■ Park or Protected Area	— Rail
▨ Project Area	— Road-Tertiary/Trail
- - - Project Area 500 m Buffer	— Powerline/Pipeline
▭ Wildlife Local Study Area	■ Urban
▭ Telkwa Caribou Herd Regional Study Area 1	■ Industrial
▭ Telkwa Caribou Herd Regional Study Area 2 Core	■ Bldg-Residential
▭ Telkwa Caribou Herd Regional Study Area 2 Matrix	■ Rec-Snowmobile
	■ Rec-SkiBike
	■ Bldg-Rec
	■ Agriculture
	■ Cutblocks
	■ Fires

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

1:450,000

0 4 8 12 16 20

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

20P0172

Production Date: Aug 05, 2021

Figure 5.4-1

Path: L:\PROJECT\82018\82018\21_Tenas_MinMap\map\REPORTING\IEA\Mapref\fig_4_1_ExistingAndPjDisturbance_202108.mxd

The 500 m buffer around the Project Area, which was implemented for the Caribou subcomponent to evaluate sensory disturbance effects from Project activities and to inform the residual effects assessment of alteration and/or loss of habitat, was compared with the results of the predicted spatial extent of sound levels dispersing from Project activities and components described in the noise model. Refer to **S4.0-C1 Atmospheric Environment VC and Appendix-4.1-A Noise Modelling Report** of the EAC Application for additional details about noise modelling completed for the Project. The 40 A-weighted decibel (dBA) daytime and nighttime noise thresholds of the model encompass 2,073 ha and 1,072 ha, respectively, around the Project Area. The 500 m buffer around the Project Area implemented for the Caribou subcomponent encompasses 2,276.14 ha. The comparison shows that the buffer is adequate to assess the adverse Project-related noise effects (based on the 40 dBA isopleth) and is conservative, in that it encompasses a larger area in which indirect effects (including noise) are predicted to occur than indicated in the noise model.

The same comparison was completed for dustfall modelling as it relates to the Caribou buffer. Refer to **S4.0-C1 Atmospheric Environment VC and S4.0-C1-Appendix 4.1-B Air Quality Modelling Report** of the **EAC Application** for additional details about air quality modelling completed for the Project. Air quality modelling predicts that dustfall deposition could occur up to 800 m from the Project Area, with the highest deposition expected within 100 m of Project components. These predicted effects resulting from high dustfall deposition are within the buffers delineated for the Caribou subcomponents, demonstrating that the selected buffers used to assess the indirect effects of Project-related dustfall on Caribou habitat were appropriate.

The application of mitigation measures to reduce the potential effect of alteration and/or loss of Caribou habitat include the Project mitigation measures and additional mitigation measures identified in **5.3**, which include reducing the footprint of the Project components, locating new disturbance in already disturbed areas, and managing activities to reduce sensory disturbance (e.g., managing emissions of noise and deposition of dust) during all phases of the Project.

As roads are decommissioned and portions of the Project Area are revegetated, the habitat is expected to become potentially available to Caribou. However, the Project Area is already considered completely disturbed and is entirely outside of selected Caribou habitat, so any reclamation activities are likely to have a marginal (if any) benefit for Caribou as the habitat will likely remain functionally unavailable.

5.4.3.1.1 Residual Effects Characterisation

The characterisation for the alteration and/or loss of Caribou habitat residual effect is provided in the following text and summarized in **Table 5.4-7**.

The Magnitude of alteration and/or loss of Caribou habitat is predicted to be Low. The disturbance model indicated that the Project is expected to cause no change in the already existing disturbance within the Project Area, and it is predicted that the Project will result in minimal to no changes in disturbance at the scale of the other Caribou study areas.

The Geographic Extent of alteration and/or loss of Caribou habitat is predicted to be Regional, based on the resulting indirect effects through sensory disturbance. The change in habitat disturbance was modelled to occur in most regional Caribou study areas.

Alteration and/or loss of Caribou habitat is expected to be of Medium-term Duration. Noise emitted from the Project Area that has the greatest potential to disturb Caribou outside the Project Area occurs during the Construction, and Operation phases of the Project. Once the Operation Phase is complete, the noise emitted from the Project Area is expected to diminish and is unlikely to cause additional disturbance. While the reclamation of the Project Area will be complete at the end of the Decommissioning and Reclamation

Phase, after which it will take decades for the reclaimed areas to become potential Caribou habitat (if the area were to remain undisturbed by other human development), it is expected that these reclaimed areas will remain functionally unavailable in a comparable manner that they are currently functionally unavailable.

The Frequency of alteration and/or loss of Caribou habitat is expected to be Frequent during the Construction, and Operations phases of the Project. Sensory disturbance, primarily through noise and dustfall that is emitted from the Project Area due to activities such as blasting, traffic, and other mining activities is predicted to affect portions of the Caribou study areas beyond the Project Area.

Alteration and/or loss of Caribou habitat is anticipated to be Fully Reversible. The Project Area will be returned to nearly baseline conditions during the Decommissioning and Reclamation and Post-closure phases. However, this removal of Project components may not benefit Caribou, as the disturbance modelling indicated that the Project Area is already entirely disturbed. The anticipated reduction in human activities during the Decommissioning and Reclamation and Post-closure phases will likely reduce sensory disturbance emitted from the Project Area. Any Project effect on Caribou habitat through sensory disturbance is expected to be fully reversed upon Post-closure.

The Context of alteration and/or loss of Caribou habitat is predicted to be High. Changes to Caribou habitat are assumed to be the ultimate cause of Caribou population declines across Canada (Festa-Bianchet et al. 2011). The state of habitat disturbance within the Caribou study areas indicates that the region has already experienced substantial alteration and loss of Caribou habitat. Most of the Caribou study areas currently exceed the disturbance threshold (i.e., 35%), indicating that the Telkwa Caribou Herd is in the high-risk category, where the population is unlikely to be self-sustaining (Environment Canada 2011). The current state of the modelled habitat disturbance and the small size of the Telkwa Caribou Herd support the High Context rating.

Table 5.4-7: Summary of the Characteristics Ratings for Alteration and/or Loss of Caribou Habitat

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	The predicted increase to the existing habitat disturbance is expected to be marginal at the scale of the Caribou study areas. It is predicted that there will be an increase between 0.047% and 0.005% in habitat disturbance to the disturbed baseline conditions. In addition, Telkwa Caribou do not use the Project Area or the areas of the Caribou study areas expected to experience the additional disturbance.
Geographic Extent	Regional	The predicted increase in habitat disturbance is anticipated to extend beyond the WLSA and affect portions of most of the Caribou study areas.
Duration	Medium-term	The predicted additional disturbance of Caribou habitat is expected to mainly occur during the Construction, and Operations phases. While the reclamation of the Project Area will likely be complete at the end of the Decommissioning and Reclamation Phase, after which it will take decades for the reclaimed areas to become potential Caribou habitat (if the area were to remain undisturbed by other human development), it is expected that these reclaimed areas will remain functionally unavailable.
Frequency	Frequent	The alteration and/or loss of Caribou habitat due to sensory disturbance from Project activities is expected to be frequent during the Construction, and Operation phases of the Project.
Reversibility	Fully reversible	The effect is expected to be Fully Reversible upon reclamation of the Project Area after the Decommissioning and Reclamation Phase, and reduction in human activity after the Operation Phase.

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Context	High	The region has experienced considerable disturbance over the past decades and the Telkwa Caribou Herd is small, indicating a high risk that the population may not be self-sustaining.

Notes: %=percent; Project=Tenas Project; WLSA=Wildlife Local Study Area

5.4.3.1.2 Likelihood

It is predicted that the Project will Likely contribute to the alteration and/or loss of Caribou habitat, even if the resulting change is minimal. Activities in the Project Area are expected to affect habitat outside the Project Area, mostly during Construction, and Operation phases.

5.4.3.1.3 Significance Determination

The Project is expected to minimally (i.e., 0.047% to 0.005%) add to existing levels of Caribou habitat disturbance and, as such, it is predicted that this Project-related residual effect will not increase the Telkwa Caribou Herd's risk of being unable to sustain a regional subpopulation. Therefore, the effect is assessed as **Not Significant**. However, as described above, population viability modelling found that Caribou subpopulations had a greater probability of growth in areas with less than 35% disturbance (Environment Canada 2011). The 35% disturbance threshold is typically used as the significance threshold for the assessment of Project effects on the alteration and/or loss of Caribou habitat. This disturbance threshold has been exceeded in most Caribou study areas, even prior to Project construction, except for the CRSA2 Core (the area best describing current Telkwa Caribou distribution), which is not expected to be affected by the Project. This also considers that Caribou are currently not using the habitat types affected within the Project Area.

The Level of Confidence of this prediction is High. The effects of habitat loss and/or alteration on Caribou are well known and information is available on the regional subpopulation (i.e., the Telkwa Caribou Herd). Existing models and analyses describe current levels of habitat disturbance and Caribou distribution to support the predictions of Project-related residual effects.

5.4.3.2 Change in Mortality

The assessment of change in Caribou mortality considers potential sources of mortality from direct Project interactions and potential effects stemming from landscape changes that could affect indirect mortality from predation. The **Wildlife Baseline Report** provides an analysis and discussion of Caribou mortality in relation to different habitat types (**Appendix 4.8-A**). Caribou mortality was found to occur disproportionately outside of selected Caribou habitat, with the relative mortality rate more than ten (10) times higher in forested areas when compared to the mortality rate in selected alpine habitat. Predation is believed to be responsible for this increased mortality. Caribou are likely avoiding forested habitat types, like those in the Project Area, as a way of separating themselves from predators.

Direct mortality due to the Project could result from vehicle or train collisions with Caribou, or Caribou getting injured when travelling through the Project Area. The potential for the Project to adversely affect direct mortality of Caribou is considered Low. The Project Area does not overlap with habitat types selected by Caribou; it occurs entirely within the forested habitat type that is avoided by Telkwa Caribou and, in terms of Caribou habitat, is already entirely disturbed by previous developments.

Vehicle collisions with Caribou are a documented source of Caribou mortality in areas where Caribou ranges contain transportation infrastructure. In mining areas in the Northwest Territories and Nunavut,

where Caribou regularly interact with active mine roads, the main mitigation for Caribou mortality has been through speed restrictions and driver awareness training (TMAC Resources Inc. 2019). Train collisions with Caribou are not well documented in Canada, partly due to the lack of railway lines in Canada that intersect current Caribou ranges. In northern Europe, where there are abundant reindeer and railways through reindeer ranges, numerous documented train collisions with reindeer have occurred (Libell 2017, du Plessis 2020).

Indirect mortality of Caribou could occur through two processes potentially affected by the Project: 1) apparent competition with more productive alternative prey species, and 2) facilitated predation by wolves. Apparent competition occurs when the density of an alternative prey species increases so that it supports a higher density of a shared predator(s), which increases predation on the other prey species. The increasing abundance of Moose and deer during the past century has likely increased the abundance of wolves, resulting in regional declines of Caribou due to wolf predation (Bergerud and Elliot 1986). Habitat-mediated apparent competition is widely considered the primary explanation for woodland Caribou declines across much of their range (e.g., DeCesare et al. 2009, Festa-Bianchet et al. 2011, Serrouya et al. 2017, Mumma et al. 2018).

Facilitated predation occurs with the development, maintenance, and/or use of roads and trails that provide easier movement for predators across the landscape. Predators, particularly wolves, use these linear features to move more quickly and, consequently, hunt more efficiently within their range (Dickie et al. 2017). The advantage of roads and trails is realized by wolves primarily in winters when clearing or packing of snow makes travel easier (Keim et al. 2019a). In addition, how humans use the roads and trails greatly affects wolf use of the features; for example, wolves avoid roads and trails that are used frequently (>5 passes per day) by humans (Keim et al. 2019b) and used the features more frequently at night when human use is lowest (Dickie et al. 2020).

The potential for the Project to indirectly affect Caribou mortality through apparent competition is limited during the Construction, and Operation phases when human activity is more likely to deter alternative prey and predators away from the Project Area. However, during the Decommissioning and Reclamation, and Post-closure phases, the Project Area is expected to temporarily create habitat that could locally support higher densities of alternative prey species, potentially increasing predator density in the region. Similarly, the potential for the Project to indirectly affect Caribou mortality through facilitated predation associated with the construction and maintenance of roads and trails is unlikely to occur during the Construction, and Operation phases because wolves are more likely to avoid the Project Area due to increased levels of human activities. During the Decommissioning and Reclamation, and Post-closure phases, human activity within the Project Area will likely be reduced and wolves could start using the roads and trails within the Project Area to move more efficiently through the area and potentially access parts of the Caribou range.

Mitigation measures to reduce the potential for direct and indirect Caribou mortality due to the Project include the Project mitigation measures and additional mitigation measures in **5.3**. Mitigation measures to reduce direct Caribou mortality (e.g., through collisions) are known to be effective and include traffic management (such as the use of signage and speed limits), employee awareness and education, as well as mandatory reporting of Caribou observations and immediate communication to staff for avoidance). Additional mitigation measures include the decommissioning and reclamation of trails and roads that may facilitate predator movement.

5.4.3.2.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in direct and indirect Caribou mortality is described in the following paragraphs and a summary is provided in **Table 5.4-8**.

The Magnitude of the change in direct Caribou mortality is predicted to be Moderate. While it is unlikely that the Project will result in direct Caribou mortalities because the Project occurs outside of the current Caribou range, due to the small size of the Telkwa Caribou Herd, each additional death is expected to affect the herd. The change in indirect mortality caused by the Project through facilitated predation and apparent competition is also expected to be Moderate. As the Project occurs outside of BEC variant groups selected by Caribou, new roads and trails are expected to provide little change in predation risk from these features. The Project is unlikely to affect apparent competition as the Project is expected to alter a small amount of undisturbed habitat and is unlikely to result in population level changes in alternative prey abundance. However, any additional Caribou mortality through these processes will likely affect the Telkwa Caribou Herd at the subpopulation level.

The Geographic Extent of the residual effect is predicted to be Regional. The risk of increased predation through apparent competition is expected to occur regionally because wolf home ranges may extend beyond the WLSA and into the Caribou regional study areas.

The Duration of change in Caribou mortality is expected to be Medium-term. Direct and indirect mortality through facilitated predation are expected to be limited to the Construction, and Operation phases. Mortality through the process of apparent competition is expected to remain until the Project Area is starting to be reclaimed and no longer has the potential to support higher densities of alternative prey.

The Frequency of change in Caribou mortality is expected to be Infrequent. Change in direct mortality due to Project activities and infrastructure could only occur when Caribou are within the Project Area, which is expected to be a rare event because the Project occurs outside of the current Caribou range. Change in indirect Caribou mortality is expected to be Infrequent as well due to the spatial separation of habitat types selected by Caribou and the forested habitat types mostly used by their predators.

The change in Caribou mortality is anticipated to be Fully Reversible. The potential for a change in direct mortality is anticipated to be reversed by the end of the Operation Phase. The change in indirect mortality is expected to be reversed once the Project Area is reclaimed to a state that is near baseline conditions after the Decommissioning and Reclamation Phase (e.g., does not provide high quality habitat for alternative prey, and roads and trails are decommissioned and reclaimed).

The Context of change in Caribou mortality is predicted to be High. Changes to Caribou habitat are assumed to be the ultimate cause of Caribou population declines across Canada; with the proximate cause of the declines believed to be predation that is facilitated by landscape changes and apparent competition with alternative prey (Festa-Bianchet et al. 2011). The Telkwa Caribou Herd has experienced considerable reductions in abundance due to predation, which currently limits herd growth (Grant 2017), and a low Caribou density amplifies even small changes in mortality. Small populations are more vulnerable to random events, including temporary high predation rates (Festa-Bianchet et al. 2006), that can cause population declines. The quantity and extent of landscape disturbance and the small Telkwa Caribou herd size support a High rating.

Table 5.4-8: Summary of the Characteristics Ratings for Change in Caribou Mortality

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Moderate	The small herd size makes the Telkwa Caribou Herd more susceptible to changes in mortality. However, additional mortality attributable to the Tenas Project (Project) is unlikely due to the spatial separation of current Caribou range and the Project Area.
Geographic Extent	Regional	A change in mortality could occur within all Caribou study areas due to wolf distribution.

Duration	Medium-term	The potential for a change in mortality is expected to occur during the Operation and Construction phases of the Project.
Frequency	Infrequent	The residual effect is expected to occur infrequently as Caribou are expected to rarely interact with the Project. Direct and indirect mortality events (through facilitated predation and apparent competition) are expected to be uncommon based on lack of spatial overlap.
Reversibility	Fully Reversible	Change in direct Caribou mortality is expected to be fully reversible at the end of the Operation Phase. Change in indirect mortality is fully reversible once the reclamation is complete.
Context	High	Caribou mortality from predation is likely the limiting factor affecting Caribou population growth. The small number of Caribou in the Telkwa Caribou Herd makes the population susceptible to changes in mortality.

5.4.3.2.2 *Likelihood*

The Likelihood that the Project will adversely affect direct Caribou mortality is assessed as Unlikely because the Project occurs outside of the current Telkwa Caribou Herd distribution reducing the potential for interactions with the Project and associated activities. In addition, the Likelihood that the Project will adversely indirectly affect Caribou mortality is assessed as Unlikely. The potential for apparent competition with alternative prey species or for facilitated predation is expected to be limited due to the observed spatial separation between the current Caribou range and the forested areas in which the Project Area is located.

5.4.3.2.3 *Significance Determination*

The Project-related change in direct and indirect mortality is predicted to be **Not Significant** because of the limited potential for Caribou to interact with the Project and associated activities. The Project Area and associated Project activities that could affect Caribou mortality are located outside of selected Caribou habitat types. No additional disturbance of the Project Area in support of Project construction and operation that could potentially change predation risk are expected based on the already completely disturbed baseline condition. The application of mitigation measures is expected to reduce the risk of direct and indirect Caribou mortality, and the residual effect of the Project on Caribou mortality is not expected to cause a change in the long-term viability of Caribou in the region.

The Level of Confidence in this prediction is High. The ecology and population trends of the Telkwa Caribou Herd are well documented, as are the processes of apparent competition and facilitated predation. Some uncertainty in the predictions exist when considering the long time period of the Project and, consequently, potential changes in the abundance of Telkwa Caribou during the life of the Project.

5.4.3.3 *Change in Movement Patterns*

The assessment of change in Caribou movement patterns considers the potential for the Project to result in a barrier to Caribou movement within and between parts of the range and selected habitat types of Caribou. The greatest potential for causing a change to Caribou movement patterns are the construction of Project infrastructure that could act as a barrier (e.g., fencing or snowbanks along the roads) and the presence and use of infrastructure (e.g., by vehicles or trains) that could reduce the likelihood of Caribou moving across the feature.

The **Wildlife Baseline Report (Appendix 4.8-A)** provides an analysis and discussion of Caribou annual and seasonal movements. This analysis showed that Telkwa Caribou moved relatively short daily distances

and that their movement was mostly restricted to the alpine and subalpine habitat types. Seasonal increases in movement rates and movement through lower elevation habitat coincided with snow free seasons or the breeding season. Caribou movement between patches of alpine and subalpine habitat types in the Howson and Telkwa ranges occurred during all seasons but more frequently during fall and winter. Analysis of movements by GPS collared Caribou indicated that only one collared Caribou may have moved slightly into the Project Area based on approximately 10 years of collar data. The movement into the Project Area represents 0.03% of all Caribou movements documented. At the scale of the WLSA, four (4) Caribou moved into the southern portion of the area, which represents 2.21% of documented Caribou movements. In summary, sparse overlap occurs between the Project Area and recorded Caribou movements, and the Project is not located between different parts of the herd's current range, where it could act as a barrier to Caribou movement.

Anthropogenic effects on Caribou movement are well documented (see Reimers and Colman 2006) and have been considered a potential issue for decades (e.g., Klein 1971, Bergerud et al. 1984). Caribou movement is affected by human infrastructure through the creation of physical barriers and by reducing the likelihood of Caribou crossing the developments (e.g., because of traffic). Known barriers to Caribou movement include game fencing along highways, snow fence, and snowbanks. The creation of most infrastructure is considered semi-permeable, as use of the infrastructure (such as roadways and railways) reduces the likelihood of Caribou crossing these features (Dyer et al. 2002). Recent evidence of roads acting as semi-permeable barriers to movement come from research on migratory Caribou in the Arctic interacting with mine roads, where individual Caribou were observed to delay crossings of roads by several days (when the traffic decreased), potentially affecting the population as Caribou were delayed accessing their seasonal ranges (Wilson et al. 2016, Boulanger et al. 2020). The location and permeability of infrastructure determines the type of effect on the population and potential ecological consequences (Sawyer et al. 2013). Road design and traffic management can alter the likelihood of Caribou crossing, thereby reducing the potential for changes in Caribou movement.

The application of mitigation measures to facilitate movement of terrestrial wildlife is expected to benefit Caribou moving through the Project Area. Project mitigation measures identified in **5.3** will increase the permeability of the Project Area for Caribou, particularly minimizing the size of the Project footprint, and the number and lengths of new roads, trails, and the railway. Application of additional mitigation measures described in **5.3**, such as minimizing human use of the transportation infrastructure through access and traffic control measures, reducing traffic volume, educating drivers to slow down and stop until Caribou have crossed roads, and the creation of gaps in snowbanks along roads during winter are expected to further increase the permeability of the Project Area.

While the location of the Project is outside of the current Telkwa Caribou range and there were limited observations of Caribou movement through the Project Area, there is a possibility that Caribou may move through the Project Area at some point during the life of the Project. Mitigation measures are expected to increase the permeability of the transportation infrastructure for Caribou and increase the likelihood of Caribou successfully crossing the Project Area.

5.4.3.3.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in Caribou movement patterns is described in the following paragraphs and a summary is provided in **Table 5.4-9**.

The Magnitude of the change in Caribou movement patterns is predicted to be Low. Existing Caribou movement paths from collar data indicate that Caribou rarely move into the Project Area, as only one (1) Caribou (i.e., 0.03% of all recorded movements) entered the Project Area during approximately 10 years of collar studies. Furthermore, the Project Area is not located in the Telkwa Caribou Herd's current range or

between seasonal ranges or habitat types; therefore, it is anticipated that the Project will not affect the herd's access to important habitat.

The Geographic Extent of the change in Caribou movement patterns is predicted to be Regional as it would happen outside their current range. Any potential change in Caribou movement is limited to the Project Area where Caribou could be subjected to restricted movement. The Project Area is expected to act as a semi-permeable barrier to Caribou that make rare movements to the area. Because the Project Area is not located between seasonal ranges or selected habitat types, the Project is not expected to impede movement on a regional scale.

The Duration of the residual effect is predicted to occur over the Medium-term. Caribou movement is expected to be altered due to the construction and operation of Project infrastructure. Once the process has started to wind down and infrastructure components are decommissioned and mining activities cease, Caribou will be able to freely move through the Project Area.

The Frequency rating of the change in Caribou movement patterns is predicted to be Infrequent. Caribou movement across Project infrastructure is expected to be limited during the Construction, and Operation phases of the Project, as evidence shows that Caribou move into the Project Area infrequently.

The change in Caribou movement patterns is predicted to be Fully Reversible. Once the Project infrastructure is decommissioned and, with that, human use of infrastructure ends, the permeability of the Project Area is expected to increase, and Caribou will be able to move freely through the area.

The Context of the residual effect is predicted to be Low. Telkwa Caribou move between the Howson and Telkwa ranges, but the movements do not follow any seasonal patterns. The lack of seasonal ranges and seasonal movements to specific areas or habitat types suggests that there is a no biological requirement to access specific parts of the annual range within a given season. In addition, the Project Area occurs outside the Telkwa Caribou Herd's range and outside the normal areas of movement, meaning that Caribou movements are not anticipated to be affected by the Project.

Table 5.4-9: Summary of the Characteristics Ratings for Change in Caribou Movement Patterns

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	Based on the sparse reported Caribou movements into the Tenas Project (Project) Area it is predicted that changes in Caribou movement are unlikely and will not affect the herd.
Geographic Extent	Regional	The effect, if it should occur, will be limited to the Project Area which is outside their current range and with that and would impede Caribou movement on a regional scale.
Duration	Medium-term	The effect, if it should occur, will be limited to the Construction, and Operation phases when activities and infrastructure could be a barrier to Caribou movement.
Frequency	Infrequent	Based on data collected for approximately 10 years, it is expected that Caribou moving into the Project Area is an infrequent event.
Reversibility	Fully Reversible	Any change in Caribou movement patterns, if it should occur, is anticipated to end following the Operation Phase when infrastructure that could be a barrier to Caribou movement is removed and activities decrease.
Context	Low	Caribou movement through the Project Area is expected to be rare and the Project is not located within or near any area of the

Residual Effects Characteristic	Rating	Summary Rationale for Rating
		Telkwa Caribou Herd range that is used to move between patches of habitat.

5.4.3.3.2 *Likelihood*

The residual effect of change in Caribou movement patterns is predicted to be Likely. Over the course of approximately 10 years, one Caribou has been documented moving into the Project Area. The Project is expected to become a semi-permeable barrier to Caribou movement during the Construction, and Operations phases. While it is anticipated, based on past observations, that few, if any, Caribou will interact with the Project and few Caribou movements will occur through the Project Area, Caribou may move through the Project Area at some point during the life of the Project. Consequently, the few times that Caribou may attempt to move into or through the Project Area, the Project components and/or activities will likely affect their movement.

5.4.3.3.3 *Significance Determination*

The residual effect of change in Caribou movement patterns is predicted to be **Not Significant**. The Project is not expected to result in a change in Caribou movement patterns that will limit Caribou access to any part of their current range or their selected habitat types.

Evidence from collar data indicated that Caribou rarely moved into the Project Area. Any change to individual Caribou movements is not expected to cause a change in the movement of the Telkwa Caribou Herd. Mitigation measures to increase the permeability of the Project Area to Caribou (e.g., minimizing the Project footprint and traffic management) are expected to increase the likelihood that Caribou can successfully move across the Project Area if they chose to.

The Level of Confidence in this prediction is High. Caribou movement in the vicinity of the Project Area and regionally (across all Caribou study areas) are well documented and understood.

5.4.4 Grizzly Bear Subcomponent

5.4.4.1 *Alteration and/or Loss of Habitat*

The assessment of the alteration and/or loss of habitat residual effect on Grizzly Bear considers the direct loss of habitat and the indirect alteration (e.g., sensory disturbances, edge effects, perceived barriers) of habitat during all Project phases. The Grizzly Bear habitat suitability model (**Appendix 4.8-A**) characterises and quantifies suitable summer living habitat within the WR-WRSA using a six (6)-class rating system as baseline information to inform the assessment of the effects of the Project on Grizzly Bear. The Magnitude of suitable habitat alteration or loss was largest for summer living habitat and as a result it was selected to assess the effect of the alteration and/or loss of habitat for Grizzly Bear. The characterisation of the alteration and/or habitat loss residual effect considers the Project effects on moderate to high suitable Grizzly Bear summer living habitat (suitable Grizzly Bear habitat) within the WR-WRSA.

Direct habitat loss was quantified by calculating the area of suitable habitat lost within the Project Area. The alteration of suitable Grizzly Bear habitat was quantified by buffering the Project Area and downgrading suitable Grizzly Bear habitat within the buffer where appropriate; suitable Grizzly Bear habitat within 250 m of linear features (e.g., roads, transmission lines) is downgraded by one class, and suitable Grizzly Bear habitat within 500 m of mine features is downgraded by one class. Progressive revegetation is anticipated to begin during the Construction Phase and habitat that is altered/lost will become available as suitable

Grizzly Bear habitat following the Post-closure Phase (i.e., after the regeneration of vegetation following reclamation. However, a conservative approach is used, in that habitat within the Project Area is considered to be unavailable to Grizzly Bear for the duration of the Project.

Direct habitat loss will be mitigated by reducing the size of the Project Area to the extent practicable during Project design. Suitable Grizzly Bear habitat will be cleared during Construction. Up to 119.1 ha of suitable Grizzly Bear habitat within the WR-WRSA is anticipated to be removed during site clearing in the Construction Phase (**Table 5.4-10**). An additional 560.6 ha of suitable Grizzly Bear habitat may experience indirect Project effects, resulting in 0.7% of the suitable habitat in the WR-WRSA being lost or altered.

Mitigation measures outlined in **5.3** are expected to reduce the alteration of habitat and maintain important habitat features (e.g., no-disturbance buffers around sensitive or important identified habitat features [e.g., dens]), and reduce the amount of habitat alteration and loss (e.g., minimize Project Area, aligning linear Project components together).

Table 5.4-10: Summary of Change in Suitable Habitat for Grizzly Bear

Habitat Suitability Category	Loss of Suitable Habitat (ha) in the Project Area	Alteration of Suitable Habitat (ha) in the WLSA	Predicted Total Change in Suitable Habitat (ha) ¹	Total Suitable Habitat (ha) in the WR-WRSA	Predicted Change in Habitat Suitability Category (%) ²
Grizzly Bear – High suitability	0.0	0.0	0.0	4,024.2	0.0
Grizzly Bear – Moderately High suitability	1.6	42.4	44.0	8,861.6	0.5
Grizzly Bear – Moderate suitability	117.5	399.1	516.6	65,196.1	0.8
Total Suitable Habitat (High, Moderately High and Moderate)	119.1	441.5	560.6	78,081.9	0.7

Notes: %=percent; ha=hectare; WLSA=Wildlife Local Study Area; WR-WRSA=Wide-ranging Wildlife Regional Study Area

¹ Predicted total change in suitable habitat (ha) in the Project Area and WLSA.

² Predicted total change in habitat by suitability category (High, Moderately High, Moderate, Total) (%) in WR-WRSA.

5.4.4.1.1 Residual Effects Characterisation

The residual effects characterisation for the alteration and/or loss of suitable Grizzly Bear habitat is provided in **Table 5.4-11**.

The Magnitude of the alteration and/or loss of suitable Grizzly Bear habitat is predicted to be Low. It is anticipated that less than 1% of suitable Grizzly Bear habitat within the WR-WRSA may be altered or lost due to the Project.

The residual effect is predicted to be Local in Geographic Extent. While the direct loss of suitable Grizzly Bear habitat is expected to be limited to the Project Area during the Construction Phase, Indirect effects are expected to occur within the WLSA along the periphery of the Project Area during all Project phases.

The alteration and/or loss of suitable Grizzly Bear habitat is predicted to occur over the Medium-term (two [2] to 50 years) because of the short time required for suitable Grizzly Bear habitat to regenerate following

disturbance. Progressive reclamation is anticipated to begin in some parts of the Project Area following Construction; however, the revegetation within most of the Project Area will occur as part of reclamation activities during the Decommissioning and Reclamation Phase up to 27 years after clearing during the Construction Phase. It is expected that many of the preferred forage species (e.g., berries, emergent vegetation, forbs) of Grizzly Bears will increase in abundance after reclamation activities, and that the Project Area will likely support areas of suitable foraging habitat within 10 years after the planting of vegetation (Stewart et al. 2012).

The Frequency of the alteration and/or loss of suitable Grizzly Bear habitat is predicted to be Frequent. While loss of suitable Grizzly Bear habitat due to clearing during the Construction Phase will occur once, alteration of suitable Grizzly Bear habitat within the WLSA by Indirect effects is anticipated to be Frequent throughout Construction, Operation, Decommissioning and Reclamation, and Infrequent during Post-closure.

The alteration and/or loss of suitable Grizzly Bear habitat is predicted to be Fully Reversible. Grizzly Bear are habitat generalists and switch habitats throughout the year to take advantage of seasonal resources (e.g., berries, emergent vegetation, forbs) in disturbed areas (e.g., burns, avalanche chutes, clearcuts) (McLellan and Hovey 2001, Nielsen et al. 2004a, COSEWIC 2012a). Progressive and final reclamation will revegetate the Project Area with a focus on an end land use of forested ecosystems. Revegetation is expected to increase the amount of ground cover within the Project Area, with a transition to a low shrub structural stage within 20 years of the Decommissioning and Reclamation Phase and potentially becoming suitable foraging habitat after 10 years. The alteration of suitable Grizzly Bear habitat is expected to be reduced within a similar time frame as sensory disturbances diminish and the vegetation regenerates.

The Context of the residual effect of the alteration and/or loss of suitable Grizzly Bear habitat is predicted to be Moderate. Suitable Grizzly Bear habitat that is altered or cleared will remain so until the Decommissioning and Reclamation Phase when revegetation will occur as part of reclamation activities. The preferred use of revegetated areas (e.g., regenerating clearcuts) appears to occur in areas where anthropogenic suppression of forest fires eliminates natural forest clearings and regenerating areas, forcing bears to look elsewhere for important food resources (e.g., berries, emergent vegetation, forbs) (Stewart et al. 2012). The mountain pine beetle and spruce beetle outbreaks in central BC and subsequent salvage logging have affected forests in the WR-WRSA, and projected forest losses are expected to increase through to 2024 (BC MFLNRO 2015a). As these areas regenerate it is anticipated that they will become suitable Grizzly Bear habitat due to the presence of important food resources (Nielsen et al. 2004a).

Anthropogenic attributes (e.g., roads) often take precedence over natural attributes as determinants of habitat quality and zones of human activity may limit the use of potential habitat (Gibeau et al. 2002, COSEWIC 2012a). Avoidance of suitable habitat due to road presence and traffic is likely due to the associated risk of human-caused mortality due to increased human access (McLellan and Shackleton 1988, Nielsen et al. 2004b). Although not all roads are avoided equally, and in southern BC females did not avoid restricted roads (i.e., access restricted to the forest industry), but avoided publicly accessible roads (Wielgus et al. 2002). In general, a threshold of 0.6 km/km² of linear access, which occurs across most of the WR-WRSA, can result in a reduced Grizzly Bear density and a reduced habitat suitability through an increase in mortality risk (Proctor et al. 2019). The Moderate Context for the residual effect considered the balance between potential increases in suitable foraging habitat with anthropogenic attributes (e.g., roads, human use).

Table 5.4-11: Summary of the Characteristics Ratings for the Alteration and/or Loss of Habitat

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	<1% of suitable Grizzly Bear habitat will be altered or lost.
Geographic Extent	Local	The effect is limited to the WLSA.
Duration	Medium-term	The loss of suitable Grizzly Bear habitat will only occur during Construction; however, the alteration of habitat will continue through all phases. The replanting of the Project Area will not be complete until the end of Reclamation (i.e., 27 years after clearing). Replanted areas will likely become suitable Grizzly Bear habitat 10 years after replanting.
Frequency	Frequent	The effect occurs continuously due to the potential for alteration of habitat to occur until the end of Decommissioning and Reclamation Phase.
Reversibility	Fully Reversible	The alteration of habitat will end following Decommissioning and Reclamation Phase and the revegetation of the Project Area will reverse the loss of habitat.
Context	Moderate	Natural changes have affected suitable Grizzly Bear habitat; however, avoidance of anthropogenic features reduces habitat suitability.

Notes: <=less than; %=percent; Project=Tenas Project; WLSA=Wildlife Local Study Area; WR-WRSA=Wide-Ranging Wildlife Regional Study Area

5.4.4.1.2 Likelihood

The Likelihood of the residual effect of the alteration and/or loss of suitable Grizzly Bear habitat is Likely. Suitable Grizzly Bear habitat is present within the Project Area which is predicted to be cleared during Construction, and habitat outside the Project Area is expected to be indirectly affected during all Project Phases.

5.4.4.1.3 Significance Determination

The residual effect of the alteration and/or loss of suitable Grizzly Bear habitat due to the Project is not expected to result in a change in suitable Grizzly Bear habitat that will alter its integrity within the WR-WRSA to the point where it is not able to sustain the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is High. The direct effects of habitat loss and alteration are well known, and mitigation measures have been proven effective on past projects; however, uncertainties exist in the accuracy of the mapping products used to identify suitable Grizzly Bear habitat.

5.4.4.2 Change in Mortality

The assessment of the change in mortality considers Project-related effects within the WR-WRSA to appropriately consider the large home ranges of Grizzly Bears. The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Grizzly Bear population estimates and mortality within the WR-WRSA. The assessment includes consideration of direct mortality from Project activities and interactions with Project components, and indirect mortality due to the Project. Most of the change in Grizzly Bear mortality is anticipated to occur during the Construction, and Operation phases; however, mortality may occur during all Project phases.

The WR-WRSA overlaps with the Bulkley-Lakes and Babine GBPU which have Moderate conservation rankings (i.e., a local conservation ranking that reflects the GBPU's population size and trend, genetic and demographic isolation, as well as threats to bears and their habitats; formerly listed as Viable), estimated populations of 439 and 313 bears, and population densities of 20 and 23 bears/1000 km² respectively (BC MOE 2020c). Anthropogenic mortality is considered the main threat affecting Grizzly Bear abundance and distribution in BC (COSEWIC 2012a). The natural mortality rate for Grizzly Bear is 1-2% and guideline values in BC for a sustainable rate for all anthropogenic mortality is 4-6%, dependent on habitat quality within a GBPU (McLellan et al. 2017). Reported historic mortality (i.e., 1977 to 2016), prior to the end of trophy hunting, in the Bulkley-Lakes and Babine GBPU's was primarily due to legal hunting and was within the estimated sustainable human-caused mortality rate (BC MOE 2020c). Additional sources of anthropogenic mortality include collisions with vehicles and trains, Indigenous harvest, animal control (i.e., mortality in defence of life or property), poaching, and mortality from sensory disturbances and environmental contaminants (COSEWIC 2012a).

Collisions with trains can result in both direct mortality and indirect mortality (i.e., mortality of orphaned cubs) and kills more Grizzly Bears than vehicles. Train mortality in BC and Alberta mostly occurs from April through October and is highest in late spring (i.e., May and June) and during the day (Clair et al. 2020). Train mortality risk increases with train speed and track curvature, suggesting Grizzly Bears have problems detecting fast-moving trains (Clair et al. 2020). In addition, spilled grain from trains may attract Grizzly Bears to the railway ROW and increase the risk of collision (Gangadharan et al. 2017). Three (3) Grizzly Bears died from train collisions between 2004 to 2016 in the Bulkley-Lakes GBPU and three (3) died between 1977 to 2004 from both train and vehicle collisions; however, estimates of collision mortalities are likely an underestimate due to inconsistent or incorrect reporting and the movement of fatally injured bears away from the collision site (McLellan et al. 1999, COSEWIC 2012a, BC MOE 2020c). Project rail activity during the Operation Phase is expected to be one (1) train consisting of 116 cars each week. The train will be travelling at a maximum of 10 km/hr within the Rail Infrastructure (on the 2.5 km Rail Loop to the Rail Loadout); up to 20 km/hour while entering and exiting the Rail Infrastructure, and the train will reach up to 70 km/hr when it is at least three (3) km from the Rail Infrastructure. The minimal increase in train traffic (i.e., one (1) train per week) due to the Project is expected to result in a minimal increase in the potential for Grizzly Bear mortality within the WR-WRSA, considering the limited suitable Grizzly Bear habitat in this area and reduced potential for Grizzly Bears to be in this area.

Direct and indirect mortality from vehicle collisions may occur along Project roads and roads used by Project-related activities. The crossing of roads by Grizzly Bears (i.e., increase in vehicle collision risk) and their use of roadside habitat is strongly influenced by vehicle traffic (Northrup et al. 2012). Increasing traffic volume results in avoidance of roads with 20 to 100 vehicles per day and strong avoidance of roads with >100 vehicles per day; however, Grizzly Bears may respond by crossing at times when traffic volumes are lower (i.e., at night) (Northrup et al. 2012). As such, higher-traffic roads (e.g., Bypass Road) are expected to result in road crossing avoidance, although not act as a barrier to Grizzly Bear movement, and potentially reduce the risk of vehicle collision mortality, if and when Grizzly Bears are present. Collision risk may increase along roads with up to 20 vehicle per day (e.g., Telkwa Coalmine Road) and at time periods when traffic is reduced, although, this may be countered by the limited amount of suitable habitat and anticipated reduced potential for Grizzly Bears to be in the area. Increased food resources (e.g., *Equisetum* sp., *Trifolium* sp., ants) along roadsides may increase the risk of mortality from vehicle collisions by attracting Grizzly Bears, and result in a change in Grizzly Bear mortality (Roever et al. 2008). It is anticipated that Project-related traffic will be highest during the Construction, and Operation phases and on the Bypass Road, and will decline following the Operation Phase. Fencing along roads can be an effective mitigation measure to reduce vehicle collision mortality; however, Grizzly Bears may breach fencing, and reduce its effectiveness, by tearing it from its posts (Gilhooly et al. 2019). It is expected that reducing traffic volumes (e.g., carpooling/bussing, truck convoys, and high-volume haul trucks) enforcing speed limits on Project roads (50 km/hr along the TAC and 70 km/hr in the Minesite), removing roadside food attractants, and

training programs on wildlife collision risk will result in a low change in Grizzly Bear mortality within the WR-WRSA.

Roads and ROWs into Grizzly Bear habitat can increase hunter access and bring people into potential conflict with Grizzly Bears, resulting in an increase of mortality risk and potential for a change in Grizzly Bear mortality (COSEWIC 2012a). Motorized access has been suggested as important predictors of Grizzly Bear mortality, and most to all Grizzly Bear deaths in BC and Alberta have occurred within 120 m of a road (Proctor et al. 2019). Licenced trophy hunting, which was responsible for most of Grizzly Bear mortality, was ended in 2017; however, legal Indigenous harvest and illegal hunting may still occur (McLellan et al. 1999, BC MFLNRORD 2017). Mortality associated with the protection of life and property represent 14.7% of known deaths in BC (COSEWIC 2012a). Many of these deaths are associated with ungulate hunters, garbage-habituated bears, and a lack of knowledge in how to reduce human-bear conflicts (COSEWIC 2012a).

Managing motorized access has been identified as an important tool in managing human-bear conflicts (Proctor et al. 2019). Consequently, it is anticipated that the closing of all new Project roads and ROWs to the public will reduce additional mortalities by minimizing additional people, and risk of human-bear conflict, within the WLSA. Additional mitigation measures (e.g., proper disposal of waste, worker awareness/bear aware training, reduced traffic volumes) are anticipated to further reduce human-bear encounters, minimize the likelihood of a lethal outcome from a human-bear conflict, and a reduction in exposure to sensory disturbances and environmental contaminants.

The relative low population density and minimal amount of suitable habitat adjacent to the Project Area is anticipated to limit the potential for interactions between Grizzly Bears and the Project. Project design measures identified in 5.3 are also expected to limit interactions between Grizzly Bears and potential sources of direct and indirect mortality, thereby minimizing the residual effect of change in mortality. The implementation of mitigation measures, as identified in 5.3 are expected to further limit interactions between Grizzly Bears and potential sources of direct and indirect mortality. Although Project activities may result in direct and/or indirect mortality of Grizzly Bears within the WR-WRSA, the residual effect of change in mortality is not expected to result in a change to the long-term persistence and viability of Grizzly Bear within the WR-WRSA.

5.4.4.2.1 Residual Effects Characterisation

The residual effects characterisation for the change in mortality for Grizzly Bear is shown in **Table 5.4-12**.

The Magnitude of the effect is assessed as Low. Mitigation measures are anticipated to be effective at reducing the direct and indirect mortality, and Grizzly Bear mortality is expected to be within the range of natural variability and management guidelines.

Direct mortality is only expected occur within the Project Area and indirect mortality is expected to only affect Grizzly Bears with home ranges that overlap the WLSA. Home range sizes have not been studied for the GBPU in the RSA; however, the average BC home range size is 200 to 300 km² for males and 100 km² for females with young (Gyug et al. 2004). Consequently, the home ranges of Grizzly Bears home ranges that overlap with the Project Area and WLSA may extend into the WR-WRSA, resulting in a Regional Geographic Extent.

It is estimated that the Duration of the effect will be Medium-term. The potential for direct mortality is expected to be highest during the Construction, and Operation phases when the Project Area will be cleared and vehicle traffic is most frequent, and it is predicted that a in change in mortality will continue through to the end of the Post-closure Phase. The potential for indirect mortality is expected to be highest during the Operation Phase. The potential for indirect mortality is anticipated to diminish in the Decommissioning and

Reclamation Phase following the removal of Project components and a reduction in Project activities and be limited during the Post-closure Phase.

The Frequency is assessed as Infrequent. Mitigation measures are expected to limit the potential for Grizzly Bear mortality; however, direct, and indirect mortality could occur sporadically through all Project phases.

It is predicted that the effect will be Fully Reversible. The risk of direct or indirect mortality is anticipated to subside during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities, and to diminish to baseline conditions following the Post-closure Phase.

The Grizzly Bear is a provincially blue-listed species and listed as Special Concern under SARA (BC CDC 2019). Anthropogenic mortality is considered to account for most of the overall mortality and is the main driver of Grizzly Bear population dynamics (COSEWIC 2012a). The Bulkley-Lakes and Babine GBPU's had Moderate conservation status and populations of 439 and 313 bears, respectively. Hunting was the main cause of mortality within both GBPU's from 1976 to 2011; however, trophy hunting was ended in 2017, and the average annual mortality from other anthropogenic sources was 2.08 bears per year. The assessment considered the sensitivity to anthropogenic mortality and the conservation status of the Bulkley-Lakes and Babine GBPU's to estimate a Moderate Context.

Table 5.4-12: Summary of Effect Characteristics Ratings for Change in Mortality

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	The change in Grizzly Bear mortality is expected to be within the range of natural variability and management guidelines.
Geographic Extent	Regional	Direct mortality is expected to occur only within the Project Area; however, indirect mortality may extend into the WR-WRSA due to the large home range of Grizzly Bears.
Duration	Medium-term	Grizzly Bear mortality may occur during all phases of the Project.
Frequency	Infrequent	It is expected that the effect may occur sporadically through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that Project-related Grizzly Bear mortality is expected to end following the end of the Post-closure Phase.
Context	Moderate	The Grizzly Bear is a provincially blue-listed species and listed as Special Concern under SARA.

Notes: Project=Tenas Project; SARA=Species At Risk Act, SC 2002, c. 29 (Government of Canada [GovCan] 2002); WR-WRSA=Wide-ranging Wildlife Regional Study Area

5.4.4.2.2 Likelihood

The Likelihood of the residual effect of the change in mortality for Grizzly Bear is Likely. Mitigation measures are expected to reduce, but not eliminate the risk of Grizzly Bear mortality.

5.4.4.2.3 Significance Determination

The residual effect of change in mortality for Grizzly Bear due to the Project is not expected to result in an increase in Grizzly Bear mortality that will alter the integrity of the population within the WR-WRSA to the point where it is not regionally sustainable. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is High. The direct effects of change in mortality are well known, direct and indirect mortality is expected to remain within the range of natural variability, and the effectiveness of mitigation measures has been proven on past projects.

5.4.4.3 *Change in Movement Patterns*

Grizzly Bears are mostly solitary animals with large home ranges in the order of 100-300 km² on average in BC (BC MWLAP 2004), so the potential for change in movement patterns of Grizzly Bear has been assessed at the scale of the WR-WRSA. Their daily and seasonal movements are primarily governed by two factors: the distribution and abundance of food and avoidance of human activity (COSEWIC 2012a). Intraspecific interactions and the availability of security and, to a lesser extent, thermal cover can also influence movement patterns. Due to their use of a wide variety of habitat types within their home range to meet their nutritional requirements, individual Grizzly Bears could interact with all Project components. Any change to their movement patterns is expected to occur primarily during the Construction, and Operation phases; however, the effect could occur during all Project phases.

As a large omnivore, habitat use by Grizzly Bears is highly seasonal, with their movements typically following regional plant phenology, timing of spring ungulate calving, and the timing of salmon runs if present within their home range (COSEWIC 2012a). In mountainous regions, this is often reflected in annual elevational migrations by bears (LeFranc et al. 1987, Proctor et al. 2012). Based on the current understanding of patterns of habitat use by Grizzly Bears in British Columbia (Hamilton et al. 2018), in the WR-WRSA it is expected that when Grizzly Bears emerge from their high elevation denning sites in the spring, they will descend to low elevations to forage on newly emergent vegetation and ungulate carrion. Through the summer they are expected to use all available habitats within their home ranges, including low elevation riparian or recently disturbed areas for berries, mid-elevation herbaceous habitats, areas near goat winter range and early summer calving areas for Moose and Caribou, and subalpine and alpine meadows for marmots and herbaceous vegetation. In the fall, when Grizzly Bears must put on as much fat as possible before winter denning, they may move back to higher elevations to exploit later-ripening berry areas or to lower elevations to primarily feed on salmon runs.

Habitat modelling conducted for Grizzly Bear as part of the inventory of baseline environmental conditions for the Project indicated limited habitat suitability for Grizzly Bears over most of the WLSA (i.e., the Project Area and areas within 5 km) (**Appendix 4.8-A**). No suitable (i.e., Moderate to High rated) spring living habitat was identified in the WLSA. Suitable summer Living habitat was found to be considerably more abundant in the WR-WRSA than in the WLSA, with the largest amount of habitat in the WLSA located approximately 3 km south of the open pit area at higher elevations. Fall Living habitat in the WLSA was mostly limited to the four (4) salmon-bearing streams. In general, the WLSA lacks relatively open berry-producing habitats important to Grizzly Bears. The limited habitat value to Grizzly Bear of the Project Area in its current condition was supported by the infrequent detections of Grizzly Bear during baseline studies, with only a single detection by a field crew and by a wildlife camera, and only 24 confirmed detections of Grizzly Bear sign out of 331 observations of bear sign (**Appendix 4.8-A**). Considering the baseline data and habitat modeling results, any interactions between Grizzly Bear and the Project are likely to be limited to dispersing sub-adults, which may be pushed into marginal habitats to avoid conflict with adult bears (Flynn et al. 2007).

In mountainous regions similar to those in the WR-WRSA, daily movements of Grizzly Bears have been estimated to average 2.4 km (Proctor et al. 2012). As with their seasonal movements, daily movements are primarily governed by food availability, but also the presence of security cover. Security habitat consists of areas of dense vegetation (e.g., shrubbery, coniferous forest) that provide visual screening cover from other bears and humans (Craighead et al. 1982). Grizzly Bears have been known to forego areas of high forage value if security cover is lacking (Gibeau et al. 2002). With the current predominance of coniferous forest ecosystems in the WLSA (**Appendix 4.8-A**), security cover is not considered a limiting factor to Grizzly

Bear movement patterns. Mitigation measures, such as minimizing the Project footprint to the smallest area practicable and progressive reclamation of the open pit area are expected to result in relatively small, localized changes in the availability of security cover.

Like daily movements, dispersal movements by Grizzly Bears in mountainous areas are relatively short and dispersal away from the core of their natal home ranges takes multiple years (McLellan and Hovey 2001). They display male-biased dispersal, with males generally dispersing three times further than females from their natal home range (e.g., 10-15 km for females and 30-45 km for males: McLellan and Hovey 2001; Proctor et al. 2004). While roads have primarily been identified as vectors of unnatural mortality for Grizzly Bears (mostly via hunting and illegal killing rather than collisions), they have been shown to disrupt bear movements and in extreme cases they have been found to form barriers to dispersal. Major transportation routes, such as Highway 1 (Gibeau et al. 2002) and Highway 3 (Proctor et al. 2012) in south-eastern BC have been found to act as complete (Highway 1) or almost complete (Highway 3) barriers to adult female movement, but not males, resulting in genetic fragmentation of Grizzly Bear sub-populations. Both cases involved high traffic volumes (1,000s to 10s of thousands of vehicles per day) and high speeds. No population fragmentation effects have been found for secondary or resource roads (Gibeau et al. 2002; Proctor et al. 2012; Proctor et al. 2019). Planned super B-train truck movements of four (4) to eight (8) trucks/hour are well below the levels of traffic volume that have been associated with population fragmentation effects. It is expected that mitigation measures to minimize the Project-related increase in vehicle traffic in the WLSA will limit the potential for disruption of Grizzly Bear movement. Similarly, the relatively small increase in rail traffic associated with the Project is unlikely to result in a barrier to Grizzly Bear dispersal.

While habitat selection studies have generally found that Grizzly Bears will avoid areas of human activity, these studies have largely focused on indices of human intrusion (e.g., road density) at the landscape scale (e.g., review by Proctor et al. 2019). Studies of the role of sensory disturbance, particularly noise, have mostly been limited to its effects on denning bears (e.g., Craighead et al. 1982, Harding and Nagy 1980, Reynolds et al. 1986, Schoen et al. 1987) rather than on movement patterns during the growing season. Depending on the intensity and consistency of noise generated by Project construction and operations, bears may avoid moving through the Project Area, resulting in functional habitat loss or may become accustomed to it (Herrero 1985, Jope 1985, Cristescu et al. 2016). To a large extent, functional habitat loss due to sensory disturbance by the Project has been captured in the Alteration and Loss of Habitat Section of this assessment as indirect habitat loss within 500 m of the open pit area and 250 m of linear features (5.7.1). Sensory disturbance from blasting operations, which may take the form of a flight response, freezing, or strong startle response (Manci et al. 1988, Weisenberger et al. 1996, Reimers and Colman 2006), is expected to extend beyond the indirect effects area but be contained within the WLSA. However, due to the infrequent nature of blasting operations and the low suitability of most of the WLSA for Grizzly Bear, the probability of interactions between Grizzly Bear movements and blasting operations is considered low. Conversely, human activities can attract bears in search of food (Herrero 1985), particularly when associated with poor waste management practices. Improperly stored human food and food waste, as well as aromatic waste material such as oils and aerosols can be attractive to bears. The implementation of mitigation measures to manage potential attractants (e.g., oils, chemicals, garbage) (see 5.3.18) are expected to mitigate any attractant effect.

Beyond the limited habitat suitability of the WLSA to Grizzly Bears and expected limited use, the implementation of the mitigation measures described in 5.3 is expected to limit interactions between Grizzly Bear movement patterns and potential sources of functional habitat loss, sensory disturbance, or attraction. Although Project activities may result in some disruption of Grizzly Bear foraging and dispersal movements within the WR-WRSA, with the implementation of Project design and other mitigation measures, the residual effect of change in movement patterns is not expected to result in a change to the long-term persistence and viability of Grizzly Bear within the WR-WRSA.

5.4.4.3.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in movement patterns is provided in **Table 5.4-13**.

The Magnitude of the effect is assessed as Low due to the small size of the Project relative to adult Grizzly Bear home ranges and the low habitat suitability of most of the WLSA to Grizzly Bear which is expected to limit interactions between bears and the Project.

The Geographic Extent is predicted to be Local. Although sensory disturbance from Project activities such as blasting may extend beyond the indirect effects area, it is expected to be wholly contained within the WLSA. In addition, proposed Project activity levels, such as haul truck movements, are below levels associated with population fragmentation effects. As such, the Project is not expected to create a barrier to Grizzly Bear dispersal.

It is estimated that the Duration of the effect will be Medium-term. The potential for the effect is expected to be greatest during the Construction, and Operation Phase when sensory disturbances (e.g., vehicle traffic, rail activity, human presence) are likely to be highest and prior to revegetation of the site during Reclamation. As Project components are removed and Project activities are reduced, it is predicted that the effect will diminish through to the end of the Post-closure Phase (i.e., within 52 years) when Grizzly Bear movement patterns are anticipated to return to pre-Project conditions.

The Frequency is assessed as Frequent. Measures to mitigate sensory disturbances (e.g., low speed limits, minimizing increases in traffic by using convoys and carpooling, preventing public access to Project components) and minimize the size of the Project Area are anticipated to limit the potential for changes in the effect; however, sensory disturbances and foraging habitat losses may influence Grizzly Bear movement patterns until the Post-closure Phase.

It is predicted that the effect will be Fully Reversible. Any changes to Grizzly Bear movement patterns are anticipated to diminish during the Decommissioning and Reclamation Phase, following the removal of Project components and a reduction in Project activities, and diminish further following the Post-closure Phase.

The residual effect of change in movement patterns is expected to have a Moderate Context. Grizzly Bear is blue-listed in BC, with the primary threat to population persistence identified as human-caused mortality (Ciarniello et al. 2004, COSEWIC 2012a). The two (2) Grizzly Bear population units that overlap with the WR-WRSA are categorised as of Moderate localized conservation concern, meaning that some management actions are required to improve their condition (Morgan et al. 2019). While big game statistics for the region over the most recent 20-year period of record indicate 143 of the 3,181 bears killed and reported by hunters were Grizzly Bears (**Appendix 4.8-A**), the hunting season for Grizzly Bear was permanently closed in BC in late-2017. Few high traffic volume roads (e.g., Highway 16) and rail lines (e.g., Telkwa Subdivision-CNR) exist within the WR-WRSA that may restrict the movement of Grizzly Bears. FSR are prevalent across the WR-WRSA at lower elevations. While these resource roads are anticipated to have relatively low traffic volumes, increased density of roads has been associated with avoidance or reduced use by Grizzly Bears relative to large roadless areas (see review by Proctor et al. 2019). Loss or changes in habitat used by prey species can adversely affect foraging opportunities. The mountain pine beetle and spruce beetle in central BC and salvage logging have reduced the amount of forest cover in the WR-WRSA (Kuzyk and Heard 2014, Kuzyk et al. 2018). Losses in forest cover due to the outbreaks are thought to result in deeper snow and a higher density of downed pine and spruce trees, which increases the energetics and difficulty in movement of ungulates and their predators across the landscape (Heard 2012). As an omnivore, these habitat changes may have resulted in an increase in open, berry-producing habitats favoured by Grizzly Bears. For these reasons, in the absence of hunting pressure, Grizzly Bear is

considered to have Moderate resilience to historic and ongoing natural and anthropogenic changes in the WR-WRSA.

Table 5.4-13: Summary of Effect Characteristics Ratings for Change in Grizzly Bear Movement Patterns

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Small size of the Project relative to adult Grizzly Bear home ranges and the low habitat suitability and use of most of the WLSA.
Geographic Extent	Local	Project activity levels are below levels associated with population fragmentation effects and are expected to be contained within the WLSA.
Duration	Medium-term	Changes to Grizzly Bear movement patterns may occur during all phases of the Project but are anticipated to end following the Post-closure Phase.
Frequency	Frequent	It is expected that the effect may occur continuously through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that potential Project-related changes to Grizzly Bear movement patterns will end following the Post-closure Phase.
Context	Moderate	Blue-listed species, but population units that intersect with the WR-WRSA classified as Viable. Limited historical hunting pressure. Few high traffic volume roads and rail-lines. Existing disturbance in the form of resource roads, cutblocks, and beetle-affected stands may have reduced availability of ungulate prey sources but may have increased availability of berry-producing habitats.

Notes: Project=Tenas Project; WLSA=Wildlife Local Study Area; WR-WRSA=Wide-Ranging Wildlife Regional Study Area

5.4.4.3.2 Likelihood

The residual effect of change in Grizzly Bear movement patterns is Likely. Grizzly Bear was detected in the Project Area during baseline studies, albeit infrequently. Mitigation measures are expected to reduce, but not eliminate any changes in movement patterns.

5.4.4.3.3 Significance Determination

The residual effect of change in Grizzly Bear movement due to the Project is expected to result in a minor disruption of their movement patterns within the WR-WRSA, such that it will not alter the integrity of the populations overlapping the WR-WRSA to the point where they are not sustainable. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. General trends in Grizzly Bear seasonal habitat use and broad responses to human activity are reasonably well understood. However, the responses of Grizzly Bears to specific sensory disturbances, such as blasting, have been poorly studied outside of the context of denning habitat. In addition, the responses of individual bears to human activity remains variable. The proposed mitigation measures for minimizing attractant effects have proven effective on past projects.

5.4.5 Moose Subcomponent

5.4.5.1 Alteration and/or Loss of Habitat

The assessment of the alteration and/or loss of habitat residual effect considers the direct loss of habitat and the indirect alteration (e.g., sensory disturbances, edge effects, perceived barriers) of habitat during all Project phases. The Moose habitat suitability model (**Appendix 4.8-A**) characterises and quantifies suitable winter habitat within the WR-WRSA using a six (6)-class rating system as baseline information for assessment of the effects of the Project on Moose. The characterisation of the alteration and/or habitat loss residual effect considers the Project effects on Moderate to High suitable winter Living Moose habitat (suitable Moose habitat) within the WR-WRSA.

Direct habitat loss is quantified by calculating the area of suitable Moose habitat lost within the Project Area. The alteration of suitable Moose habitat is quantified by buffering the Project Area and downgrading suitable habitat within the buffer where appropriate; suitable Moose habitat within 250 m of linear features (e.g., roads, transmission lines) is downgraded by one (1) class, and suitable Moose habitat within 500 m of mine features is downgraded by one (1) class. Progressive revegetation is anticipated to begin during Construction and habitat that is altered/lost will become available as suitable Moose habitat following Post-closure Phase (i.e., after the regeneration of vegetation following reclamation. However, a conservative approach is used, in that habitat within the Project Area is considered unavailable to Moose for the duration of the Project.

Direct habitat loss will be mitigated by reducing the size of the Project Area to the extent practicable during Project design. Suitable Moose habitat will be cleared during Construction. Up to 961.3 ha (1.1%) of suitable Moose habitat within the WR-WRSA is anticipated to be removed, all within the Project Area, during site clearing in the Construction Phase (**Table 5.4-14**). An additional 193.5 ha (0.2%) of suitable Moose habitat may experience indirect Project effects. Mitigation measures outlined in **5.3** are anticipated to reduce the effects.

Mitigation measures are expected to maintain important identified habitat features, where possible, and reduce the alteration of habitat (e.g., minimize Project Area, common corridors for linear Project components).

Table 5.4-14: Summary of Change in Suitable Habitat for Moose

Habitat Suitability Category	Loss of Suitable Habitat (ha) in the Project Area	Alteration of Suitable Habitat (ha) in the WLSA	Predicted Total Change in Suitable Habitat (ha) ¹	Total Suitable Habitat (ha) in the WR-RSA	Predicted Change in Habitat Suitability Category (%) ²
Moose – High suitability	63.8	69.9	133.7	8,495.0	1.6
Moose – Moderately High suitability	406.3	144.2	550.5	27,123.1	2.0
Moose – Moderate suitability	491.2	(20.6)	470.6	47,764.8	1.0
Total	961.3	193.5	1,154.8	83,382.9	1.4

Notes: %=percent ; ha=hectare; Project=Tenas Project; WLSA=Wildlife Local Study Area; WR-WRSA=Wide-Ranging Wildlife Regional Study Area

¹ Predicted total change in suitable habitat (ha) in the Project Area and Wildlife LSA.

² Predicted total change in habitat by suitability category (High, Moderately High, Moderate, Total) (%) in Wide-ranging Wildlife RSA.

5.4.5.1.1 *Residual Effects Characterisation*

The residual effects characterisation for the alteration and/or loss of suitable Moose habitat is provided in **Table 5.4-15**.

The Magnitude of the alteration and/or loss of suitable Moose habitat is predicted to be Low. It is anticipated that up to 1.4% of suitable Moose habitat within the WR-WRSA may be altered or lost due to the Project.

The residual effect is predicted to be Local in Geographic Extent. While the direct loss of suitable Moose habitat is expected to be limited to the Project Area during the Construction Phase, Indirect effects are expected to occur within the WLSA along the periphery of the Project Area during all Project phases.

The alteration and/or loss of suitable Moose habitat is predicted to occur over the Medium-term (2 to 52 years) because of the short time required for suitable Moose habitat to regenerate following disturbance. Progressive revegetation is anticipated to begin in some parts of the Project Area following the Construction Phase; however, the revegetation within most of the Project Area will occur as part of reclamation activities during the Decommissioning and Reclamation Phase (i.e., up to 23 years after site clearing). It is expected that many of the preferred forage species will increase in abundance after reclamation activities, and that the Project area will likely support areas of suitable foraging habitat within 10 years after revegetation (Roe and Kennedy 1989, Collins and Schwartz 1998).

The Frequency of the alteration and/or loss of suitable Moose habitat is predicted to be Frequent. While loss of suitable Moose habitat due to clearing during the Construction Phase will occur once, alteration of suitable Moose habitat within the WLSA by indirect effects is anticipated to be Frequent throughout Construction, Operation, Decommissioning and Reclamation phases, and Infrequent during the Post-closure Phase.

The alteration and/or loss of suitable Moose habitat is predicted to be Fully Reversible. Progressive and final reclamation will revegetate disturbed areas within the Project Area with a focus on an end land use of forested ecosystems. Moose prefer habitat following a disturbance due to a proliferation of regenerating forage, and it is anticipated that revegetated areas will become suitable Moose habitat within 10 years (Peek et al. 1976). Thus, suitable Moose habitat lost within the Project Area has the potential to regenerate over a short timeframe. Progressive revegetation may occur in some parts of the Project Area prior to the Post-closure Phase; however, most revegetation is anticipated to occur following the end of the Operation Phase and become suitable Moose habitat following the Post-closure Phase. In addition, the alteration of suitable Moose habitat is expected to be reduced within a similar time frame as sensory disturbances diminish and the vegetation regenerates.

The Context of the residual effect of the alteration and/or loss of suitable Moose habitat is predicted to be Moderate. Suitable Moose habitat that is altered or cleared will remain so until the Decommissioning and Reclamation Phase when revegetation will occur. Revegetated areas are expected to become suitable Moose habitat within a few years of revegetation and Moose are known to prefer habitat following disturbance due to a proliferation of preferred forage (Peek et al. 1976). The mountain pine beetle (*Dendroctonus ponderosa*) and spruce beetle (*Dendroctonus rufipennis*) outbreaks and salvage logging in central BC have likely affected suitable Moose habitat in the WR-WRSA (Kuzyk and Heard 2014, G. Kuzyk et al. 2018). In 2019 forestry losses in the Bulkley TSA due to the mountain pine beetle outbreak totalled 1,979 ha and estimated at less than 600 ha due to the spruce beetle outbreak (Westfall et al. 2019). Projected losses due to the mountain pine beetle outbreak are expected to continue to increase through to 2024 (BC MFLNRO 2015b). Moose are expected to initially lose habitat following infestation, then benefit in the short term from increased forage resources but stand succession and a loss in mature forest stands may cause harm in the long-term (Richie 2008). Overall, variability resulting from natural disturbance to suitable Moose habitat is expected to increase over the near future. Therefore, the Context of the residual

effect considered the balance in the Short-term and Long-term suitable Moose habitat gains and losses as the result of the Project and the mountain pine beetle outbreak to predict a Moderate rating for Context.

Table 5.4-15: Summary of the Characteristics Ratings for the Alteration and/or Loss of Habitat for Moose

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	1.4% of suitable Moose habitat is predicted to be altered or lost.
Geographic Extent	Local	The effect is limited to the WLSA.
Duration	Medium-term	The loss of habitat will only occur during the Construction Phase; however, the alteration of habitat will continue through all phases. The replanting of the Project Area will not be complete until the end of Reclamation (i.e., 27 years after clearing). Replanted areas are predicted to become suitable Moose habitat within 5-10 years of replanting.
Frequency	Frequent	The effect occurs continuously due to the potential for the alteration of habitat to occur until the end of the Decommissioning and Reclamation Phase.
Reversibility	Fully Reversible	The alteration of habitat is anticipated to end following the Decommissioning and Reclamation Phase and the revegetation of the Project Area is expected to reverse the loss of habitat
Context	Moderate	Other projects and natural changes have affected suitable Moose habitat; however, suitable Moose habitat has been shown to be resilient to disturbance.

Notes: %=percent; Project=Tenas Project; WLSA=Wildlife Local Study Area

5.4.5.1.2 Likelihood

The Likelihood of the residual effect of the alteration and/or loss of suitable Moose habitat is Likely. Suitable Moose habitat within the Project Area is expected to be cleared during the Construction Phase and indirectly affected outside the Project Area during all Project phases.

5.4.5.1.3 Significance Determination

The residual effect of the alteration and/or loss of suitable Moose habitat due to the Project is not expected to result in a change in suitable Moose habitat that will alter its integrity within the WR-WRSA to the point where it is not able to sustain the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The direct effects of habitat loss and alteration are well known, and mitigation measures have been proven effective on past projects; however, there is uncertainty with long-term habitat suitability due to natural changes from the mountain pine beetle outbreak. Uncertainty also exists in relation to the accuracy of the mapping products used to identify suitable Moose habitat.

5.4.5.2 Change in Mortality

The characterisation of the change in mortality residual effect considers Project-related effects within the WR-WRSA. The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Moose population estimates and mortality within the WR-WRSA. The assessment includes consideration

of direct mortality from Project activities and interactions with Project components, and indirect mortality due to the Project. Most Moose mortality risk is anticipated to occur during the Construction, and Operation Phases; however, the risk of Moose mortality occurs during all Project phases.

Potential sources of direct mortality for Moose include interactions with Project activities, most likely vehicle, or train collisions. Provincial estimates of annual Moose mortality from MVCs range from 300 to 500, but potentially up to 1,200 (Child et al. 1991, Sielecki 2010). Estimates are only available for numbered highways and an unknown number of mortalities occur along resource roads (Child et al. 1991, Sielecki 2010). MVC statistics in BC are not corrected to traffic volumes due to a lack of data for specific highway sections for the seasons in which most MVCs occur (Sielecki 2010). Annual MVCs in the Bulkley-Stikine region were variable between 1988 and 2007 and ranged from 17 to 98, but generally increased (Sielecki 2010). MVCs in northern BC are more common in the winter (Dec-Feb), and they appear to coincide with times of high snowfall when Moose are found alongside highways that are actively kept cleared of snow (Child et al. 1991, Sielecki 2010). Other factors include poor to no light conditions (i.e., from 18:00 to 02:00 hours) and at speeds exceeding of 80 km/hr (Stuart 1984, Child et al. 1991, O'Keefe and Rea 2012). Similar results have been found in other regions, where speed (i.e., >80 km/hr), vehicle traffic (i.e., approximately 1,000 – 6,000 vehicles/day), and time of day (i.e., evening through early morning) were factors commonly responsible for MVCs (Joyce and Mahoney 2001, Dussault et al. 2006, Danks 2007). Seasonal changes in MVCs vary by region; however, in BC it is thought that increased Moose use of valley bottoms during winter is the main factor in the increase in winter mortalities (Child et al. 1991, O'Keefe and Rea 2012). It is anticipated that Project-related traffic will be highest during the Construction, and Operation phases, and declining following the Operation Phase. It is expected that the reduced traffic volumes, with carpooling/bussing, truck convoys, and high-volume haul trucks, enforcing speed limits on Project roads, and increased worker awareness of MVCs through training programs will result in a low increase in the change of mortality for Moose within the WR-WRSA.

Although minimal research has addressed the effect of train traffic on Moose, collisions are known to cause direct mortality across Canada (Kerr and Dillon 2018, Hamr et al. 2019). To address Moose mortality concerns in northern BC a Moose Rail Mortality Working Group was formed in 2007 to review Moose mortality along CNR's Telkwa subdivision between Smithers and Endako (Kerr and Pollard 2016). Investigations over the past 10 years have included mortality surveys and the monitoring of mitigation methods to reduce Moose mortality. Exclusion fences were found to decrease collision risk significantly, although they were not able to entirely keep Moose off the rails within the fenced areas (Kerr and Pollard 2016). Annual winter Moose mortality along the Telkwa subdivision (i.e., a high-speed mainline, 201 km length of track between Endako and Smithers) has varied from 30 to 155 per year between 2007 to 2019, although collisions were not evenly distributed along the length of track (Kerr and Pollard 2016, 2017, Kerr and Dillon 2018). Train traffic from January to March during this period was from approximately 1,000 to 1,400 trains. Project rail activity during the Operation Phase is expected to be one (1) train consisting of 116 cars each week. The train will be travelling at a maximum of 10 km/hr within the Rail Infrastructure (on the 2.5 km Rail Loop to the Rail Loadout); up to 20 km/hour while entering and exiting the Rail Infrastructure, and the train will reach up to 70 km/hr when it is at least three (3) km from the Rail Infrastructure. The minimal increase in train traffic due to the Project is expected to result in a low increase in Moose mortality within the WR-WRSA.

Additional sources of direct mortality include interactions with Project components, such as exposure to contaminated sites and entrapment within pits, waterbodies (e.g., settling ponds), or within snowbanks along roads resulting in an increased risk of vehicle collision. Mitigation measures (e.g., breaks in snowbanks, exclusion fencing around contaminated ponds) have been found to be effective at minimizing Moose mortality for other projects.

Potential sources of indirect mortality for Moose may include increased hunter (e.g., Indigenous harvest, legal, and illegal) access, ease of predator travel and access, and sensory disturbances that reduce body

condition or increase stress (Beazley et al. 2004, Barber et al. 2010, Ewacha 2016, Mumma and Gilligham 2019a, b). The Provincial Framework for Moose Management in British Columbia states that “Science has shown that predator management, habitat enhancement and protection, other forms of access management (e.g., road deactivation) and Indigenous harvest are also important management levers that can influence Moose populations, and in many cases may have a much greater impact than hunting regulation changes access” (BC MFLNRO 2015b). Implementing mitigation measures mentioned in the Provincial Framework are anticipated to minimize most sources of indirect Moose mortality that could result from the Project. Provincial surveys of abundance and licensed harvest estimates are used to assess that harvest levels are sustainable for Indigenous use, support a sustainable licensed hunter harvest, and provide for diverse hunter opportunities (Hatter 1999). As a result, it is anticipated that any changes in mortality due to an increase in hunter access will remain within the allowable harvest limits. As a result, it is anticipated that any increase in risk of mortality for Moose will be within the natural range of variability.

Project design measures identified in **5.3 Mitigation Measures** are expected to limit interactions between Moose and potential sources of direct and indirect mortality, thereby minimizing the residual effect of change in mortality. The implementation of additional mitigation measures, as identified in **5.3**, are expected to further limit interactions between Moose and potential sources of direct and indirect mortality. Although Project activities may result in direct and/or indirect mortality of Moose within the WR-WRSA, the implementation of Project design measures and additional mitigation measures, the residual effect of change in mortality is not expected to result in a change to the long-term persistence and viability of Moose within the WR-WRSA.

5.4.5.2.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in Moose mortality is provided in **Table 5.4-16**.

The Magnitude of the effect is assessed as Low. Mitigation measures are anticipated to be effective at reducing the direct and indirect mortality, and the risk of mortality is expected to be within the range of natural variability. Therefore, it is predicted that the Project will result in a Low Magnitude of change in mortality on Moose.

The Geographic Extent is predicted to be Regional. Direct mortality is expected to only occur within the Project Area; however, indirect Moose mortality may occur outside the Wildlife LSA and into the WR-WRSA. The home range of Moose in central BC is large (10 to 262 km² and the home ranges of Moose that occur in the WR-WRSA are expected to overlap with the Project Area and the WLSA (Demarchi 2003, Scheideman 2018). Sources for direct mortality (e.g., vehicle and rail collisions) that occur within the WLSA may affect Moose with home ranges outside of the WLSA and sources for indirect mortality (e.g., increased hunter access, changes to health, changes to predator-prey dynamics) may also result in mortality outside the WLSA.

It is estimated that the Duration of the effect will be Medium-term. The potential for direct mortality is expected to be highest during the Construction, and Operation phases when vehicle and rail traffic is most frequent, and it is predicted to continue through to the end of the Post-closure Phase. The potential for indirect mortality is expected to be highest during the during Operation Phase, when Project components may result in indirect mortality. The potential for indirect mortality is anticipated to abate in the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and be limited during the Post-closure Phase.

The Frequency is assessed as Infrequent. Mitigation measures (e.g., low speed limits, reduction in traffic by convoys and carpooling, preventing public access to Project components) are anticipated to limit the potential for Moose mortality; however, direct, and indirect mortality could occur sporadically through all Project phases.

It is predicted that the effect will be Fully Reversible. The risk of direct or indirect mortality are anticipated to subside during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities, and to diminish to baseline conditions following the Post-closure Phase.

The residual effect of change in mortality is expected to have a Moderate Context. Moose populations can be resilient to additional mortality when factors (e.g., survival, recruitment, sex ratios) suggest an increasing population; however, the presence of multiple stressors may affect the ability for Moose populations to recover from any additional increases in mortality (Gasaway et al. 1983, Solberg et al. 1999). Estimates of the Moose population in the game management unit overlapping with the Project (6C), suggest a declining population between 2006 to 2015; however, population estimates within the Bulkley Valley suggest continuing variability in the population since 1992 (Kuzyk et al. 2018). Therefore, the Context of the residual effect considered the uncertainty related to Moose population characteristics to predict a Moderate rating.

Table 5.4-16: Summary of Effect Characteristics Ratings for Change in Mortality

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	The risk of mortality is expected to be within the range of natural variability.
Geographic Extent	Regional	Direct mortality is expected to occur only within the Project Area; however, indirect mortality may extend into the WR-WRSA.
Duration	Medium-term	Moose mortality may occur during all phases of the Project.
Frequency	Infrequent	It is expected that the effect may occur sporadically through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that Project-related Moose mortality will end following the end of the Post-closure Phase.
Context	Moderate	Uncertainty in population estimates suggest that there may be a intermediate level of historic or ongoing anthropogenic or natural disturbance.

Notes: Project=Tenas Project; WR-WRSA=Wide-ranging Wildlife Regional Study Area

5.4.5.2.2 Likelihood

The Likelihood of the residual effect of the change in Moose mortality is Likely. Mitigation measures are expected to reduce, but not eliminate the risk of Moose mortality.

5.4.5.2.3 Significance Determination

The residual effect of change in Moose mortality due to the Project is not expected to result in a increase in Moose mortality that will alter the integrity of the population within the WR-WRSA to the point where it is not sustainable or is unavailable to contribute to the regional population. Moose have large home ranges and any that overlap with the Project Area are expected to extend into the WR-WRSA. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The direct effects of change in mortality are well known, and mitigation measures have been proven effective on past projects and are anticipated to reduce direct and indirect mortality to within the range of natural variability. However, there is uncertainty about the ability for the regional population to assimilate additional mortality.

5.4.5.3 *Change in Movement Patterns*

The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Moose within the WR-WRSA. The assessment builds off the baseline report to address changes to seasonal and daily Moose movement patterns that could result from Project activities and interactions with Project components. A change to Moose movement patterns is anticipated to occur primarily during the Construction, and Operation phases; however, the effect could occur during all Project phases.

Moose populations in central BC, and likely those within the WR-WRSA, may contain both seasonally migratory and non-migratory individuals (Demarchi 2003, Kerr and Dillon 2018). Moose movement between seasonal ranges is driven by an accumulation or reduction in snowpack, as increasing snowpack can negatively influence mobility and forage availability (Coady 1974, Demarchi 2003). Snowpack depth and seasonal persistence of snow cover typically increases with elevation (Demarchi 2003). As a result, Moose in mountainous regions of BC, and likely those in the WR-WRSA, usually migrate between winter-spring ranges in valley bottoms and higher-elevation summer ranges, although some Moose remain in the valleys year-round (BC MELP 2000, Demarchi 2003, Kerr and Dillon 2018). The use of migration corridors between seasonal ranges is traditional and is passed from adult females to their offspring (LeResche 1972, Sweanor and Sandegren 1989).

Daily movement rates of Moose differ seasonally and are generally highest during the summer and lowest during early and late winter (Scheideman 2018). Average daily movement rates in mountainous regions of northern BC were approximately 2.4 km per day during the summer and 0.96 km per day during the winter (Gillingham and Parker 2008). Movement rates between males and females are generally similar throughout the year, except during the rut when male Moose travel greater distances than females (Scheideman 2018).

Moose may change their movement patterns in response to a loss or fragmentation of habitat or to sensory disturbances. Reductions in either the spatial heterogeneity of habitat or the forest area present in their summer home range can reduce the probability of seasonal Moose movements (Borowik et al. 2020). The amount of intact forest and density of roads may also influence Moose movement, suggesting fragmentation can affect movement (Wattles and DeStefano 2013, Farley et al. 2014). Late-winter Moose movement is primarily influenced by snow depth and as snow depth increases, the use and crossing of open areas decreases as Moose shift to closed canopy forest and edge habitats (Ardea Biological Consulting 2004, Poole and Stuart-Smith 2005).

The effect of anthropogenic features on Moose movement is variable. Moose may reduce their movements as human encroachment into Moose habitat increases and are more likely to avoid areas with higher densities of anthropogenic features (Lykkja et al. 2009, Neumann et al. 2013). Some linear features (e.g., roads, snowbanks) create actual, or are perceived as, barriers and can create corridor effects as Moose are deflected from crossing the feature and move alongside it; however, transmission lines are not avoided, potentially due to low human use, a lack of a physical barrier, and the presence of abundant browse (Laurian et al. 2008, Bartzke et al. 2015). The barrier and corridor effects are also higher for combinations of roads with powerlines or rivers compared to single roads, but not with powerlines and rivers (Bartzke et al. 2015). Avoidance of crossing a road may occur less frequently in response to reduced traffic volume or during migration, when Moose may utilize well established travel routes and corridors (Neumann 2009).

Moose may perceive traffic and other human activity as analogous to predation risk and change their movement patterns accordingly (e.g., avoidance of higher traffic roads over lower traffic roads, crossing and using areas closer to roads at night when traffic volumes are lower, the avoidance of areas near buildings during periods of high-human activity) (Laurian et al. 2008, Lykkja et al. 2009, Eldegard et al. 2012). The perception of human activity and risk may vary between male and female Moose, as male Moose have been found to be more willing than cow and calf pairs to use areas closer to roads and more

willing to use areas near buildings and with higher densities of buildings during periods of low-human activity (Lykkja et al. 2009, Eldegard et al. 2012). Moose may also be attracted to anthropogenic features if these areas are avoided by predators, provide desirable resources (e.g., salt, abundant browse), or relief from biting insects (Kelsall and Simpson 1987, Laurian et al. 2008, Muhly et al. 2011).

Seasonal Moose movement patterns within the WR-WRSA are unknown but anticipated to occur between higher elevation summer habitat and suitable Moose winter habitat along the valley bottoms. Shrubby cutblocks and burns are common within the WR-WRSA and an important source of suitable Moose habitat; however, adjacent access roads reduce their habitat value. Suitable Moose habitat in the WR-WRSA is generally located mid- to low-slope and along valley bottoms in the Telkwa, Bulkley, and Morice River corridors and little overlap with Project components. Mine Infrastructure is located upslope of suitable Moose habitat along the Telkwa River Valley and it primarily overlaps with habitat rated very low to low suitability. It is anticipated that Moose use of the area is low and there is limited potential for effect on daily and/or seasonal movement of Moose. The TAC is within a matrix of suitable Moose habitat upslope from the Bulkley River Valley and regular vehicle traffic is expected. The road and disturbance from traffic may cause deflections in seasonal movements across the road and in daily movements of Moose with home ranges overlapping with the TAC. Traffic and human activity along this component are anticipated to be highest during the Construction, and Operation phases and declining following the Operation Phase.

Project design measures identified in **5.3** are expected to reduce new barrier effects on seasonal movement patterns of Moose through the use of existing roads and aligning linear features into a common ROW where possible. Daily movement rates are lowest in winter and this is expected to limit the potential for interactions between Moose and Project components during that season (i.e., Moose conserve energy through reduced movement). It is expected that the reduced traffic and human disturbance, with carpooling/bussing, truck convoys, and high-volume haul trucks, enforcing speed limits on Project roads, and working training programs will limit the potential for Project effects on both seasonal and daily movement. The implementation of additional mitigation measures, as identified in **5.3**, are expected to further limit interactions between Moose and potential sources of sensory disturbance and habitat loss and fragmentation. Although Project activities may result in daily and seasonal changes in Moose movement patterns within the WR-WRSA, the implementation of Project design measures and additional mitigation measures, the residual effect of change in movement patterns is not expected to result in a change to the long-term persistence and viability of Moose within the WR-WRSA.

5.4.5.3.1 Characterisation of Residual Effects

The residual effects characterisation for the change in change in movement patterns is provided in **Table 5.4-17**.

The Magnitude of the effect is assessed as Low and within the range of natural variability. Natural variability in Moose movement patterns is anticipated to have increased following the mountain pine and spruce beetle outbreaks and mitigation measures are anticipated to be effective and reduce because mitigation measures are anticipated to be effective, and it is predicted that Project-related changes to Moose movement patterns will be within the range of natural variability.

The Geographic Extent is predicted to be Regional. The home range of Moose in central BC is large (10 to 262 km²) and the home ranges of some Moose that occur in the WR-WRSA are expected to overlap with the Project Area and the WLSA (Demarchi 2003, Scheideman 2018). As a result, it is predicted that the effect of changes in Moose movement patterns will be Regional.

It is estimated that the Duration of the effect will be Medium-term. The potential for the effect is expected to be greatest during the Construction, and Operation phases when sensory disturbances (e.g., vehicle traffic, rail activity, human presence) is likely to be highest and prior to the revegetating of the site during

reclamation activities. As Project components are removed and Project activities are reduced it is predicted that the effect will diminish through to the end of the Post-closure Phase (i.e., within 52 years) when Moose movement patterns are anticipated to return to baseline conditions.

The Frequency is assessed as Frequent. Measures to mitigate sensory disturbances (e.g., low speed limits, reduction in traffic by convoys and carpooling, preventing public access to Project components) and minimize the Project Area are anticipated to minimize changes in the effect; however, sensory disturbances and previously cleared habitat may influence Moose movement patterns until the Post-closure Phase.

It is predicted that the effect will be Fully Reversible. Any changes to Moose movement patterns are anticipated to subside during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and diminish further following Post-closure.

The residual effect of change in movement patterns is expected to have a Moderate Context. Few high traffic volume roads (e.g., Highway 16) and rail lines (e.g., Telkwa Subdivision-CNR) exist within the WR-WRSA that may restrict the movement of Moose. FSR are prevalent across the WR-WRSA, but they are anticipated to have relatively low traffic volumes that do not restrict the movement of Moose. The mountain pine beetle and spruce beetle in central BC and salvage logging have reduced the amount of forest cover in the WR-WRSA (Kuzyk and Heard 2014, Kuzyk et al. 2018). Losses in forest cover due to the outbreaks are thought to result in deeper snow and a higher density of downed pine and spruce, which increases the energetics and difficulty in movement across the landscape (Heard 2012). In 2019 forestry losses in the Bulkley TSA due to the mountain pine beetle outbreak totalled 1,979 ha and estimated at less than 600 ha due to the spruce beetle outbreak (Westfall et al. 2019). Projected forest losses due to the mountain pine beetle outbreak are expected to continue to increase through to 2024 (BC MFLNRO 2015a, b). It is anticipated that the changes to habitat resulting from the mountain pine and spruce beetle outbreaks will increase the variability in Moose movement across the landscape, and as a result the context is predicted to be a Moderate rating.

Table 5.4-17: Summary of Effect Characteristics Ratings for Change in Movement Patterns

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Any changes to Moose movement patterns are expected to be within the range of natural variability.
Geographic Extent	Regional	Changes to Moose movement patterns are expected to occur outside the WLSA due to the large home range size of Moose.
Duration	Medium-term	Changes to Moose movement patterns may occur during all phases of the Project but are anticipated to end following the Post-closure Phase.
Frequency	Frequent	It is expected that the effect may occur continuously through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that potential Project-related changes to Moose movement patterns will end following the end of the Post-closure Phase.
Context	Moderate	Existing disturbance from roads is not expected to limit Moose movement, but increased snow depths and downed trees due to the beetle outbreaks are expected to reduce the ease of movement across the landscape.

Notes: Project=Tenas Project; WLSA=Wildlife Local Study Area

5.4.5.3.2 *Likelihood*

The Likelihood of the residual effect of the change in Moose movement patterns is Likely. Mitigation measures are expected to reduce, but not eliminate any changes in movement patterns.

5.4.5.3.3 *Significance Determination*

The residual effect of change in Moose movement patterns due to of the Project is not expected to result in an increase in Moose movement patterns that will alter the integrity of the population within the WR-WRSA to the point where it is not sustainable or is unavailable to contribute to the regional population. It is expected that a Moose home range that overlaps with the Project Area will extend into the WR-WRSA. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The effects of change in Moose movement patterns are well known, and mitigation measures have been proven effective on past projects and are anticipated to reduce changes in movement patterns to within the range of natural variability. However, there is uncertainty about the ability for the regional population to assimilate additional changes in movement patterns due to ongoing uncertainties regarding the natural variability.

5.4.6 Bats Subcomponent

5.4.6.1 *Alteration and/or Loss of Habitat*

The alteration and/or loss of habitat residual effect considers the direct loss of habitat and the indirect alteration (e.g., sensory disturbances, edge effects, perceived barriers) of habitat for Bats during all Project phases. The Bat habitat suitability model (**Appendix 4.8-A**) characterises and quantifies suitable foraging habitat within the WRSA using a four-class rating system as baseline information for assessment of the effects of the Project on Bats. Additional models were created to quantify roosting, maternity roosting, and hibernating habitat within the WRSA; this analysis informed the effects assessment and will benefit implementation of mitigation measures such as for stratifying pre-clearing surveys. The magnitude of suitable habitat alteration or loss was largest for foraging habitat and as a result it was selected to assess the effect of the alteration and/or loss of habitat for Bats. The characterisation of the alteration and/or habitat loss residual effect considers the Project effects on moderate to high suitable Bat foraging habitat (suitable Bat habitat) within the WRSA.

Progressive revegetation is anticipated to begin during Construction and habitat that is altered/lost will become available as suitable Bat habitat following Post-closure (i.e., after the regeneration of vegetation following reclamation. However, a conservative approach is used, in that habitat within the Project Area is considered unavailable to Bats for the duration of the Project. Direct habitat loss will be mitigated by reducing the size of the Project Area to the extent practicable during Project design.

Up to 764.8 ha (1.9%) of suitable Bat habitat within the WRSA is anticipated to be removed or altered during site clearing in the Construction Phase (**Table 5.4-18**). In this analysis it was assumed that all suitable habitat in the Project Area would be lost, which is an overestimate of the habitat loss that will occur. Mitigation measures outlined in **5.3** are anticipated to reduce the effects.

Mitigation measures are expected to maintain important identified habitat features (e.g., no-disturbance buffers around sensitive or important habitat features [e.g., hibernacula, maternity roosts]), and reduce the loss or alteration of habitat (e.g., minimize Project Area, align linear Project components within same ROW).

Table 5.4-18: Summary of Change in Suitable Habitat for Bats

Habitat	Predicted Total Change in Suitable Habitat (ha) ¹	Total Suitable Habitat (ha) in the WRSA	Predicted Total Change in Suitable Habitat (%) ²
Bats – High Suitability	0	1,969.1	0
Bats – Moderate Suitability	764.8	39,230.9	1.9
Total	764.8	41,200.0	1.9

Notes: %=percent ; ha=hectare; WRSA= Wildlife Regional Study Area

¹ Predicted total change in suitable habitat (ha) in the Project Area and Local Study Area (LSA).

² Predicted total change in suitable habitat (%) in the Wildlife RSA.

5.4.6.1.1 Residual Effects Characterisation

The residual effects characterisation for the alteration and/or loss of suitable Bat habitat is provided in **Table 5.4-19**.

The Magnitude of the alteration and/or loss of suitable Bat habitat predicted to be Low. It is anticipated that up to 0.4% of suitable Bat habitat within the WRSA will be lost within the Project Area during the Construction Phase.

The residual effect is predicted to be Local in Geographic Extent. While the direct loss of suitable Bat habitat is expected to be limited to the Project Area during Construction, indirect effects to suitable Bat habitat are expected to occur within the WLSA along the periphery of the Project Area during all Project phases.

The change in suitable Bat habitat is predicted to occur over the Long-term (>52 years) because of the relatively long time required for suitable Bat habitat to regenerate following disturbance. Progressive revegetation is anticipated to begin in some parts of the Project Area following Construction; however, the revegetation within most of the Project Area will occur during reclamation activities during the Decommissioning and Reclamation Phase up to 27 years after clearing during the Construction Phase. Revegetation is expected to increase the amount of forest within the Project Area with a transition to mature forest approximately 80 years following initial reclamation. Suitable habitat may occur within 52 years (Medium-term) for little brown myotis; however, suitable habitat for northern myotis and roosting habitat for both species are expected to regenerate in the Long-term (i.e., >52 years).

The Frequency of the alteration and/or loss of suitable Bat habitat is predicted to be Frequent. While loss of suitable Bat habitat due to clearing during the Construction Phase will occur once, alteration of suitable Bat habitat within the WRSA by indirect effects is anticipated to be Frequent throughout the Construction, Operation, Decommissioning and Reclamation phases, and Infrequent during the Post-closure Phase.

The change in suitable Bat habitat is predicted to be Fully Reversible. Progressive and final reclamation will revegetate disturbed areas within the Project Area with a focus on an end land use of forested ecosystems. It is anticipated that the Project Area will transition into mature forest (i.e., suitable Bat habitat) within approximately 80 years after revegetation. It is therefore predicated that any losses to suitable Bat habitat have the potential to be Fully Reversible. In addition, the alteration of suitable Bat habitat is expected to be Fully Reversible starting in the Decommissioning and Reclamation Phase, as sensory disturbances diminish, and revegetation reduces edge effects and fragmentation.

The Context of the residual effect of alteration and/or loss of suitable Bat habitat is predicted to be Moderate. Progressive reclamation activities (e.g., revegetation) are anticipated to begin in some parts of the Project Area following Construction; however, the revegetation within most of the Project Area will occur as part of

reclamation activities during the Decommissioning and Reclamation Phase up to 27 years after clearing during the Construction Phase. As a result, most of the suitable Bat habitat that is altered or cleared due the Project will remain in that state until the Decommissioning and Reclamation Phase when the Decommissioning and Reclamation Phase will occur. Little brown myotis foraging habitats are abundant in the WRSA and are likely not limiting. Summer roosts for both species and preferred foraging habitat for northern myotis is mature and old-growth forest which are approximately 30% of the WRSA. The mountain pine beetle and spruce beetle outbreaks and subsequent salvage logging in central BC have reduced the amount of forest cover and likely affected suitable Bat habitat in the WRSA. Projected forest losses due to the mountain pine beetle outbreak are expected to continue to increase through to 2024 and further reduce mature forest cover (BC MFLNRO 2015a).

Table 5.4-19: Summary of the Characteristics Ratings for the Alteration and/or Loss of Habitat

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Low	<1% of suitable Bat habitat within the WRSA will be altered or lost.
Geographic Extent	Local	The effect is limited to the WLSA.
Duration	Long-term	The loss of suitable Bat habitat will only occur during the Construction Phase; however, the alteration of habitat will continue through all phases. The replanting of the Project Area will not be complete until the end of Reclamation (i.e., 27 years after clearing). Replanted areas will likely become suitable Bat habitat (i.e., northern myotis foraging habitat and summer roosting habitat for both species) 80 years after replanting.
Frequency	Frequent	The effect occurs continuously due to the potential for alteration of habitat to occur until the end of the Decommissioning and Reclamation Phase.
Reversibility	Fully Reversible	The alteration of habitat will end following the Decommissioning and Reclamation Phase and the revegetation of the Project Area is expected to reverse the loss of habitat.
Context	Moderate	Mountain pine and spruce beetle have affected suitable habitat within the WRSA; however, suitable habitat can be resilient to disturbance.

Notes: <=less than; %=percent; Project=Tenas Project; WLSA=Wildlife Local Study Area; WRSA=Wildlife Regional Study Area

5.4.6.1.2 Likelihood

The Likelihood of the alteration and/or loss of suitable Bat habitat is Likely. Suitable Bat habitat within the Project Area is expected to be cleared during the Construction Phase and indirectly affected outside the Project Area during all Project phases.

5.4.6.1.3 Significance Determination

The alteration and/or loss of suitable Bat habitat due to the Project is not expected to result in a change in suitable Bat habitat that will alter its integrity within the WRSA to the point where it is not able to sustain the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The direct effects of habitat loss are known; however, it is unknown if habitat features (e.g., hibernacula, maternity roosts), while not identified during baseline studies, may be present within the Project Area and lost or affected due to clearing. Uncertainty also exists with respect to the extent that suitable Bat habitat may be altered (e.g., sensory disturbances,

fragmentation, perceived barriers). Uncertainty also exists in relation to the accuracy of the mapping products used to identify suitable Bat habitat.

5.4.6.2 *Change in Mortality*

The characterisation of the change in mortality residual effect considers Project-related effects within the WRSA. The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Bats within the WRSA. The assessment includes consideration of direct mortality from Project activities and interactions with Project components, and indirect mortality due to the Project. Most Bat mortality risk is anticipated to occur during the Construction, and Operation phases; however, the risk of Bat mortality occurs during all Project phases.

Potential Project-related interactions that may act as sources of mortality include vehicle collisions (i.e., road mortality), clearing of roost trees, and exposure to environmental contaminants (ECCC 2018). Low-flying Bat species (e.g., little brown myotis, northern myotis) are more prone to vehicle collisions than high-flying species (Fensome and Mathews 2016). Little brown myotis and northern myotis use roads for commuting, and little brown myotis will also forage in edge habitat along roads (Limpens et al. 1989, Grindal 1996). Surrounding habitat, seasonal timing, and traffic volume can affect collision risk (Lesiński et al. 2011, Medinas et al. 2013). Little brown myotis travel at the forest canopy height when crossing roads and often at less than 2 m when crossing open fields (Russell et al. 2009). Areas where the road surface is raised (e.g., bridges) and traffic height may exceed the canopy height, where roads cross through deforested areas or areas of low canopy height, or where roads bisect or pass close to high quality habitat (e.g., waterbodies, riparian areas) may increase the risk of vehicle mortality (Russell et al. 2009, Fensome and Mathews 2016). Mortality risk for female bats may increase in late spring and early summer when they form maternity roosts (Medinas et al. 2013, Fensome and Mathews 2016). In addition, juvenile bats, which emerge in late summer, are at a higher risk of vehicle mortality risk than adults (Medinas et al. 2013, Fensome and Mathews 2016). Nightly traffic volume affects the risk of vehicle mortality and roosts adjacent to high traffic roads may experience unsustainable mortality (Russell et al. 2009, Medinas et al. 2013, Fensome and Mathews 2016). There are also anecdotal reports of bats colliding with all-terrain vehicles (ATVs) (ECCC 2018). Mitigation measures to reduce the Project footprint and minimize road length have been considered as mitigation measures to reduce vehicle mortality (Russell et al. 2009). Reducing traffic speed and volume when bats are active may also reduce the risk of vehicle mortality (Altringham and Kerth 2016). It is anticipated that the implementation of mitigation measures that reduce vehicle speeds and traffic volumes will result in a low increase in mortality risk for Bats.

Timber harvesting (e.g., logging, site clearing) may remove mature trees and snags used as roosts, and roosting bats may be killed if the trees or snags are occupied when cleared (ECCC 2018). BMPs, such as clearing trees when bats are not active (i.e., hibernating) and pre-clearing surveys to identify potential roost trees followed by an appropriate survey to confirm use (BC MOE 2016), are expected to minimize the risk of mortality to Bats.

Environmental contaminants from mining (e.g., waste rock, potential acid generating material) can result in release of chemical contaminants to both water and soil (ECCC 2015). Contaminated aquatic habitats may increase risk of exposure to Bats, such as little brown myotis, that feed on flying and emergent aquatic insect prey over water (ECCC 2018). High feeding rates of Bats potentially result in the high accumulation of contaminants in Bats that feed over water (Kannan et al. 2010). Reported indirect effects of contaminants in Bats include impairment of flight and foraging ability, resulting in higher predation risk and lower energy accumulation, immunosuppression, reduced reproductive success, and change in metabolic activity (Clark and Lamont 1976, Eidels et al. 2007, Kannan et al. 2010). However, there is no evidence that environmental contaminants are regularly encountered by most Bat populations and no published evidence of population level impacts on Bats (ECCC 2018). It is expected that appropriate mitigation measures to reduce the release of environmental contaminants will result in a low increase in mortality risk for Bats.

Interactions between Bats and potential sources of direct and indirect mortality are expected to be reduced through the Project design measures identified in **5.3 Mitigation**. Additional interactions between Bats and potential sources of direct and indirect mortality are expected to be limited through the implementation of mitigation measures identified in **5.3**. Although Project-related mortality of Bats may occur, the implementation of Project design and additional mitigation measures are expected to minimize the change in mortality residual effect and provide for the long-term persistence and viability of Bats within the WRSA.

5.4.6.2.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in Bat mortality is provided in **Table 5.4-20**.

Mitigation measures are anticipated to be effective at reducing the risk of mortality to be within the range of natural variability. Therefore, it is predicted that the Project will result in a Low Magnitude of change in mortality on Bats.

Mortality is expected to only occur within the Project Area and is expected to only affect Bats with home ranges inside the WLSA and indirect mortality is expected to only affect Bats within the WLSA. The mean home ranges of pregnant female Bats (i.e., typically the largest home range for Bats) are 30 ha in little brown myotis and 65 ha in northern myotis, and the mean commuting distance between roosts and foraging areas is 3.8 km in little brown myotis and 585 m in northern myotis (Henry et al. 2002, Owen et al. 2003). As a result, it is expected that the home ranges for female Bats to overlap between the Project Area and the WLSA and the Geographic Extent is predicted to be Local.

The Duration of the effect is predicted to be Medium-term. It is predicted that the risk of mortality will be highest during the Construction, and Operation phases, when the Project Area will be cleared and vehicle traffic is most frequent. Mortality risk is anticipated to decrease in the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and become limited during the Post-closure Phase.

The Frequency is assessed as Infrequent; however, direct, and indirect mortality could occur sporadically through all Project phases; however, mitigation measures (e.g., pre-clearing wildlife surveys, low speed limits, reduction in traffic volume, vegetation management) are anticipated to limit the mortality risk for Bats.

It is predicted that the effect will be Fully Reversible. The risk of mortality is anticipated to subside during the Decommissioning and Reclamation Phase, following the removal of Project components and a reduction in Project activities, and to diminish to baseline conditions following Post-closure.

The residual effect of change in mortality is expected to have a Moderate Context. Northern myotis is a provincially blue-listed species and both species are listed as Endangered under SARA. Bat populations in eastern Canada have declined rapidly following the arrival of white nose syndrome; however, white nose syndrome has not been detected in BC and the status of Bat populations are unknown or thought to be secure (BC CDC 2015b, c). Therefore, the Context of the residual effect considered the uncertainty related to the Bat population characteristics and the provincially blue-listed statistics for northern myotis to predict a Moderate rating.

Table 5.4-20: Summary of Effect Characteristics Ratings for Change in Mortality

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	The risk of mortality is expected to be within the range of natural variability.

Residual Effects Characteristic	Rating	Rationale for Rating
Geographic Extent	Local	Mortality is expected to occur only within the Project Area; however, the home ranges of Bats are expected to overlap between the Project Area and the WLSA.
Duration	Medium-term	Bat mortality may occur during all phases of the Project.
Frequency	Infrequent	It is expected that the effect may occur sporadically through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that Project-related Bat mortality will end following the end of Post-Closure.
Context	Moderate	Northern myotis is a provincially blue-listed species. Northern myotis and little brown myotis are both listed as Endangered under SARA; however, the reason for designation, white nose syndrome, is currently unknown in BC and the provincial populations are unknown or stable.

Notes: Project=Tenas Project; SARA=Species At Risk Act, SC 2002, c. 29 (Government of Canada [GovCan] 2002); WLSA=Wildlife Local Study Area; WRSA=Wildlife Regional Study Area

5.4.6.2.2 Likelihood

The residual effect of the change in Bat mortality is predicted to be Likely. Mitigation measures are expected to reduce, but not eliminate the likelihood of a change in mortality.

5.4.6.2.3 Significance Determination

The change in mortality residual effect due to the Project is not expected to result in a increase in Bat mortality that will alter the integrity of the population within the WRSA to the point where it is not able to sustain the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The direct effects of change in mortality are well known and direct and indirect mortality is expected to remain within the range of natural variability; however, the effectiveness of mitigation measures have not been proven on past projects and the population status of Bats in the region is unknown.

5.4.6.3 Change in Movement Patterns

The assessment of the change in movement patterns considers Project-related effects within the WRSA due to the relatively small home range size of Bats. The **Wildlife Baseline Report (Appendix 4.8-A)** summarises the existing knowledge of Bats within the WRSA. The assessment builds off the wildlife baseline report to consider changes to seasonal and daily Bat movement patterns that could result from Project activities and interactions with Project components. Changes to Bat movement patterns are anticipated to occur primarily during the Construction, and Operation phases; however, the effect may occur during all Project phases.

Bats undergo daily and seasonal movement patterns. Seasonal movement between hibernacula and summering sites occurs in the spring (i.e., April and May) and the fall (i.e., August through November). Summer daily movement patterns involve nocturnal travel between foraging sites and diurnal roosting sites; however, little daily movement occurs during hibernation (COSEWIC 2013, BC MOE 2016). During daily movement patterns Bats typically fly to foraging areas at the height of the forest canopy, although a range in flight altitudes (i.e., 2 – 40 m) may be used, up to 6.3 km from their diurnal roost (COSEWIC 2013,

Randall et al. 2014). Prior to hibernation Bats engage in swarming activity at hibernacula or other sites, and if a different site is used, Bats move again prior to hibernation (COSEWIC 2013, BC MOE 2016).

Daily movements can be affected by a variety of anthropogenic factors (e.g., vehicle presence, traffic noise, traffic volume, habitat fragmentation) that may extend from roads up to 300 m in woodlands and 500 m in open fields (Zurcher et al. 2010, Bennett and Zurcher 2012, Medinas et al. 2013, Bennett et al. 2013). Bats are less likely to cross roads in the presence of vehicles and when vehicle noise levels exceed 66 dB, and Bats may have a traffic noise threshold when all road crossings are avoided when vehicle noise levels exceed 88 dB (Zurcher et al. 2010, Bennett and Zurcher 2012). The volume of traffic can also act as a barrier to Bat movement when it exceeds 2,400 vehicles/hour and can alter movements when it exceeds 120 vehicles/hour (Bennett et al. 2013). Roads can fragment Bat habitat by creating gaps in vegetation cover, which can alter Bat movement patterns when gaps in movement corridors exceed 2.5 m. Interlinked tree canopies over roads may reduce changes to Bat movement patterns by creating connected movement corridors and dampening the noise from traffic (Bennett and Zurcher 2012).

Light pollution can also affect Bat movement patterns and may be related to a species' foraging behaviour. Aerial hawking bats (e.g., little brown myotis) may be attracted to lit areas by an increase in prey; however, slow flying bats that glean insects (e.g., northern myotis) may avoid lit areas due to an increase in predation risk (Environment Canada 2015). In addition, light spectra may also influence Bat movements, where white and green light caused avoidance in slow-flying species and red-light does not affect Bat movement (Spoelstra et al. 2017).

Bats are considered short-distance regional migrants that have high site fidelity and move 100 to 500 km between summering and wintering locations; however, few hibernacula are known in BC, and as a result little is known about the connectivity between summer foraging areas and hibernacula (COSEWIC 2013, Environment Canada 2015, BC MOE 2016). Migratory habitat and behaviour is also mostly unknown; however, the relative lack of wind farm bat mortality suggests that Bats migrate at relatively low heights (i.e., <40 m), but above natural obstacles (Reynolds 2006, Environment Canada 2015). This suggests that Bats may fly at higher altitudes during seasonal movements than daily movements; however, it is unknown whether factors that influence daily movement patterns influence seasonal movement patterns. For the purposes of this assessment, it was assumed that factors affecting daily movement patterns also affect seasonal movement patterns.

Daily Bat movement patterns within the WRSA are unknown but are anticipated to occur only during the growing season (i.e., April through October) and between roosting habitat (i.e., forest patches) and foraging habitat (i.e., forests, forest edges, riparian areas, wetlands). When moving through open areas it is assumed that Bats follow linear vegetation patches that can create movement corridors. The TAC and other Project roads cross through suitable Bat habitat and the gap created by road ROWs and vehicle traffic may reduce road crossing movements in Bats with home ranges that overlap with Project road ROWs. Vehicle activity along this component, and the potential for this residual effect, are anticipated to be highest during Construction, and Operation phases, and declining following the Operation Phase.

Project design measures identified in **5.3 Mitigation Measures** (e.g., using existing roads, aligning linear features into a common ROW where possible) are expected to reduce new barriers (e.g., sensory disturbances, habitat fragmentation) to Bat movement patterns. Mitigation to reduce traffic volume, the timing of traffic, and traffic noise (e.g., carpooling/bussing, truck convoys, speed limit enforcement on Project roads) and to minimize light pollution (e.g., use of directed/shielded lighting) is expected to reduce the potential for changes to Bat movement patterns. The implementation of additional mitigation measures, as identified in **5.3**, are expected to further reduce changes to movement patterns. Although Project activities may result in changes to the daily and seasonal in Bat movement patterns within the WRSA, it is expected that following the implementation of Project design measures and mitigation measures the

residual effect of change in movement patterns is not expected to result in a change to the long-term persistence and viability of Bats within the WRSA.

5.4.6.3.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in change in movement patterns is provided in **Table 5.4-21**.

The Magnitude of the effect is assessed as Low and within the range of natural variability. Forest cover within the WRSA is anticipated to have been altered and reduced (i.e., creating natural forest gaps) following the mountain pine and spruce beetle outbreaks, and therefore the natural variability in Bat movement patterns is expected to have increased. Mitigation measures are anticipated to be effective and as a result it is predicted that Project-related changes to Bat movement patterns will be within the range of natural variability.

The Geographic Extent is predicted to be Local. Seasonal movement distances for Bats are unknown in the WRSA. Daily movement distances are typically within 6.3 km and home ranges that overlap with the Project Area are expected to extend only into the WLSA (Environment Canada 2015).

It is estimated that the Duration of the effect will be Medium-term. The potential for the effect is expected to be greatest during the Construction, and Operation phases when sensory disturbances (e.g., vehicle traffic, directed lighting, human presence) are likely to be highest and prior to the revegetating of the site during the Decommissioning and Reclamation Phase. As Project components are removed and Project activities are reduced it is predicted that the effect will diminish through to the end of the Post-closure Phase (i.e., within 52 years) when Bat movement patterns are anticipated to return to baseline conditions.

The Frequency is assessed as Frequent. Measures to mitigate sensory disturbances (e.g., low speed limits, directed lighting) and minimize the Project Area are anticipated to reduce changes to movement patterns; however, sensory disturbances and cleared habitat may influence Bat movement patterns until Post-closure.

It is anticipated that the effect will be Fully Reversible. Any changes to Bat movement patterns are anticipated to subside during the Decommissioning and Reclamation Phase following the removal of Project components and a reduction in Project activities and diminish further following the Post-closure Phase.

The residual effect of change in movement patterns is expected to have a Moderate context. Northern myotis is a provincially blue-listed species and both species are listed as Endangered under SARA. Bat populations in eastern Canada have declined rapidly following the arrival of white nose syndrome; however, white nose syndrome has not been detected in BC and the status of Bat populations are unknown or thought to be secure (BC CDC 2015b, c). Therefore, the context of the residual effect considered the uncertainty related to the Bat population characteristics and the provincial blue-listed status for northern myotis to predict a Moderate rating.

Table 5.4-21: Summary of Effect Characteristics Ratings for Change in Movement Patterns

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Any changes to Bat movement patterns are expected to be within the range of natural variability.
Geographic Extent	Local	Changes to Bat movement patterns are expected to occur only inside the WLSA due to the relatively small home range size of little brown myotis and northern myotis.

Residual Effects Characteristic	Rating	Rationale for Rating
Duration	Medium-term	Changes to Bat movement patterns may occur during all phases of the Project but are anticipated to end following the Post-closure Phase.
Frequency	Frequent	It is expected that the effect may occur continuously through the life of the Project.
Reversibility	Fully Reversible	Project-related changes to Bat movement patterns are anticipated to end following the end of the Post-closure Phase.
Context	Moderate	Northern myotis is a provincially blue-listed species. Northern myotis and little brown myotis are both listed as Endangered under SARA; however, the reason for designation, white nose syndrome, is currently unknown in BC and the provincial populations are unknown or stable.

Notes: BC=British Columbia; Project=Tenas Project; SARA=Species At Risk Act, SC 2002, c. 29 (Government of Canada [GovCan] 2002); WLSA=Wildlife Local Study Area

5.4.6.3.2 Likelihood

It is estimated that it is Likely that a change in movement patterns will result in a residual effect. Mitigation measures are expected to reduce, but not eliminate any changes in movement patterns.

5.4.6.3.3 Significance Determination

The residual effect of change in Bat movement patterns due to the Project is not expected to result in a change to Bat movement patterns that will alter the integrity of the population within the WRSA to the point where it is not sustainable or is unavailable to contribute to the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Low. The effects of change in Bat movement patterns are not well known, and mitigation measures have not been proven effective on past projects; however, they are anticipated to reduce changes in movement patterns to within the range of natural variability.

5.4.7 Western Toad Subcomponent

5.4.7.1 Alteration and/or Loss of Habitat

The assessment of the alteration and/or loss of habitat residual effect examines the direct loss of habitat and the indirect alteration (e.g., sensory disturbances, edge effects, perceived barriers) of habitat during all Project phases. The characterisation and quantification of suitable living habitat within the WLSA by the Western Toad Living habitat suitability model (**Appendix 4.8-A**) used a four(4)-class rating system as baseline information for assessment of the effects of the Project on Western Toad. Additional models were created to quantify reproducing and hibernating habitat within the WLSA; this analysis informed the effects assessment and will benefit implementing mitigation measures. The Magnitude of suitable habitat alteration or loss was largest for Living habitat and as a result it was selected to assess habitat change for Western Toad. The characterisation of the alteration and/or habitat loss residual effect considers the Project effects on moderate to high suitable Western Toad Living habitat (suitable Western Toad habitat) within the WLSA.

Progressive replanting of vegetation is anticipated to begin during Construction and habitat that is altered/lost will become available as suitable Western Toad habitat following Post-closure (i.e., after the

regeneration of vegetation following reclamation. However, a conservative approach was used, in that habitat within the Project Area was considered to be unavailable to Western Toads for the duration of the Project.

Site clearing is anticipated to remove or alter up to 1,072.6 ha (8.2%) of suitable Western Toad habitat within the WLSA in the Construction Phase (**Table 5.4-22**). In this analysis it was assumed that all suitable habitat in the Project Area would be lost, which is an overestimate of the habitat loss that will actually occur. Mitigation measures outlined in **5.3** are anticipated to reduce the effects.

Mitigation measures are expected to maintain important identified habitat features (e.g., no-disturbance buffers around sensitive or important habitat features [e.g., ponds or other waterbodies used for breeding]), and reduce the loss or alteration of habitat (e.g., minimize Project Area, common corridors for linear Project components).

Table 5.4-22: Summary of Change in Suitable Habitat for Western Toad

Habitat	Predicted Total Change in Suitable Habitat (ha) ¹	Total Suitable Habitat (ha) in the WRSA	Predicted Total Change in Suitable Habitat (%) ²
Western Toad – High Suitability	292.0	7,412.7	3.8
Western Toad – Moderate Suitability	780.6	5,431.4	14.4
Total	1,072.6	13,136.1	8.2

Notes: %=percent ; ha=hectare; WRSA=Wildlife Regional Study Area

¹ Predicted total change in suitable habitat (ha) in the Tenas Project Area and Local Study Area (LSA).

² Predicted total change in suitable habitat (%) in the WRSA.

5.4.7.1.1 Residual Effects Characterisation

The alteration and/or loss of suitable toad habitat residual effects characterisation is provided in **Table 5.4-22**.

The Magnitude of the alteration and/or loss of suitable toad habitat is predicted to be Moderate. Within the WLSA it is anticipated that up to 8.2% of suitable toad habitat will be altered or lost due to clearing within the Project Area during the Construction Phase.

The Geographic Extent of the residual effect is predicted to be Local. While the direct loss of suitable toad habitat is expected to be limited to the Project Area during the Construction Phase, indirect effects on suitable toad habitat are expected to occur within the WLSA along the periphery of the Project Area during all Project phases.

The alteration and/or loss of suitable toad habitat is predicted to occur over the Medium-term (2 to 52 years). Progressive revegetation is anticipated to begin in some parts of the Project Area following the Construction Phase; however, within most of the Project Area the replanting of vegetation will occur during the Decommissioning and Reclamation Phase and cleared suitable Western Toad habitat is considered unavailable to Western Toads for the Duration of the Project (i.e., 27 years). Replanted vegetation is expected to increase the amount of ground cover within the Project Area with a transition to a low shrub structural stage within 20 years of reclamation. Western Toads prefer areas with high shrub and ground cover (COSEWIC 2012b), and it is expected that previously cleared areas will transition to suitable toad habitat within a Medium-term Duration (i.e., within 52 years).

It is predicted that the Frequency of the alteration and/or loss of suitable toad habitat will be Frequent. While loss of suitable toad habitat due to clearing during the Construction Phase will occur once, the alteration of suitable toad habitat by indirect effects within the WLSA is anticipated to be Frequent throughout Construction, Operation, Decommissioning and Reclamation phases, and Infrequent during the Post-closure Phase.

The alteration and/or loss of suitable toad habitat is predicted to be Fully Reversible. Progressive and final reclamation will replant vegetation with a focus on an end land use of forested ecosystems in disturbed areas within the Project Area. Optimal habitats for Western Toads are terrestrial areas with dense shrub cover, complex ground cover, and moderate to high ground humidity levels (COSEWIC 2012b). It is anticipated that replanted areas will transition into a low shrub structural stage, characterised by low, dense shrub cover, within 20 years. Thus, it is anticipated that suitable toad habitat lost within the Project Area has the potential to regenerate. In addition, as sensory disturbances diminish, and vegetation regenerates the alteration of suitable toad habitat is expected to be reduced within a similar time frame.

The Context of the residual effect of alteration and/or loss of suitable toad habitat is predicted to be Low. Western Toads are known to prefer habitats that occur following a disturbance (e.g., forest fire, logging, insect outbreaks) (COSEWIC 2012b). Past mountain pine beetle and spruce beetle outbreaks and subsequent salvage logging in central BC have likely reduced suitable toad habitat in the WLSA. Projected forest losses due to the mountain pine beetle outbreak are expected to continue to increase through to 2024 (BC MFLNRO 2015a). As areas affected by the mountain pine and spruce beetle outbreaks regenerate, they are anticipated to become suitable toad habitat within a short timeframe.

Table 5.4-23: Summary of the Characteristics Ratings for the Alteration and/or Loss of Habitat for Western Toad

Residual Effects Characteristic	Rating	Summary Rationale for Rating
Magnitude	Moderate	A total of 8.2% of suitable toad habitat within the WLSA is predicted be altered or lost, which is within the range of 6 to 15% for Moderate.
Geographic Extent	Local	The effect is limited to the WLSA.
Duration	Medium-term	The loss of habitat will only occur during the Construction Phase; however, the alteration of habitat will continue through all phases. The revegetation of lost habitat will not be complete until the end of the Decommissioning and Reclamation Phase (i.e., 27 years after clearing). Replanted areas are predicted to become suitable toad habitat within 5 to 10 years of replanting.
Frequency	Frequent	The effect occurs continuously due to the potential for alteration of habitat to occur until the end of the Decommissioning and Reclamation Phase.
Reversibility	Fully Reversible	The alteration of habitat is anticipated to end following the Decommissioning and Reclamation Phase, and the revegetation of the Project Area will reverse the loss of habitat.
Context	Low	The mountain pine and spruce beetle outbreaks have affected suitable toad habitat; however, suitable toad habitat has been shown to be resilient to disturbance.

Notes: %=percent; WLSA=Wildlife Local Study Area

5.4.7.1.2 *Likelihood*

The Likelihood of the residual effect of the alteration and/or loss of suitable toad habitat is Likely. Suitable toad habitat is present within the Project Area which is predicted to be cleared during the Construction Phase and indirectly affected during all Project phases.

5.4.7.1.3 *Significance Determination*

The residual effect of the alteration and/or loss of habitat is assessed as **Not Significant**. It is not expected that the effect will alter the integrity of suitable toad habitat within the WLSA to the point where it is not able to sustain the regional population.

The Level of Confidence of this prediction is Moderate. Confidence is provided by the proven effectiveness of mitigation measures used on past projects and that the effects of the alteration and/or loss of habitat are known. This is tempered by uncertainties with long-term habitat suitability due to natural changes from the mountain pine and spruce beetle outbreaks within the WLSA and in the accuracy of the mapping products used to identify suitable toad habitat.

5.4.7.2 *Change in Mortality*

The characterisation of the change in mortality residual effect considers Project-related effects within the WLSA. The existing knowledge of Western Toads within the WLSA is summarized in the **Wildlife Baseline Report (Appendix 4.8-A)**. Direct mortality from Project activities and interactions with Project components and indirect mortality due to the Project are included in the assessment. The potential for Western Toad mortality occurs during all Project phases; however, the highest potential for mortality is anticipated to occur during the Construction, and Operation phases.

The two (2) main sources of anthropogenic mortality are collisions with vehicles (i.e., road mortality) and exposure to environmental contaminants (e.g., heavy metals, pesticides, road salt). Adults undergo relatively long distance (i.e., up to 2.44 km) annual migrations between hibernating sites, breeding sites, and summer home ranges that increase road mortality risk and extend the area to which individuals may be affected (Carr and Fahrig 2001). Risk of road mortality is influenced by traffic volume and can negatively influence toad abundance (Fahrig et al. 1995). Western Toads rely on high adult survival to sustain populations through periods of poor reproductive success, and adult road mortality can have pronounced effects on local populations (ECCC 2016). Juvenile toads are also vulnerable to road mortality during mass movements away from natal sites following metamorphosis (COSEWIC 2012b). Under-road amphibian passages with fencing are considered one of the most effective mitigation strategies to reduce amphibian road mortality and have been installed to effectively alleviate Western Toad mortality along migration routes (COSEWIC 2012b, Wind 2020). Road closures during migratory periods have also been effective at reducing road mortality; however, other mitigation measures (e.g., reduced speed limits, signage, awareness programs) rarely result in a significant reduction in road mortality (Wind 2020). It is anticipated that the installation of appropriate amphibian crossing structures will result in a low increase in Western Toad mortality.

Little information is known on the effects of specific contaminants on Western Toads, although environmental contaminants are known to cause mortality in other amphibians (ECCC 2016). Western Toads are at risk of contaminants at tailings ponds and runoff from anthropogenic areas (Brinkman 1998, BC MOE 2014b). Environmental contaminants may also cause indirect mortality through loss of prey base, immunosuppression, and developmental abnormalities (ECCC 2016). Mitigation measures (e.g., avoid using chemicals and road salt near wetlands and waterbodies, contain wastewater management) may be effective; however, targeted monitoring and inspections will be completed by environmental inspectors to verify mitigation effectiveness (**8. Follow-up Strategy**) and determine if adaptive management and

monitoring is required (BC MOE 2014a). It is anticipated that the use of appropriate mitigation measures and adaptive mitigation will be effective at reducing the risk of mortality to Western Toad.

Interactions between Western Toad and potential sources of direct and indirect mortality are expected to be limited by Project design measures identified in **5.3 Mitigation Measures** and the implementation of additional mitigation measures as identified in **5.3**. Direct and indirect mortality of Western Toad within the WLSA may occur due to the Project; however, the long-term persistence and viability of Western Toad in the WLSA is not expected to change due to the implementation of Project design measures and additional mitigation measures.

5.4.7.2.1 *Residual Effects Characterisation*

The change in toad mortality residual effects characterisation is provided in **Table 5.4-24**.

The Magnitude of the effect is assessed as Low. Direct and indirect mortality is expected to be reduced by the implementation of effective mitigation measures (i.e., road underpasses, pre-clearing surveys and salvages) and the risk of toad mortality is expected to remain within the range of natural variability. Therefore, it is predicted that the Project will result in a Low Magnitude of change in mortality on Western Toad.

Direct mortality is expected to only occur within the Project Area and is expected to only affect toads with home ranges inside the WLSA and indirect mortality is expected to only affect toads within the WLSA. The mean summer home range is small and variable (i.e., ranging from 0.001 km² to 2.46 km²) (COSEWIC 2012b). Western Toads move up to 2.44 km between spring breeding sites and summer home ranges and juveniles may disperse over 2.7 km from natal sites, although occasional dispersal movements up to 13 km have been noted (Schmetterling and Young 2008, Bull 2009, Bartlet et al. 2010). As a result, it is expected that the adult summer home ranges and dispersing juvenile toads to only overlap between the Project Area and the WLSA and the Geographic Extent is predicted to be Local.

The Duration of the effect is estimated to be Medium-term (i.e., 2 to 52 years). Direct and indirect mortality risk is expected to be highest during the Construction, and Operation phases when the Project Area will be cleared, and vehicle traffic is most frequent. Direct and indirect mortality risk is predicted to continue through to the end of the Post-closure Phase when all Project activities end. Although it is anticipated to diminish following the removal of Project components and reduction in Project activities in the Decommissioning and Reclamation Phase and become minimal during the Post-closure Phase.

The risk of toad mortality is anticipated to be minimized following the implementation of mitigation measures (e.g., road underpasses, pre-clearing surveys and salvages); however, direct, and indirect mortality could occur sporadically through all Project phases. Therefore, the effect is predicted to be Infrequent.

The effect is predicted to be Fully Reversible. The risk of mortality will continue through all Project phases, although it is anticipated to be lower during the Decommissioning and Reclamation Phase, and to diminish to baseline conditions following the Post-closure Phase.

The residual effect of change in mortality is expected to have a Moderate context. Western Toad is listed as Special Concern under SARA and yellow-listed provincially. Western Toad is widespread and abundant across a large portion of its Canadian range, but little information exists on population sizes or densities, and few populations have been systematically monitored (COSEWIC 2012b). The main mortality threats are the disease chytridiomycosis and vehicle (e.g., trucks, ATVs) mortality; however, no population mortality estimates are available and juvenile mortality can be high (ECCC 2016). This species relies on high adult survival to sustain populations through periods of poor reproductive success, and threats that affect adult survival can have particularly pronounced effects (ECCC 2016). Therefore, the context of the residual effect

considered the uncertainty related to Western Toad population characteristics, sensitivity to adult mortality, and the listing as Special Concern under SARA to predict a Moderate rating.

Table 5.4-24: Summary of Effect Characteristics Ratings for Change in Mortality

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	The risk of mortality is expected to be within the range of natural variability.
Geographic Extent	Local	Direct mortality is expected to occur only within the Project Area; however, indirect mortality may extend into the WLSA.
Duration	Medium-term	Toad mortality may occur during all phases of the Project.
Frequency	Infrequent	It is expected that the effect may occur sporadically through the life of the Project.
Reversibility	Fully Reversible	Project-related toad mortality is anticipated to end after Post-closure.
Context	Moderate	Western Toad is listed as Special Concern under SARA.

Notes: Project=Tenas Project; SARA=Species At Risk Act, SC 2002, c. 29 (Government of Canada [GovCan] 2002); WLSA=Wildlife Local Study Area

5.4.7.2.2 Likelihood

Mitigation measures are expected to reduce, but not eliminate the risk of toad mortality. Therefore, the likelihood of a change in mortality residual effect is predicted to be Likely.

5.4.7.2.3 Significance Determination

The risk of toad mortality due to the Project is anticipated to remain below the level at which it would alter the integrity of the population within the WLSA to the point where it is not able to sustain the regional population. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is High. The direct effects of change in mortality are well known and direct and indirect mortality is expected to remain within the range of natural variability, and mitigation measures have been proven effective on past projects.

5.4.7.3 Change in Movement Patterns

Due to the importance of pond and wetland breeding areas to Western Toad populations, their relatively small home ranges, and the fact they are commonly found within 2 km of their breeding sites (Davis 2000), the potential for change in their movement patterns due to the Project was assessed at the scale of the Wildlife LSA (equivalent to the Vegetation and Wetland RSA). The maintenance of connectivity between breeding and upland habitats has been identified as critical to the survival of individual Western Toad populations (Wind and Dupuis 2002, COSEWIC 2012b). A change to toad movement patterns is anticipated to occur primarily during the Construction, and Operations phases; however, the effect could occur during all Project phases.

Western Toads are active from early spring to late-fall and hibernate through winter. While solitary for most of the year, adult Western Toads aggregate annually at their breeding sites. They display high site fidelity to natal breeding sites, returning to the same breeding site year-after-year, even when other potential sites are available ([Carpenter 1954, Bartelt and Peterson 1994, Davis 2000, Jones and Goettl 1998 in] Wind

and Dupuis 2002). The beginning of the breeding season each year is marked by the mass movement of adults from upland habitats to their natal breeding sites to complete mating and egg-laying during a 1-2-week period (ECCC 2020). Following breeding, adults may remain foraging in upland habitat adjacent to their breeding site, or may disperse to other wetland, riparian, and upland habitats (Muths 2003).

The end of the breeding season is marked by the mass emergence and dispersal of toadlets (Provincial Western Toad Working Group [PWTWG] 2014). Depending on the size and quality of the breeding site, dispersing toadlets can number in the hundreds to hundreds of thousands (ECCC 2020). Although the exact timing of these events will vary from year-to-year, depending on factors such as ambient air temperatures and persistence of ice (Gyug 2000), the breeding season for the WLSA has been estimated to cover the May to August period. While adult toads are mostly found within 2 km of their breeding sites, long distance migrations between breeding and hibernation sites of up to 13 km have been recorded (Schmetterling and Young 2008).

Outside of the breeding season, adult Western Toad are frequently found across the landscape. They utilize a broad range of ecosystems when foraging or dispersing that includes a variety of grassland, forest, shrub, marsh, and meadow habitats, which at higher elevations include avalanche slopes and subalpine meadows (Wind and Dupuis 2002). The presence of security and thermal cover in the form of shrubs, dense herb layers, coarse woody debris, boulders, or burrows dug by themselves or by other animals (COSEWIC 2012b) is important for facilitating their movement around the landscape. Females tend to travel further than males to reach foraging grounds, with female home ranges estimated to be in the order of approximately 17 ha compared to 7 ha for males (Jones 2000). Daily movements of adult toads have been reported to be up to 500 m, although such long-distance single-day movements may be infrequent, with the species observed to move little most of the time (Davis 2000). The daily activity pattern of toads has been found to vary by elevation and latitude, likely in response to ambient air temperatures. In the southern part of their range in BC they are nocturnal, whereas at higher elevations and higher latitudes, such as in the Project Area, they are diurnal, but may switch to nocturnal activity in the peak of summer (COSEWIC 2012b).

Foraging and dispersal habitat was represented by “Living-Growing” habitat in the habitat suitability model developed for the species as part of the inventory of baseline conditions for the Project (**Appendix 4.8-A**). High and Moderate rated Living-Growing habitat was found to be relatively widely distributed in the WLSA, accounting for 37% of its total area and intersecting with all Project components. The largest overlap of suitable (i.e., Moderate-high rated) foraging and dispersal habitat with Project infrastructure was in the open pit area and Western Toad of all life-stages were detected at 17 locations in this area (**Appendix 4.8-A**). Project design measures have limited the potential for adverse effects on toad foraging and dispersal movements but cannot eliminate them. ROWs for infrastructure such as transmission lines are utilized as movement corridors by Western Toads (Rach 2020), so these Project components are anticipated to have low potential to alter toad movement patterns.

Western Toads use roads as travel corridors and will cross roads of any size to move between upland and breeding habitat (COSEWIC 2012b). The use of existing resource roads during the Construction Phase and measures taken to minimize the Project-related increase in traffic on existing roads, such as the use of carpooling/bussing and enforcing speed limits, are expected to lower the potential for adverse effects of toad movements during the Construction Phase. Transportation corridors have, however, been associated with mass mortality events of toads in BC during breeding migration movements, thereby representing barriers to successful migration and dispersal (COSEWIC 2012b). Under-road amphibian passages with fencing are considered one (1) of the most effective mitigation strategies to reduce amphibian road mortality, and when installed, effectively alleviate Western Toad mortality along breeding migration routes (COSEWIC 2012b, Wind 2020). The high volume of over-size haul-trucks that will use the dedicated Bypass Road during operations (4 to 8 trucks/hour, 7 days a week) has the potential to create such a barrier. Western Toad adults and juveniles were detected at seven sites along the planned haul route during

baseline studies, including three sites within 200 m of the planned route where toad breeding was observed (**Appendix 4.8-A**). The route also passes approximately 500 m south of a sizeable wetland complex that was identified as the largest patch of suitable toad breeding habitat in the WLSA. Baseline studies did not identify any migratory breeding or dispersal pathways intersected by the planned Bypass Road route. Pre-construction monitoring of toad movement patterns along the route will be undertaken at key times during the breeding season to identify any defined travel routes and determine the site specific mitigation measures (e.g., locations of crossing structures).

Although Project activities will result in some disruption to Western Toad daily and seasonal movements within the WLSA, with the implementation of Project design and other mitigation measures described in **5.3**, the residual effect of change in movement patterns is not expected to result in a change to the long-term persistence and viability of Western Toad breeding populations within the WLSA.

5.4.7.3.1 *Residual Effects Characterisation*

The residual effects characterisation for the change in Western Toad movement patterns is provided in **Table 5.4-25**.

The Magnitude of the effect is assessed as Low due to the extensive distribution of suitable foraging and dispersal habitat throughout the WLSA, and the availability of mitigation measures that are known to be effective in mitigating the creation of barriers to movement of toads between upland and breeding habitat.

The Geographic Extent is predicted to be Local due to the small size of Western Toad home ranges and the concentration of the effect to the open pit area and potentially along the Bypass Road within the WLSA.

It is estimated that the duration of the effect will be Medium-term. The potential for the effect is expected to be greatest during Construction, and Operations phases when suitable foraging and dispersal habitat is lost and the potential for the Bypass Road to act as a migratory barrier during the breeding season is highest. As portions of the open pit area are reclaimed during the Operation Phase, Project components are removed during Post-closure Phase activities, and thermal and security cover is progressively re-established, it is predicted that the effect will diminish through to the end of the Post-Closure Phase (i.e., within 52 years) when Western Toad movement patterns are expected to be similar to pre-Project conditions.

The frequency is assessed as Frequent. Measures to mitigate the loss of foraging, migratory and dispersal habitat (e.g., minimizing the Project Area, use of existing disturbed area, carpooling during construction) are anticipated to minimize changes in the effect; however, progressive expansion of the open pit area and the maintenance of high daily traffic volumes on the Bypass Road throughout the Operation Phase may influence Western Toad movement patterns until the Post-closure Phase.

It is predicted that the effect will be Fully Reversible. Any changes to Western Toad movement patterns are anticipated to diminish during the Decommissioning and Reclamation Phase, following the removal of Project components and a reduction in Project activities, and further diminish following the Post-closure Phase.

The residual effect of change in movement patterns is expected to have a Low Context. Western Toads are a yellow-listed species in BC and designated as a species of Special Concern within SARA, with the primary threats to population persistence identified as transportation corridors and invasive species (ECCC 2020). Pre-construction monitoring of toad movement patterns along the planned Bypass Road route and the availability of proven mitigation measures for transportation corridors are expected to substantially reduce the potential for the Bypass Road to function as a reproductive barrier to toads. Project activities are not expected to result in the introduction of epidemic diseases or invasive species. Potentially suitable

foraging and dispersal habitat is widely available within the WLSA due to the species broad requirements for security and thermal cover. In the absence of the main threats to the species, Western Toads are considered to have high resilience to historic and ongoing natural and anthropogenic changes in the WLSA.

Table 5.4-25: Summary of Effect Characteristics Ratings for Change in Western Toad Movement Patterns

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Suitable foraging and dispersal habitat widely available in WLSA; mitigation measures for Bypass Road have been effective elsewhere.
Geographic Extent	Local	Western Toads have small home ranges; effects are expected to be concentrated in the open pit area and along the Bypass Road.
Duration	Medium-term	Changes to Western Toad movement patterns may occur during all phases of the Project but are anticipated to end following the Post-Closure Phase.
Frequency	Frequent	It is expected that the effect may occur continuously through the life of the Project.
Reversibility	Fully Reversible	It is anticipated that potential Project-related changes to Western Toad movement patterns will end following the Post-Closure Phase.
Context	Low	Main threats to the species can be mitigated or are not expected to be affected by the Project; suitable habitat for movement is widespread in the WLSA despite anthropogenic disturbance.

Notes: Project=Tenas Project; WLSA=Wildlife Local Study Area

5.4.7.3.2 Likelihood

The residual effect of change in Western Toad movement patterns is Likely. Western Toads were detected along the Bypass Road route, open pit area the Rail Loadout Locations, and at several other sites in the WLSA during baseline studies (**Appendix 4.8-A**). Mitigation measures are expected to reduce, but not eliminate any changes in movement patterns.

5.4.7.3.3 Significance Determination

The residual effect of change in Western Toad movement due to the Project is expected to result in a minor disruption of toad movement patterns within the WLSA such that it will not alter the integrity of the population within the WLSA to the point where it is not sustainable. Therefore, the effect is assessed as **Not Significant**.

The Level of Confidence of this prediction is Moderate. The effects of habitat modifications and transportation corridors on changes in toad movement patterns are reasonably well understood. Specific mitigation measures, such as the installation of amphibian-friendly road crossings, are known to be effective. However, no baseline information on toad movement patterns in the vicinity of the Bypass Road was available to determine whether such measures are warranted or where they might be most effective. Pre-construction monitoring of toad movements along the route will be undertaken during the breeding season to determine the need for, and location of, any specific measures to mitigate potential barrier effects of the Bypass Road.

5.5 Summary of Potential Project–Related Residual Effects and Significance

The assessment process identified the following potential residual effects of the Project on the Wildlife VC:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns.

The assessment process characterised the potential residual effects of the Project on Furbearers, Caribou, Grizzly Bear, Moose, Bats, Western Toad, the results of which are summarized in **Table 5.5-1: Summary of Residual Effects on the Wildlife Valued Component (VC) Subcomponents**.

The residual effects of the Project were not expected to result in a change to the viability and persistence of the subcomponents within the Wildlife RSAs and were therefore predicted to be **Not Significant**.

Considering the residual effects are predicted to be Not Significant for all subcomponents, it is predicted that the Project effects are not expected to alter the integrity of the Wildlife VC within the WRSA, CRSA1, CRSA2 Core and Matrix, or WR-WRSA to the point where it is not able to sustain regional populations and is available to contribute to ecological function; therefore, the residual effects are predicted to be Not Significant **Table 5.5-1**). All residual effects are carried forward into **6. Cumulative Effects Assessment (CEA)**.

Table 5.5-1: Summary of Residual Effects on the Wildlife Valued Component (VC) Subcomponents

Residual Effects	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Subcomponent	Residual Effects Characterisation								
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	▪ Transportation of equipment, materials, and personnel (C, O, D, P) ▪ Site clearing (C) ▪ Construction of Surface Water Management Infrastructure; Bypass Road; haul roads and service roads; Goathorn Creek Bridge; Coal Processing Plant (CPP); administration buildings; powerline and substation; Rail Infrastructure; water discharge infrastructure; and material handling systems (C) ▪ Improvements to existing private road and Forest Service Roads (FSR) (C) ▪ Mining the open pit (O) ▪ Operation of Surface Water Management Infrastructure; CPP; water discharge infrastructure; material handling systems; and solid waste management systems (O) ▪ Maintenance of Bypass Road; improved private road and FSR; haul roads and service roads; bridge over Goathorn Creek; administration buildings; powerline and substation; Rail Infrastructure; and storage piles and stockpiles (O) ▪ Progressive reclamation (O) ▪ Dismantle and remove mining equipment and facilities (D) ▪ Reclamation and closure activities at Minesite (D) ▪ Reclamation and closure of Bypass Road; bridge over Goathorn Creek; powerline and substation; and Rail Infrastructure (D) ▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and ongoing monitoring (P)	▪ Avoid sensitive environments ▪ Limit Project footprint and Project Area ▪ Reclamation measures (Refer to RCP) ▪ Project footprint boundaries ▪ Transport measures ▪ Project component design ▪ Blasting measures (Refer to EMP) ▪ Coal processing measures ▪ Seepage management measures ▪ Water capture measures ▪ Management of ML/ARD ▪ Project design and siting ▪ Minimize habitat disturbance ▪ Timing considerations. (Refer to WMP) ▪ Wildlife education program (Refer to WMP) ▪ Wildlife protection protocols (Refer to WMP) ▪ Manage potential wildlife attractants (Refer to WMP)	Furbearers	L	LSA	LT	FF	FR	L	L	NS	M
			Caribou	L	RSA	MT	FF	FR	H	L	NS	H
			Grizzly Bear	L	LSA	MT	FF	FR	M	L	NS	H
			Moose	L	LSA	MT	FF	FR	M	L	NS	M
			Bats	L	LSA	LT	FF	FR	M	L	NS	M
			Western Toad	M	LSA	MT	FF	FR	L	L	NS	M
Change in Mortality	▪ Transportation of equipment, materials, and personnel (C, O, D, P) ▪ Site clearing (C) ▪ Construction of Surface Water Management Infrastructure; Bypass Road; haul roads and service roads; Goathorn Creek Bridge; CPP; administration buildings; powerline and substation; Rail Infrastructure; water discharge infrastructure; and material handling systems (C) ▪ Improvements to existing private road and FSR (C) ▪ Mining the open pit (O) ▪ Operation of Surface Water Management Infrastructure; CPP; water discharge infrastructure; material handling systems; and solid waste management systems (O) ▪ Maintenance of Bypass Road; improved private road and FSR; haul roads and service roads; bridge over Goathorn Creek; administration buildings; powerline and substation; Rail Infrastructure; and storage piles and stockpiles (O) ▪ Progressive reclamation (O) ▪ Dismantle and remove mining equipment and facilities (D) ▪ Reclamation and closure activities at Minesite (D) ▪ Reclamation and closure of Bypass Road; bridge over Goathorn Creek; powerline and substation; and Rail Infrastructure (D) ▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and ongoing monitoring (P)	▪ Avoid sensitive environments ▪ Limit Project footprint and Project Area ▪ Project footprint boundaries ▪ Transport measures ▪ Project component design ▪ Blasting measures (Refer to EMP) ▪ Coal processing measures ▪ Seepage management measures ▪ Water capture measures ▪ Management of ML/ARD ▪ People, employees, contractors, and onsite policies ▪ Project design and siting ▪ Minimize habitat disturbance ▪ Timing considerations (Refer to WMP) ▪ Wildlife education program (Refer to WMP) ▪ Wildlife protection protocols (Refer to WMP) ▪ Manage hazardous materials (Refer to FMSCP and WMPRE) ▪ Manage potential wildlife attractants (Refer to WMP)	Furbearers	L	RSA	MT	IF	FR	M	L	NS	M
			Caribou	M	RSA	MT	IF	FR	H	L	NS	H
			Grizzly Bear	L	RSA	MT	IF	FR	M	L	NS	M
			Moose	L	RSA	MT	IF	FR	M	L	NS	M
			Bats	L	LSA	MT	IF	FR	M	L	NS	M
			Western Toad	L	LSA	MT	IF	FR	M	L	NS	H

Residual Effects	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Subcomponent	Residual Effects Characterisation								
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Change in Movement Patterns	▪ Transportation of equipment, materials, and personnel (C, O, D, P) ▪ Site clearing (C) ▪ Construction of Surface Water Management Infrastructure; Bypass Road; haul roads and service roads; Goathorn Creek Bridge; CPP; administration buildings; powerline and substation; Rail Infrastructure; water discharge infrastructure; and material handling systems (C) ▪ Improvements to existing private road and Forest Service Roads (C) ▪ Mining the open pit (O) ▪ Operation of Surface Water Management Infrastructure; CPP; water discharge infrastructure; material handling systems; and solid waste management systems (O) ▪ Maintenance of Bypass Road; improved private road and FSR; haul roads and service roads; bridge over Goathorn Creek; administration buildings; powerline and substation; Rail Infrastructure; and storage piles and stockpiles (O) ▪ Progressive reclamation (O) ▪ Dismantle and remove mining equipment and facilities (D) ▪ Reclamation and closure activities at Minesite (D) ▪ Reclamation and closure of Bypass Road; bridge over Goathorn Creek; powerline and substation; and Rail Infrastructure (D) ▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and ongoing monitoring (P)	▪ Avoid sensitive environments ▪ Limit Project footprint and Project Area ▪ Project footprint boundaries ▪ Transport measures ▪ Project component design ▪ Blasting measures (Refer to EMP) ▪ Coal processing measures ▪ Seepage management measures ▪ Water capture measures ▪ Management of ML/ARD ▪ People, employees, contractors, and onsite policies ▪ Project design and siting ▪ Minimize habitat disturbance ▪ Timing considerations (Refer to WMP) ▪ Wildlife education program (Refer to WMP) ▪ Wildlife protection protocols (Refer to WMP) ▪ Manage hazardous materials (refer to FMSCP and WMPRE) ▪ Manage potential wildlife attractants (Refer to WMP)	Furbearers	L	RSA	MT	FF	FR	M	L	NS	M
			Caribou	L	RSA	MT	IF	FR	L	U	NS	H
			Grizzly Bear	L	LSA	MT	FF	FR	M	L	NS	M
			Moose	L	RSA	MT	FF	FR	M	L	NS	M
			Bats	L	LSA	MT	FF	FR	M	L	NS	M
			Western Toad	L	LSA	MT	FF	FR	L	L	NS	H

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecomissioning and Reclamation, (P)ost-closure
EMP=Explosives Management Plan (S13.0-C6); FMSCP=Fuel Management and Spill Control Plan (S13.0-C7); ML/ARD=metal leaching/acid rock drainage; Project=Tenas Project; RCP=Reclamation and Closure Plan (S13.0-C15); WMP=Wildlife Management Plan (S13.0-C21); WMPRE=Waste Management Plan for Refuse and Emissions (S13.0-C20)

Magnitude: Low (L), Moderate (M), High (H)
Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), beyond Regional (beyond RSA)
Duration: Short-term (ST), Medium-term (MT), Long-term (LT)
Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)
Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)
Context: Low (L), Moderate (M), High (H)
Likelihood: Unlikely (UL), Likely (L)
Significance: Not-Significant (NS), Significant (S) Level of Confidence: High (H), Moderate (M), or Low (L)
Level of Confidence: High (H), Moderate (M), or Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table.

6. CUMULATIVE EFFECTS ASSESSMENT

A cumulative effect is when a Project-related residual effect on a VC interacts both spatially and temporally with the effects of the residual effects of other projects or activities that have been or will be carried out, to produce a combined effect. This subsection presents an assessment of the cumulative effects on the Wildlife VC.

Provincial guidelines establish the criteria that must be met for the consideration of a CEA, and note that if a reviewable project is expected to result in any residual adverse effects on the selected VCs then a CEA must be considered for all residual adverse effects, not only those predicted to be **Significant** (BC EAO 2013).

The environmental effects of past and existing projects and activities are captured in the baseline conditions (i.e., **4. Existing Conditions**). Thus, the likelihood of cumulative effects due to ongoing and future projects is the focus of this CEA. The approach to the cumulative effects methodology and assessment was guided by the Guideline for the Selection of Valued Components and Assessment of Potential Effects (BC EAO 2013) and follows the methodology outlined in **3.2**.

As described in **3.2.4.1 Spatial Boundaries**, the CEA spatial boundaries match those used in the residual effects assessment and include the WLSA (Western Toad), WRSA (Furbearers and Bats), WR-WRSA (Grizzly Bear, Moose), CRSA1 and CRSA2 Core and Matrix (Caribou), as defined in **Table 3.2-3**, collectively referred to as the Wildlife Cumulative Effects Study Area (WCESA).

The temporal boundaries for the CEA on the Wildlife VC encompass the periods during which the proposed Project-related residual effects are expected to interact with residual effects of other past, present, or reasonably foreseeable future projects and activities (i.e., any new future developments following the submission of the effects assessment through to the anticipated final year of the mine after the Passive Post-closure Phase is complete). The following temporal boundaries are evaluated as part of each CEA:

- ▶ past: beginning before major industrial resource development actions were undertaken in the region, and extending to 2017;
- ▶ present: 2017 to 2021, overlapping with the Project's baseline studies and effects assessment; and
- ▶ foreseeable future: 2021 to 2073, any new future developments following the submission of the effects assessment through to the anticipated final year of the Project after the Passive Post-closure Phase is complete.

No administrative boundaries were identified or used for the assessment of the Wildlife VC.

6.1 Potential Cumulative Effects

As outlined in **5.2 Potential Project-related Effects**, the following Project-related residual effects were considered for their potential to interact cumulatively with the residual effects of projects and activities identified within, or extending into the WRSA:

- ▶ alteration and loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns.

6.1.1 Ongoing and Future Projects and Activities

The CEA considers all past, ongoing and reasonably foreseeable future projects and activities, and a complete list considered for the CEA is provided in the Project and Activity Inclusion List (**S3.0-C1 Assessment Methodology**); however, only those with likely overlapping residual effects on the Wildlife VC were considered in the CEA (**Table 6.1-1**), followed by text that provides supporting rationale.

Table 6.1-1: Projects Included in the Assessment of the Wildlife Valued Component (VC) Based on Spatial and Temporal Interaction

Project/Activity Name	Interacts with Project-related Effects on the Wildlife VC as a Past, Present or Future Project/Activity	
	Past and Present	Future
Agricultural Activities	Yes	Yes
Big Onion Mine Project	Yes	Yes
Bulbous Toe Project	Yes	Yes
Coastal Gaslink	Yes	Yes
Dome Mountain Mine Project	No	Yes
Forestry Activities	Yes	Yes
Harvesting Activities (i.e., fishing, hunting, trapping)	Yes	Yes
Maple Leaf Cannabis Production Facility	No	No
Pacific Northern Gas Looping Pipeline	No	Yes
Pacific Trails Pipeline	No	Yes
Prince George to Terrace Capacitors Project	No	Yes
Recreation Activities	Yes	Yes
Telkwa to Smithers Bike Trail	No	Yes
Urban Development/Hudson Bay Mountain Development	Yes	Yes

Note: VC=Valued Component

The following projects and activities are expected to have residual effects on Wildlife overlapping with the WCESA (**Figure 6.1-1**):

- ▶ **Agricultural Activities:** Ongoing agricultural activities (e.g., crop production and harvesting, livestock production) are anticipated to continue; however, it is unknown if agricultural activities may expand. Any expansion of agricultural activities is expected to require vegetation clearing and result in the loss of habitat. Agricultural activities can cause sensory disturbances that may result in the alteration of habitat and changes in movement patterns. Agricultural activities also have the potential to result in a change in mortality (e.g., vehicle collisions). It is expected that ongoing agricultural activities will follow recommended BMPs and appropriate legislation and regulation to minimize, but not eliminate, any potential effects. Overall, the residual effects resulting from these activities have the potential to interact cumulatively with the Project residual effects of the alteration and loss of habitat, change in mortality, and change in movement patterns;

- ▶ **Big Onion Mine Project:** This mine exploration project is located within the WCESA approximately 17 km east of Smithers. The project is currently in the exploration phase with the most recent exploration activities completed between 2006 and 2009. The current spatial extent of activities on the property may change in the reasonably foreseeable future with the continuation of exploration activities and possible advancement of the project into the development stage. This proposed porphyry copper mine, if constructed, would require vegetation clearing within the project boundaries and may result in the alteration and loss of habitat. Project activities (e.g., vehicle operation, vegetation clearing) and infrastructure (e.g., water management ponds, transmission lines) have the potential to result in changes in habitat, mortality and movement patterns. If this mine is approved it is anticipated that construction and operation activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Due to the anticipated alteration and loss of habitat, change in mortality, and change in movement patterns, the residual effects resulting from this project have the potential to interact cumulatively with the Project residual effects within the WRSA;
- ▶ **Bulbous Toe Project:** This slow-moving landslide approximately 10 km west of the Project has a major transmission line traversing it, and as a result one (1) of the towers requires periodic maintenance. Anticipated work includes ongoing maintenance at the transmission towers, which will require vehicle and equipment traffic through the WRSA. Future activities (e.g., vehicle traffic, maintenance activities) are not anticipated to result in the loss of habitat; however, they are anticipated to cause sensory disturbances that may result the alteration of habitat, a change mortality, and a change in movement patterns. It is expected that maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Therefore, it is predicted that the residual effects resulting from this project may interact cumulatively with the Project residual effects within the WCESA;
- ▶ **Coastal Gaslink:** This pipeline is currently under construction approximately 70 km south of the Project and will involve the construction and operation of a natural gas pipeline within a 32 m wide ROW and associated access roads. Vegetation clearing during construction is expected to result in the loss of habitat. Project activities (e.g., vehicle traffic) are expected to cause sensory disturbances that may result in the alteration of habitat, a change in mortality, and a change in movement patterns. It is predicted that construction and maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Due to the anticipated effects, the residual effects resulting from this pipeline project have the potential to interact cumulatively with the Project residual effects;
- ▶ **Dome Mountain Mine Project:** The proposed cut and fill gold mine is located approximately 40 km northeast of the Project. If constructed, the mine is anticipated to require vegetation clearing and result in the loss of habitat. Mine activities (e.g., vehicle operation, blasting) are anticipated to result in the alteration of habitat, change in mortality, and change in movement patterns. If this mine is approved it is predicted that construction and maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Due to the potential for project residual effects, it is anticipated that the residual effects resulting from this mine may interact cumulatively with the Project residual effects;
- ▶ **Forestry Activities:** The WCESA is located within the Bulkley and Morice TSAs. It is estimated that 36,577.7 ha of forest within the WRSA, 67,720.5 ha within the WR-WRSA, 49,761.9 ha within the CRSA1, and 25,595.2 ha within the CRSA2 will be harvested between 2021 and 2073 (**S4.0-C8-Vegetation VC**). These are considered overestimates of the total extent of disturbance, as all future forestry activities are expected to be conducted with consideration of provincial and regional timber management objectives and do not account for reforestation or natural forest succession over the

course of the Project lifespan (approximately 52 years). Forestry activities are expected to follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. As a result, these forestry activities are expected to contribute to the alteration and loss of habitat and changes to movement patterns, through vegetation clearing, fragmentation, and sensory disturbances. Forestry activities may also result in a change in mortality through vehicle collisions and vegetation clearing. Due to the potential for residual effects, it is anticipated that the residual effects resulting from forestry activities may interact cumulatively with the Project residual effects;

- ▶ Harvesting Activities (i.e., fishing, hunting, trapping): Improved access to the WCESA may result in increased localized harvesting (e.g., trapping, hunting) of wildlife (e.g., Moose, marten). Hunting and trapping activities are regulated by BC MFLNRORD to maintain populations within management guidelines, and as a result are not anticipated to interact cumulatively with a change in mortality. In addition, while these activities are not anticipated to result in the loss of habitat, they may cause sensory disturbances that can result in the alteration of habitat and a change in movement patterns. As a result, the residual effects resulting from these activities are anticipated to interact cumulatively with the Project residual effects of alteration and loss of habitat and change in movement patterns;
- ▶ Pacific Northern Gas Looping Pipeline: The construction of the Pacific Northern Gas Looping Pipeline approximately 70 km south of the Project, is anticipated to require vegetation clearing along the pipeline ROW, access roads, and workspaces. Project activities are anticipated to result in sensory disturbances, dust deposition, fragmentation, and other factors that can result in the alteration of habitat. Activities during Project construction have the potential to result in a change in mortality and movement patterns; however, while it is not anticipated that the operation of the pipeline will result in mortality it may result in change in movement patterns. If this pipeline is approved it is expected that construction and maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Due to the potential for alteration and loss of habitat, and change in mortality and movement patterns, the residual effects resulting from this project may interact cumulatively with the Project residual effects;
- ▶ Pacific Trails Pipeline: The Pacific Trails Pipeline is a proposed natural gas pipeline with a 38 m wide ROW passing east-west along the south side of the WCESA. The construction of the pipeline is anticipated to require vegetation clearing resulting in the loss of habitat. Project activities (e.g., vehicle traffic, maintenance) have the potential to result in a change in mortality and may cause sensory disturbances that can result in the alteration of habitat and changes in movement patterns. If this pipeline is approved it is expected that construction and maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Due to the potential for the alteration and loss of habitat, a change in mortality, and a change in movement patterns, the residual effects resulting from the pipeline project may cumulatively interact with the Project residual effects;
- ▶ Prince George to Terrace Capacitors Project: This project involves constructing three (3) new capacitor stations along the 450 km transmission line between Prince George and northwest BC. One (1) station will be located approximately 20 km east of the Rail Loadout facility and within the WCESA. The construction of the station has the potential to result in the alteration and loss of habitat. Vehicle traffic during both construction and operation has the potential to result in a change in mortality and movement patterns. If this project is approved it is expected that construction and maintenance activities will follow approved mitigation measures, recommended BMPs, and appropriate legislation and regulation to minimize, but not eliminate, the potential effects. Therefore, due to potential for the alteration and loss of habitat and changes in mortality and movement

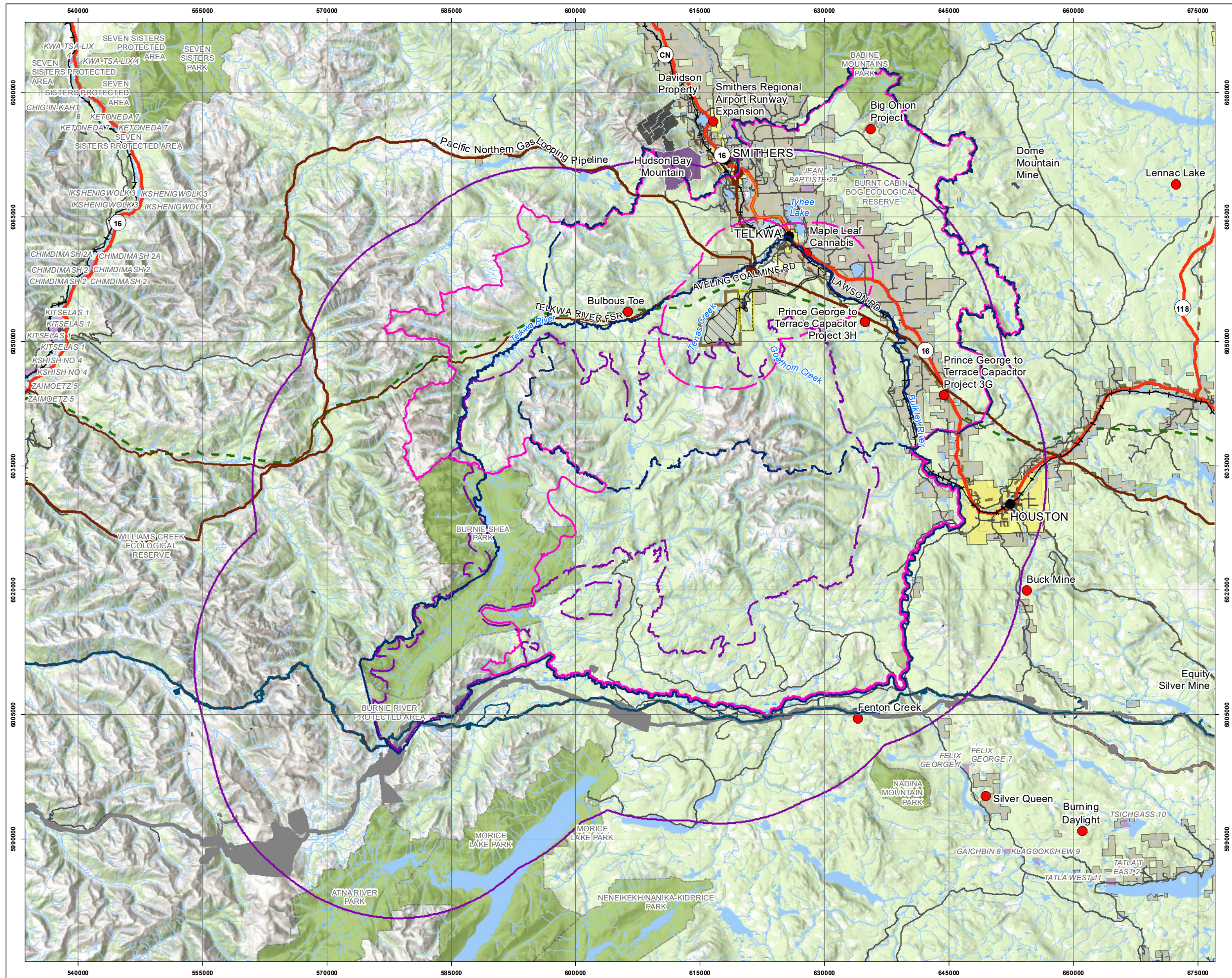
patterns the residual effects resulting from this project may interact cumulatively with the Project residual effects;

- ▶ Recreation Activities: Ongoing use of existing recreational trails within the WCESA for recreational activities (e.g., off-highway vehicle use, hiking, camping) is expected. These activities can cause sensory disturbances that may result in the alteration of habitat and changes in movement patterns. As a result, the residual effects resulting from these activities may interact cumulatively with the Project residual effects;
- ▶ Telkwa to Smithers Bike Trail: The proposed bike trail is situated along a 12 km section of Highway 16 within the WLSA between Smithers and Telkwa. The proposed bike trail would be located off the highway along the existing ROW. Total trail width would be 3 m with either a paved or gravel surface; and
- ▶ Urban Development: The municipality of Telkwa and the proposed Hudson Bay Mountain Estates (approximately 10 km northeast of the Project) are located within the WCESA. Anticipated urban development and maintenance projects (e.g., road works, housing construction, industrial operations) involve short-term construction periods and longer-term operations or activities that are localized to areas of existing disturbance. Overall, it is anticipated that any new developments or maintenance activities within Telkwa are not likely to contribute to the cumulative alteration or loss of habitat, changes in mortality or movement patterns as they are within previous disturbed areas. The development of the Hudson Bay Mountain Estates is anticipated to require vegetation clearing that may result in the loss of, and sensory disturbances may result in the alteration of habitat and changes in movement patterns. Activities associated with the proposed development (e.g., vehicle operation, construction) may result in a change in mortality and movement patterns. As a result, the residual effects resulting from these urban development activities may interact cumulatively with the Project residual effects.

Projects and activities that are not expected to have residual effects that interact cumulatively with the Project's residual effects on the Wildlife VC are:

- ▶ Maple Leaf Cannabis Production Facility: This facility is planned for a brownfield site previously developed for nursery use near the village of Telkwa. The development and operation of this facility is not expected to contribute to the loss or alteration of habitat for wildlife. It is also predicted that due to the pre-existing disturbance around the proposed facility this project will not result in a change in mortality or movement patterns, and it is therefore not anticipated that this project will result in residual effects that could interact cumulatively with the Project residual effects.

Path: L:\PROJECT\S2018\18P0172_Tenas_Maps\Map\REPORTING\EA\Wildlife\fig_1_1_Proyecto Actividad CEA_202107.mxd



Tenas Project

Location of projects and activities included in the Wildlife Valued Component cumulative effects assessment

Legend

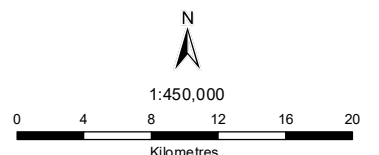
- | | |
|--|--|
| ● Project | ▨ Project Area |
| ● City/Town | ▭ Wildlife Local Study Area |
| — Rail Line | ▭ Wildlife Regional Study Area |
| — Highway | ▭ Wide-Ranging Wildlife Study Area |
| — Road | ▭ Telkwa Caribou Herd Regional Study Area 1 |
| — 138 kV Transmission Line | ▭ Telkwa Caribou Herd Regional Study Area 2 Core |
| — 500 kV Transmission Line | ▭ Telkwa Caribou Herd Regional Study Area 2 Matrix |
| — Watercourse | |
| — Wetland | |
| — Waterbody | |
| — Park or Protected Area | |
| — First Nation Reserve | ▭ Coastal GasLink Pipeline Ltd. |
| — Municipal Area | ▭ Pacific Northern Gas Ltd. |
| — General Private Property | ▭ Pacific Trail Pipelines Management Inc. |
| ▭ Tenas Coal Licenses | ▭ Telkwa to Smithers Bike Trail |
| ▭ Telkwa Coal Limited Private Property | ▭ Hudson Bay Mountain Resort Tenure |
| | ▭ Mining Leases |

Notes

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

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base



NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

20P0172	Production Date: Jul 27, 2021	Figure 6.1-1
---------	-------------------------------	--------------

TELKWA COAL
LIMITED

EDI
ENVIRONMENTAL DESIGN INC.

6.2 Additional Mitigation Measures

Additional mitigation measures to those considered in the assessment of Project-related effects (**5.3 Mitigation Measures**) are not considered to be necessary to avoid or minimize the predicted cumulative effects on the Wildlife VC and its subcomponents. It is assumed that the current and future projects and activities include appropriate environmental protection measures as required by laws and regulations, and will comply with the goals and objectives of the following documents, as appropriate:

- ▶ Bulkley Land and Resource Management Plan (GovBC 1998);
- ▶ Telkwa Land Use Plan (GovBC 1999);
- ▶ Morice Land and Resource Management Plan (GovBC 2007);
- ▶ Bulkley Valley Sustainable Resource Management Plan (BC MAL 2005);
- ▶ Biodiversity Guidebook (BC MOF 1995);
- ▶ Landscape Unit Planning Guide (BC MOF and BC MELP 1999);
- ▶ *Forest and Range Practices Act*, SBC 2002, c 69 (GovBC 2002b) (*FRPA*) and associated Regulations;
- ▶ Riparian Management Area Guidebook (GovBC 1995); and
- ▶ *Riparian Areas Protection Act*, SBC 1997, c 21 (GovBC 1997) and associated Regulations.

Implementation of the BMPs and mitigation strategies within these documents is expected to reduce the potential for cumulative effects on the Wildlife VC.

6.3 Cumulative Effects Characterisation of Significance

6.3.1 Furbearers Subcomponent

The interactions between the predicted Project residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**) were reviewed to determine potential cumulative effects on Furbearers. The CEA was conducted qualitatively based on the available information, as spatial information is not available for future projects and activities or their potential residual effects.

Residual effects on the Furbearers subcomponent resulting from the Project relative to the baseline conditions were identified and assessed as **Not Significant** in **5.4.2**. Historic and ongoing disturbances, in combination with the residual effects of the Project and from reasonably foreseeable projects and activities are expected to act cumulatively to affect Furbearers in the WCESA through the alteration and/or loss of habitat, changes in mortality, and changes in movement patterns. Most of the reasonably foreseeable projects and activities identified in **Table 6.1-1** are expected to have residual effects that interact cumulatively with the Project effects of alteration and/or loss of habitat, change in mortality, and change in movement patterns.

Cumulative effects on Furbearers have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of Effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.1.1 *Alteration and/or Loss of Habitat*

The CEA of the alteration and/or loss of habitat residual effect on Furbearers considers the direct loss of habitat and the indirect alteration of habitat which is caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. It determines if the Project-related residual effect interacts with the residual effects of other past, current, or reasonably foreseeable projects and activities in the WCESA. As described in 5.4.2, existing habitat disturbances due to past and ongoing anthropogenic development and natural disturbances have altered the WCESA resulting in the current amount and condition of the habitat. The cumulative effect characteristics for alteration and/or loss of habitat on Furbearers are summarized below and provided in **Table 6.3-1**.

While the amount of vegetation clearing required for most of the past, current, and reasonably foreseeable projects and activities is unknown, it is anticipated that some alteration and/or loss of habitat will occur. These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are considered effective at maintaining habitat within the range of natural variability and management guidelines. Due to the spatial and temporal uncertainty, the amount of habitat alteration and/or loss at any point in time is unknown; however, it is expected that the amount will be within management guidelines and therefore the Magnitude is predicted to be Low.

Past, current, and reasonably foreseeable projects and activities that may interact with the residual effects of the Project are located throughout the WCESA. Therefore, the cumulative effect of the alteration and/or loss of habitat is predicted to be Regional in Geographic Extent.

Regenerating stands following vegetation clearing, forest harvesting, and/or reclaimed areas are anticipated to become suitable Furbearer habitat after 50 years. Progressive revegetation may occur in some parts of the Project Area during the Construction Phase; however, most revegetation is anticipated to occur following the end of the Operation Phase. As a result, it is anticipated that interactions between the residual effects from past, current, and reasonably foreseeable projects and activities and the residual effects of the Project will continue to occur beyond the life of the Project (i.e., >52 years). Therefore, the cumulative effect is expected to be Long-term in Duration.

Habitat loss as the result of vegetation clearing for the Project and other past, current and reasonably foreseeable projects and activities is anticipated to be Infrequent (i.e., timber harvest will occur as a one (1)-time event at any one location); however, sensory disturbances are likely to occur regularly resulting in the Frequent alteration of habitat.

It is anticipated that most cleared vegetation as the result of the Project and other past, current, or reasonably foreseeable project or activity will be allowed to regenerate upon completion. The Project Area is therefore expected to return to near-baseline conditions, similar to the future state of the areas of other projects and activities that operate within the WCESA. As a result, the cumulative effect is considered Fully Reversible.

Suitable Furbearer habitat can be reasonably resilient to stress and regenerate; however, the regeneration of cleared vegetation into suitable Furbearer habitat may take 50 years after a disturbance. In addition, the variability in natural disturbances (e.g., insect outbreaks) within the WCESA are expected to increase in frequency. Therefore, a Moderate rating is predicted for the Context of cumulative alteration and/or loss of habitat.

The Project and other past, current, and reasonably foreseeable projects and activities have required or are anticipated to require vegetation clearing and cause sensory disturbances. Therefore, it is Likely to result in the cumulative alteration and/or loss of habitat.

It is not expected that the cumulative alteration and/or loss of habitat will alter the integrity of Furbearer habitat within the WCESA to the point where it is not sustainable or available to contribute to ecological function. Therefore, the cumulative effect of alteration and/or loss of habitat on Furbearers is predicted to be **Not Significant**.

While the direct effects of habitat loss are relatively well known, uncertainty exists with respect to the extent and degree of habitat alteration resulting from sensory disturbances, habitat fragmentation, and the regeneration of reclaimed areas into suitable habitat. Therefore, the Level of Confidence for the cumulative effect is Moderate.

6.3.1.2 *Change in Mortality*

The assessment of the cumulative effect of change in mortality on Furbearers considers potential sources of mortality from direct interactions and potential effects stemming from landscape changes that could affect indirect mortality. The cumulative change in mortality characteristics for Furbearers are summarized below and provided in **Table 6.3-1**.

Past, current, and reasonably foreseeable projects and activities have the potential to result in a change in mortality through increased vehicle activity (i.e., vehicle collisions) and ease of access (i.e., trapping). These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are effective at maintaining mortality within the range of natural variability and management guidelines. Therefore, the Magnitude of the change in Furbearer mortality from the Project's residual effects interacting cumulatively with the residual effects from other projects and activities is assessed as Low.

Reasonably foreseeable projects and activities that may interact cumulatively with the Project's residual effects are located throughout the WRSA. Therefore, the cumulative effect of the change in mortality is predicted to be Regional in Geographic Extent.

It is anticipated that interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities will not continue to occur beyond the life of the Project (i.e., <52 years). Therefore, the cumulative effect is expected to be Medium-term in Duration.

Vehicle traffic from projects and activities occurs most regularly along the major transportation routes (e.g., Highway 16) and in urban areas, but is less frequent along FSRs which are typically closer to suitable Furbearer habitat. Vehicle collisions are expected to be more likely to occur where roads are near or intersect suitable Furbearer habitat. Due to the lower volume of vehicle traffic on roads that are closer to Furbearer habitat, it is anticipated that the potential for cumulative Furbearer mortality will be Infrequent.

The residual effects of the Project are anticipated to revert to baseline conditions upon completion, and as a result, interactions with the residual effects of past, current, and reasonably foreseeable projects and activities will end. Therefore, the cumulative effect is considered Fully Reversible.

It is anticipated that the Project's residual effects interacting with residual effects of past, current, and reasonably foreseeable projects and activities will be Fully Reversible. The Project's potential for a change in direct mortality is anticipated to end by the end of the Decommissioning and Reclamation Phase and the change in indirect mortality is expected to be reversed after Post-closure. Furbearer populations in BC are considered stable (e.g., American marten, wolverine) or declining (e.g., fisher), but are also both provincially (e.g., fisher, wolverine) and federally (e.g., wolverine) listed. As a result, and considering the stability, abundance, and resiliency of each representative species, the cumulative effect is predicted to have a Moderate Context for a change in mortality.

Residual effects from past, current, and reasonably foreseeable projects and activities (i.e., increased vehicle traffic, environmental contamination, and trapping) are anticipated to interact with the Project's residual effects and result in a Likely change in mortality for Furbearers.

It is not expected that a cumulative change in mortality will alter the integrity of Furbearer populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The direct effects of change in mortality are well known and direct and indirect mortality is expected to remain within the range of natural variability; however, the effectiveness of mitigation measures have not been proven on past projects. Therefore, the Level of Confidence for the CEA is Moderate.

6.3.1.3 *Change in Movement Patterns*

The CEA of change in movement on Furbearers considers potential barriers, either real or perceived that may influence Furbearer movements. The cumulative effect characteristics for change in movement patterns on Furbearers are summarized below and provided in **Table 6.3-1**.

Furbearers (i.e., wolverine) are anticipated to have minimal contact with most projects and activities due to their preference for higher elevation habitat and their avoidance of anthropogenic disturbance (i.e., most projects and activities will occur within or adjacent to previously disturbed areas). In addition, it is expected that approved projects and activities will follow relevant mitigation measures, BMPs, regulations, and legislation that are anticipated to reduce changes to Furbearer movement patterns. Therefore, the Magnitude for a cumulative change in movement patterns is assessed as Low.

Interactions between the Project's residual effects, and the residual effects of past, current, and reasonably foreseeable projects and activities are located throughout the WRSA. Therefore, the cumulative effect of the change in movement patterns is predicted to be Regional in Geographic Extent.

It is anticipated that interactions between residual effects of past, current, and reasonably foreseeable projects and activities and the Project's residual effects will end after Post-closure (i.e., <52 years). Therefore, the Duration for changes in movement patterns is expected to be Medium-term.

Sensory disturbances (e.g., human presence, vehicle traffic, blasting) can result in changes to Furbearer movement patterns. It is expected that sensory disturbances will occur with regularity for the life of the Project and are anticipated to interact with the residual effects of past, current, and reasonably foreseeable projects and activities and are therefore assessed as being Frequent.

The Project Area is expected to revert to baseline conditions following Post-closure and will not continue to have residual effects that interact with the residual effects of past, current, and reasonably foreseeable projects and activities. Therefore, the Reversibility of cumulative changes in movement patterns is considered Fully Reversible.

Wolverine was selected as a representative Furbearer species in the assessment for a change in movement. Increased anthropogenic presence (e.g., road density) is associated with avoidance or reduced use of habitat by wolverines. The Project and most past, current, and reasonably foreseeable projects and activities are anticipated to occur at lower to mid-elevations where anthropogenic disturbances are already present, and as a result wolverine use and movement across higher elevation areas are not anticipated to change. Therefore, a Moderate rating is predicted for the Context of a cumulative change in movement patterns.

The residual effects of the Project and the residual effects of other past, current, and reasonably foreseeable projects and activities are anticipated to interact and cause sensory disturbances and are Likely to result in a change in Furbearer movement patterns.

It is not expected that a cumulative change in movement patterns will alter the integrity of Furbearer populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The effects of the interactions between the Project's residual effects and the residual effects of other past, current, and reasonably foreseeable projects and activities (e.g., sensory disturbances, forest harvesting, transportation activities) on changes in movement patterns are reasonably well understood and mitigation measures have proven effective for similar species. However, the cumulative effect of anthropogenic activities remain poorly understood. Therefore, the Level of Confidence of the prediction of a cumulative change in movement patterns is Moderate.

6.3.1.4 Summary

The CEA process identified the following potential residual effects of the Project on the Furbearer subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effects due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Furbearer subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-1: Summary of Cumulative Effects on Furbearers Subcomponent

Cumulative Effects	Contributing Activities* within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	LT	FF	FR	M	L	NS	M
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	IF	FR	M	L	NS	M
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.2 Caribou Subcomponent

The interactions between the predicted Project residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**) were reviewed to determine potential cumulative effects on Caribou. The CEA was conducted qualitatively based on the available information. Spatial information was not available for reasonably foreseeable future projects and activities including their potential residual effects.

Residual effects on the Caribou subcomponent resulting from the Project relative to the baseline condition were identified and assessed as **Not Significant** in **5.4.3**. Residual effects stemming from past, current, and reasonably foreseeable projects and activities may act cumulatively with the residual effects of the Project to affect Caribou in the WRSA through the alteration and/or loss of habitat, changes in mortality, and changes in movement patterns. These cumulative effects on Caribou have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, Likelihood, Significance and Confidence. Characterisation criteria and Significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.2.1 Alteration and/or Loss of Habitat

The CEA of the alteration and/or loss of habitat residual effect on Caribou considers the direct loss of habitat and the indirect alteration of habitat which is caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. It determines if the Project-related residual effect interacts with the residual effects of other past, current, or reasonably foreseeable projects and activities in the WRSA.

As described in **5.4.3**, existing habitat disturbances due to past and ongoing anthropogenic development and natural disturbances have altered the WRSA (consisting of the Project Area, WLSA, CRSA1, CRSA2 Core, and CRSA2 Matrix for the Caribou subcomponent) resulting in currently existing alteration and/or loss of habitat. The combined anthropogenic and natural disturbances were used to assess existing Caribou habitat disturbance based on observed Caribou population trends for herds across Canada showing that most Caribou subpopulations whose ranges were >35% disturbed were reported to be declining (Environment Canada 2012). The existing habitat disturbance was assessed as 100% for the Project Area, 90.11% for the WLSA, 48.35% for the CRSA1, 22.89% for the CRSA2 Core, and 58.65% for the CRSA2 Matrix, indicating that the existing disturbance (without the Project) already exceeds the 35% threshold recommended in the 2014 Recovery Strategy (Environment Canada 2014) in the Project Area, WLSA, CRSA1, and CRSA2 Matrix, but remains below the threshold at the scale of the CRSA2 Core.

The Project is not predicted to add any new disturbance (i.e., habitat loss and/or alteration of habitat) to the CRSA2 Core, and it is expected to increase the existing habitat disturbance (through sensory disturbance) in the other areas comprising the WRSA for Caribou minimally – by 0.047% in the WLSA, 0.012% in the CRSA1, and 0.005% in the CRSA2 Matrix. However, spatially overlapping ongoing and reasonably foreseeable future projects and activities are expected to result in additional habitat disturbance and thus, may cumulatively interact with the Project residual effect. This could result in increased levels of habitat disturbance and result in an exceedance of the recommended disturbance threshold of 35% in areas that are currently below the threshold. While there are several current and reasonably foreseeable projects and activities located within the Caribou study areas (as depicted on **Figure 6.1-1**), none of these developments occur or are planned close to the current range of the Telkwa Caribou Herd that currently resides year-round in subalpine and alpine habitat types (**4.2.2**).

Forest fires have occurred in the past and may happen in the future in the Telkwa Caribou Herd range contributing to habitat disturbance in addition to that caused by other projects and activities. However,

disturbance threshold analyses by Environment Canada (2014) concluded that anthropogenic disturbances had a greater effect than natural disturbance on the reduced probability of persistence at the Caribou subpopulation scale. Therefore, this CEA considers anthropogenic disturbances stemming from past, present and reasonably foreseeable future project and activities.

The cumulative effect characteristics for alteration and/or loss of habitat on Caribou are summarized below and provided in **Table 6.3-2**.

The Magnitude of the cumulative effect of alteration and/or loss of Caribou habitat resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be Low. The disturbance model indicated that the Project is expected to cause no change in the existing disturbance within the Project Area, and it is predicted that the Project will result in minimal to no changes in disturbance at the scale of the other Caribou study areas. Residual effects stemming from current and reasonably foreseeable projects and activities may add cumulatively to the habitat disturbance in the WRSA; however, the current range of the Telkwa Caribou Herd is predicted to not overlap with these projects and activities as the Caribou prefer alpine and subalpine habitat types.

The cumulative effect of alteration and/or loss of Caribou habitat resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be of Regional Geographic Extent, based on the resulting indirect effects through sensory disturbance possibly occurring in most regional Caribou study areas that comprise the WRSA.

The cumulative effect of alteration and/or loss of Caribou habitat resulting from the Project's residual effect interacting with residual effects from other projects and activities is expected to be of Medium-term Duration. Noise and dust (as the main source of habitat alteration through sensory disturbance) emitted from the Project and other projects and activities operating in the WRSA may act cumulatively. Once the Operation Phase of the Project is complete, sensory disturbance emitted from the Project Area is expected to diminish and is unlikely to act cumulatively with other noise and dust sources. While the reclamation of the Project Area will eventually (i.e., in the Long-term) create potential Caribou habitat (if the area remains undisturbed by other human development), it is expected that these reclaimed areas will remain functionally unavailable to the Telkwa Caribou Herd.

The Frequency of cumulative alteration and/or loss of Caribou habitat resulting from the Project's residual effect interacting with residual effects from other projects and activities is expected to be Frequent. Sensory disturbance, primarily through noise and dustfall emitted from other projects and activities in addition to those stemming from the Project is predicted to affect portions of the WRSA.

The effect of alteration and/or loss of Caribou habitat resulting from the Project's residual effect interacting with residual effects from other projects and activities is anticipated to be Fully Reversible. The Project Area is expected to be returned to near-baseline conditions, similar to the future state of the areas where other projects and activities will operate within the WRSA. In addition to the removal of project components and infrastructure, the anticipated reduction in project-related human activities at the end of projects' operations will likely reduce sensory disturbance. As such, any cumulative effect on Caribou habitat through sensory disturbance stemming from the Project and other projects and activities in the WRSA is expected to be fully reversed upon their closure.

The Context of alteration and/or loss of Caribou habitat resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be High. Changes to Caribou habitat are assumed to be the primary cause of Caribou population declines across Canada and the state of habitat disturbance within the WRSA indicates that the region has already experienced substantial alteration and loss of Caribou habitat in the past. Disturbance models showed that

most of the Caribou study areas (included in the WRSA) currently exceed the disturbance threshold (i.e., 35%), indicating that the Telkwa Caribou Herd is in the high-risk category, where the population is unlikely to be self-sustaining (Environment Canada 2011). This threshold has already been reached in most Caribou study areas without the Project or other reasonably foreseeable projects or activities being approved and developed. The current state of the modelled habitat disturbance, the small size of the Telkwa Caribou Herd, and their provincial and federal conservation status support the High Context rating.

It is predicted that the Project's residual effects interacting cumulatively with residual effects from other projects and activities will Likely contribute to the alteration and/or loss of Caribou habitat, even if the resulting change is minimal. Activities in the Project Area and the operations areas of other projects and activities are expected to cumulatively affect habitat in the WRSA through sensory disturbances.

The interaction of the Telkwa Caribou Herd with the Project is limited to sporadic historical interactions within the southern portion of the WLSA and the residual effects of the Project are expected to result in minimal additional disturbances of Caribou habitat in the WRSA. While other past, current and reasonably foreseeable future projects and activities are likely to affect Caribou habitat (through sensory disturbances) in the WRSA, most of the WRSA is not currently used by the Telkwa Caribou Herd. The one study area that best describes the current range of the herd, is the CRSA2 Core with a disturbance level of 22.89% and the addition of the Project is predicted to not add any new disturbance (both in the form of habitat alteration and habitat loss) (**Table 5.4-6**). The disturbed area within the CRSA2 Core does not exceed the recommended 35% total disturbance (Environment Canada 2014), and the addition of the Project will not result in an exceedance, leaving the total disturbance at 22.89%. Considering the current, well documented distribution and habitat use of the Telkwa Caribou Herd, which is limited to the CRSA2 Core, the Project's contribution to cumulative effects is predicted to be **Not Significant**.

The Level of Confidence of this prediction is High. The effects of habitat loss and/or alteration on Caribou are well known and information is available for the Telkwa Caribou Herd. Existing models and analyses describe current levels of habitat disturbance and Caribou distribution supporting the predictions of cumulative effects on the Telkwa Caribou Herd.

6.3.2.2 *Change in Mortality*

The assessment of the cumulative effect of change in mortality on Caribou considers potential sources of mortality from direct interactions and potential effects stemming from landscape changes that could affect indirect mortality from predation. It determines if the Project-related residual effect interacts with the residual effects of other past, current, or reasonably foreseeable projects and activities in the WRSA. Direct mortality stemming from the Project and other projects and activities could result from vehicle or train collisions with Caribou, or Caribou getting injured when travelling through areas where activities take place. The potential for the Project to contribute cumulatively to direct mortality of Caribou is considered low because the Project Area does not overlap with habitat types selected by Caribou and is already entirely disturbed by previous developments. While there are several current and reasonably foreseeable projects and activities located within the Caribou study areas (as depicted on **Figure 6.1-1**), none of these developments occur or are planned close to the current range of the Telkwa Caribou Herd that resides year-round in subalpine and alpine habitat types (**4.2.2**).

As described in **5.4.3**, indirect mortality of Caribou could occur through two (2) processes involving Caribou predation: apparent competition with more productive alternative prey species, and facilitated predation by wolves. Apparent competition occurs when the density of an alternative prey species increases so that it supports a higher density of a shared predator(s) which increases predation on the other prey species. Facilitated predation occurs with the development, maintenance, and/or use of roads and trails that provide easier movement for predators across the landscape. The potential for the Project to indirectly affect

Caribou mortality through apparent competition is limited during Construction, and Operation phases when human activity is more likely to deter alternative prey and predators away from the Project Area. However, during the Decommissioning and Reclamation, and Post-closure phases, the Project Area is expected to temporarily create habitat that could locally support higher densities of alternative prey species, potentially increasing predator density in the region. Similarly, the potential for the Project to indirectly affect Caribou mortality through facilitated predation through the construction and maintenance of roads and trails is unlikely to occur during the Construction, and Operation phases because wolves are more likely to avoid the Project Area due to increased levels of human activity. During the Decommissioning and Reclamation, and Post-closure phases, human activity within the Project Area will likely be reduced and wolves could start using the roads and trails within the Project Area to move more efficiently through the area and potentially access parts of the Telkwa Caribou Herd range.

The cumulative effect characteristics for change in mortality on the Caribou subcomponent are summarized below and provided in **Table 6.3-2**.

While it is unlikely that the Project will result in a change of direct and indirect Caribou mortalities because the Project occurs outside of the current Caribou range, due to the small size of the Telkwa Caribou Herd, each additional death is expected to affect the herd. Therefore, any additional Caribou mortality through direct and indirect mortality, will likely affect the Telkwa Caribou Herd at the subpopulation level. Past, current, and reasonably foreseeable projects and activities have the potential to result in a change in direct and indirect Caribou mortality e.g., through increased vehicle activity and increased predation. These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are effective at maintaining mortality within the range of natural variability and management objectives. Therefore, the Magnitude resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and is assessed as Moderate.

The cumulative effect of a change in mortality resulting from the Project's residual effects interacting with residual effects from other projects and activities is predicted to be of Regional Geographic Extent. The risk of increased predation through apparent competition is expected to occur regionally because wolf home ranges may extend across the WRSA. In addition, reasonably foreseeable projects and activities are located throughout the WRSA.

The Duration of direct and indirect changes in mortality resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be of Medium-term. Direct and indirect mortality through facilitated predation is expected to be limited to the Construction, and Operation phases and after that the Project is not expected to cumulatively interact with other projects and activities. Mortality through the process of apparent competition is expected to remain until the Project Area is starting to be reclaimed and no longer has the potential to support higher densities of alternative prey. At that time, the Project is not expected to cumulatively interact with other projects and activities to affect indirect mortality.

The Frequency of direct and indirect changes in mortality resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Infrequent. Change in direct mortality due to Project activities and infrastructure could only occur when Caribou are within the Project Area, which is expected to be a rare event because the Project occurs outside of the current Telkwa Caribou Herd range. Other future projects and activities operating within the WRSA are not expected to occur within the current Caribou range. Change in indirect Caribou mortality is expected to be Infrequent as well due to the spatial separation of habitat types selected for by Caribou and the forested habitat types mostly used by their predators.

The cumulative effect of change in Caribou mortality resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is anticipated to be Fully Reversible. The potential for a change in direct mortality is anticipated to be reversed by the end of the Operation Phase and the operations of other projects and activities. Similarly, the change in indirect mortality is expected to be reversed once the Project Area and the areas of other developments operating in the WRSA are reclaimed to a state that is near baseline conditions and do not provide high quality habitat for alternative prey, and roads and trails are decommissioned and reclaimed.

The Context of change in Caribou mortality resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be High. Changes to Caribou habitat are assumed to be the primary cause of Caribou population declines across Canada; with the proximate cause of the declines believed to be predation that is facilitated by landscape changes and apparent competition with alternative prey (Festa-Bianchet et al. 2011). The Telkwa Caribou Herd has experienced considerable reductions in abundance due to predation which currently limits herd growth (Grant 2017), and a low Caribou density amplifies even small changes in mortality. Small populations are more vulnerable to random events, including temporary high predation rates (Festa-Bianchet et al. 2006), that can cause population declines. The quantity and extent of landscape disturbance and the small Telkwa Caribou Herd size support a High rating.

The Likelihood that the Project's residual effects interacting cumulatively with residual effects from other projects and activities will adversely affect direct and indirect Caribou mortality is assessed as Unlikely. The Project occurs outside of the current Telkwa Caribou Herd distribution, reducing the potential for interactions. Other future projects and activities operating in the WRSA are not expected to interact with the Caribou due to the spatial separation of the Caribou range and the forested areas where projects and activities will take place, reducing the potential for the Project's residual effects to cumulatively interact with those of future projects and activities.

The change in direct and indirect mortality resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be **Not Significant** because of the limited potential for Caribou to interact with the Project as well as the limited likelihood of other developments being constructed in the current Telkwa Caribou Herd range. The application of mitigation measures is expected to reduce the risk of direct and indirect Caribou mortality, and the residual effect of the Project on Caribou mortality is not expected to cause a change in the long-term viability of Caribou in the region. While other past, current and reasonably foreseeable future projects and activities may affect indirect Caribou mortality (through increased predation) in the WRSA, the Project's contribution to cumulative effects is predicted to be **Not Significant**.

The Level of Confidence in this prediction is High. The ecology and population trends of the Telkwa Caribou Herd are well documented and so are the processes of apparent competition and facilitated predation. Some uncertainty in the predictions exist when considering the long duration of the Project as well as residual effects from other projects and activities and, consequently, potential changes in the abundance of Telkwa Caribou during the life of the Project.

6.3.2.3 *Change in Movement Patterns*

The CEA of change in Caribou movement patterns considers the potential for barriers to be constructed that may affect Caribou movement within and between parts of the Caribous' range and selected habitat types. The CEA determines if the Project-related residual effect interacts with the residual effects of other past, current, or reasonably foreseeable projects and activities in the WRSA.

As described in **5.4.3**, Caribou movement is affected by human infrastructure through the creation of physical barriers and by reducing the likelihood of Caribou crossing the developments (e.g., because of traffic). Therefore, the greatest potential for causing a change to Caribou movement patterns are the construction of infrastructure that could act as a barrier (e.g., fencing or snowbanks along the roads) and the presence and use of infrastructure (e.g., by vehicles or trains). Analysis of movements by GPS collared Caribou indicated that Telkwa Caribou movement was mostly restricted to the alpine and subalpine habitat types (outside of the Project Area) and that only one collared Caribou may have moved slightly into the Project Area and four (4) Caribou moved into the southern portion of the WLSA. While there are several current and reasonably foreseeable projects and activities located within the Caribou study areas (as depicted on **Figure 6.1-1**), none of these developments occur or are planned close to the current range of the Telkwa Caribou Herd who are residing year-round in subalpine and alpine habitat types (**4.2.2**).

The cumulative effect characteristics for the change in Caribou movement patterns on Caribou are summarized below and provided in **Table 6.3-2**.

The Magnitude of the change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Low. Based on their current range and their preference for higher elevation habitat, the Telkwa Caribou Herd is anticipated to have minimal contact with the Project and other current and future projects and activities in the WRSA. In addition, most projects and activities will occur within or adjacent to previously disturbed areas, which are strongly avoided by the Telkwa Caribou. Similar to the proposed mitigation measures for the Project, it is expected that approved projects and activities in the WRSA will follow relevant mitigation measures, BMPs, regulations, and legislation that are anticipated to reduce effects on Caribou movement patterns.

The Geographic Extent of the change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Regional as it would happen outside their current range in other portions of the WRSA. While the Project is not expected to result in residual effects impeding movement on a regional scale, residual effects may act cumulatively with other projects and activities to affect Caribou movement patterns in the WRSA.

The cumulative effect of change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to occur over a Medium-term Duration. Caribou movement is expected to be altered due to the construction and operation of Project infrastructure. Once decommissioning has begun and infrastructure components are removed and mining activities cease, Caribou will be able to freely move through the Project Area. After operation activities have ceased, the Project is not expected to cumulatively interact with other projects and activities operating in the WRSA to affect a change in movement patterns.

The Frequency rating of the change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Infrequent. Caribou movement outside of their current range in the subalpine and alpine habitat types is expected to be a rare event based on past observations. Future projects and activities operating within the WRSA are not expected to occur within the current Caribou range and the Project would contribute to cumulative effects if Caribou were to move outside their current range during the Project's Construction, and Operation phases when infrastructure and traffic have the potential to impede the Caribous' movement.

The change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Fully Reversible. Once the Project infrastructure is decommissioned and, with that, human use of infrastructure ends, the permeability of the Project Area is expected to increase and not affect Caribou movement patterns any

longer. At that time, the Project's residual effects are not expected to interact with residual effects from other operations within the WRSA.

The Context of the change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Low. Caribou movement outside of their current range in the subalpine and alpine habitat types is expected to be a rare event and the observed lack of seasonal ranges and seasonal movements to specific habitat types indicates that there is no biological requirement to access specific areas. In addition, the Project Area occurs outside the Telkwa Caribou Herd's range and future projects and activities operating within the WRSA are not expected to occur within the current Caribou range.

The residual effect of change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be Likely. While it is anticipated, based on past observations, that few, if any, Caribou will interact with the Project, Caribou may move through the Project Area at some point during the life of the Project. In these unlikely circumstances, Project components and activities may affect their movement, especially when considering interactions with effects from other projects and activities operating in the WRSA. Consequently, the few times that Caribou may attempt to move into or through the Project Area, the Project components and/or activities in addition to those of other projects or activities will likely affect their movement patterns.

The residual effect of change in Caribou movement patterns resulting from the Project's residual effects interacting cumulatively with residual effects from other projects and activities is predicted to be **Not Significant**. The Project, interacting with other current and reasonably foreseeable projects and activities, is not expected to result in a change in Caribou movement patterns that will limit Caribou access to any part of their current range or their selected habitat types.

The Level of Confidence in this prediction is High. Caribou movement in the vicinity of the Project Area and regionally (across all Caribou study areas within the WRSA) are well documented and understood.

6.3.2.4 Additional Considerations

While the residual effects assessment and the CEA determined that the Project-related residual effects as well as the cumulative effects on the Caribou subcomponent are **Not Significant**, it is acknowledged that any potential effects on the Telkwa Caribou Herd are of concern because the population size is currently estimated to be 25 individuals (Hoffman and Grant 2019). It is recognized that, in light of the population trend and the small number of remaining Caribou, the herd is likely in peril even if future developments in the region, including the Project, do not occur. The Project interaction with the Telkwa Caribou Herd is limited to sparse, historical interaction with the southern portion of the WLSA and the effects of the Project are considered but are not expected to result in a further decline of this herd. However, the overall fate of the Telkwa Caribou Herd is likely one of continued decline, even without the Project, due to inter-related natural disturbances, such as predation, forest fires and climate change. Changes to Caribou habitat are assumed to be the ultimate cause of Caribou population declines across Canada (Festa-Bianchet et al. 2011) and most of the Caribou study areas (except for the CRSA2 Core which best describes current Caribou range) currently exceed the disturbance threshold (i.e., 35%), indicating that the Telkwa Caribou Herd is in the high-risk category, where the population is unlikely to be self-sustaining (Environment Canada 2011). Even without future anthropogenic changes to the landscape, ongoing development and natural processes (e.g., forest fires) may continuously add to Caribou habitat disturbance and thus accelerate the 35% disturbance threshold outlined in the 2014 Recovery Strategy (Environment Canada 2014) across all Caribou study areas. While the Project effects are predicted to not significantly contribute to alteration and/or loss of Caribou habitat, a change in Caribou movement patterns or a change in mortality, a

combination of past, current and future anthropogenic and natural disturbances may result in the continued decline of the Telkwa Caribou Herd.

6.3.2.5 Summary

The CEA process identified the following potential residual effects of the Project on the Caribou subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effects due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Caribou subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-2: Summary of Cumulative Effects on Caribou Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	FF	FR	H	L	NS	H
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	M	RSA	MT	IF	FR	H	L	NS	H
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	IF	FR	L	L	NS	H

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.3 Grizzly Bear Subcomponent

The interactions between the predicted Project residual effects and the residual effects of other past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**) are anticipated to interact were reviewed to determine potential cumulative effects of alteration and/or loss of habitat, changes in mortality, and changes in movement patterns on Grizzly Bears. Spatial information is not available for future projects and activities or their potential residual effects, therefore the CEA was conducted qualitatively based on the available information. Residual effects on Grizzly Bear resulting from the Project were identified and assessed as **Not Significant** in **5.4.4**. Many of the projects and activities identified in **Table 6.1-1** may interact cumulatively with the Project effects of alteration and/or loss of habitat, change in mortality, and change in movement patterns.

Cumulative effects on Grizzly Bear have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of Effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.3.1 *Alteration and/or Loss of Habitat*

The CEA of the alteration and/or loss of habitat residual effect on Grizzly Bear considers the direct loss of habitat and the indirect alteration of habitat caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. The cumulative alteration and/or loss of habitat characteristics on Grizzly Bear are summarized below and are provided in **Table 6.3-3**.

Vegetation clearing is anticipated to be required for most of the reasonably foreseeable projects and activities; however, the amount to be cleared is unknown, although it is anticipated that some alteration and/or loss of habitat will occur. These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are considered effective at maintaining habitat within the range of natural variability and management guidelines. Due to the spatial and temporal uncertainty, the amount of habitat alteration and/or loss at any point in time is unknown; however, it is expected that the amount will be within management guidelines and therefore the Magnitude is predicted to be Low.

The residual effects from the Project are expected to interact with the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

Areas cleared of vegetation can regenerate into suitable Grizzly Bear habitat over a relatively short period of time (i.e., <52 years). As a result, it is anticipated that interactions between the residual effects of the Project Area and the residual effects of past, current, and reasonably foreseeable projects and activities will be Medium-term in Duration.

Vegetation clearing for the Project and other past, current, and reasonably foreseeable projects (e.g., timber harvesting) are anticipated to occur as a one-time event at any one (1) location and is therefore predicted to be Infrequent. The alteration of habitat is predicted to be Frequent due to ongoing sensory disturbances (e.g., vehicle traffic). Therefore, the Frequency is considered Frequent.

Upon the completion of the Project and other past, current, and reasonably foreseeable projects and activities it is anticipated that most cleared vegetation will be allowed to regenerate and revert to native vegetation within the timeframe of the assessment. Therefore, the cumulative effect is considered Fully Reversible.

Suitable Grizzly Bear habitat (e.g., berry patches, riparian areas, avalanche slopes) can be resilient to stress and regenerate within 10 years of a disturbance. Natural disturbances (e.g., insect outbreaks) are expected to increase in frequency within the timeframe of the CEA and it is expected that any anthropogenic disturbances will be within natural variation. Therefore, a Moderate rating is predicted for the Context of the cumulative alteration and/or loss of habitat.

Vegetation clearing and sensory disturbances as the result of reasonably foreseeable projects and activities are predicted to Likely to result in the cumulative alteration and/or loss of habitat.

It is not expected that the cumulative effect of alteration and/or loss of habitat will alter the integrity of Grizzly Bear habitat within the WRSA to the point where it is not sustainable or available to contribute to ecological function. Therefore, the cumulative effect of the alteration and/or loss of habitat on Grizzly Bear is predicted to be **Not Significant**.

The alteration and/or loss of habitat is relatively well known and appropriate mitigation measures have proven to be effective; however, uncertainty exists with respect to the spatial and temporal nature of habitat alteration and/or loss resulting from reasonably foreseeable projects and activities. Therefore, the Level of Confidence for the cumulative effect is Moderate.

6.3.3.2 Change in Mortality

The assessment of the cumulative effect of change in Grizzly Bear mortality considers potential sources of mortality from direct interactions and potential effects stemming from landscape changes that could affect indirect mortality. The cumulative effect characteristics for change in mortality on Grizzly Bear are summarized below and provided in **Table 6.3-3**.

A change in mortality through increased vehicle activity (i.e., vehicle collisions) and ease of access (i.e., illegal hunting) may occur due to Project interactions with past, current, and reasonably foreseeable projects and activities (e.g., Coastal Gaslink, forestry). These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are considered effective at maintaining mortality within the range of natural variability and management guidelines. Therefore, the Magnitude for a cumulative change in mortality is predicted to be Low.

The residual effects from past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA are expected to interact with the residual effects of the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

It is anticipated that interactions between the Project's residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities will not occur beyond the life of the Project (i.e., <52 years). Therefore, the cumulative effect is expected to be Medium-term in Duration.

Collisions with vehicles and trains have been an occasional cause of anthropogenic mortality in the WRSA. Mortality from vehicle and train collisions have not occurred annually and are not anticipated to change over the timeframe of the assessment. Therefore, the cumulative change in mortality is predicted to be Infrequent.

The residual effects of the Project are anticipated to revert to baseline conditions upon completion, and as a result, interactions with the residual effects of past, current, and reasonable, foreseeable projects and activities will end. Therefore, the cumulative effect is considered Fully Reversible.

The estimated sustainable human-caused mortality rates for the populations within the two (2) GBPU's that overlap the WR-WRSA were within BC guideline values prior to the end of the Grizzly Bear hunt. It is not anticipated that following the end of the hunt that any change in mortality due to the reasonably foreseeable projects and activities will exceed BC's guideline values. Therefore, the Context for the cumulative change in mortality is assessed as Low.

Vehicle and train collisions that are associated with past, current, and reasonably foreseeable projects and activities are anticipated to interact with the Project's residual effects and are Likely to result in change in mortality.

It is not expected that the cumulative effect of a change in mortality will alter the integrity of Grizzly Bear populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The effect of change in mortality on Grizzly Bear populations is reasonably well known and mitigation measures have proven effective on past projects; however, the cumulative effect of reasonably foreseeable projects and activities is not well known. Therefore, the Level of Confidence for the cumulative effect assessment is Moderate.

6.3.3.3 *Change in Movement Patterns*

The assessment of the change in Grizzly Bear movement patterns considers potential barriers, either real or perceived, that may influence movements. The cumulative change in movement characteristics on Grizzly Bear are summarized below and are provided in **Table 6.3-3**.

Grizzly Bears will generally avoid areas of human activity, which has often been related to road density and vehicle traffic. It is unknown if road density or vehicle traffic will increase due to of past, current, and reasonably foreseeable projects and activities; however, it is assumed that any approved projects or activities will follow appropriate mitigation measures to minimize additional changes to Grizzly Bear movement patterns. Therefore, the Magnitude is assessed as Low.

Past, current, and reasonably foreseeable projects and activities are located throughout the WRSA and their residual effects are anticipated to interact with the residual effects of the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

The residual effects of the Project are predicted to end following Post-closure and will no longer interact with the residual effects of past, current, and reasonably foreseeable projects and activities. Therefore, the cumulative effect is expected to be Medium-term in Duration.

Changes to movement patterns are predicted to be Frequent, due to ongoing sensory disturbances (e.g., vehicle traffic) associated with the Project and other past, current, and reasonably foreseeable projects and activities.

Residual effects of the Project that may influence movement patterns across the landscape are anticipated to revert to baseline conditions upon completion of the Project and will no longer interact with the residual effects of past, current, and reasonably foreseeable projects and activities. Therefore, the Reversibility of cumulative changes in movement patterns is considered Fully Reversible.

Grizzly Bear is a provincially blue-listed species and listed as Special Concern under COSEWIC. Increased anthropogenic activity (e.g., vehicle traffic, road density) is associated with avoidance and potential changes

to movement patterns; however, they can habituate to some stresses. Therefore, a Moderate rating is predicted for Context of a cumulative change in movement.

The residual effects of past, current, and reasonably foreseeable projects and activities that may result in barriers to movement patterns are predicted to interact with the residual effects of the Project and are Likely to result in changes in movement patterns.

It is not expected that the cumulative effect of a change in movement patterns will alter the integrity of Grizzly Bear populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The affect of anthropogenic activity (e.g., vehicle activity, road density) on changes in movement patterns is reasonably well understood and mitigation measures can be effective; however, the cumulative effects of reasonably foreseeable projects and activities are not well known. Therefore, the Level of Confidence for the cumulative effect prediction is Moderate.

6.3.3.4 Summary

The CEA process identified the following potential residual effects of the Project on the Grizzly Bear subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effects due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Grizzly Bear subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-3: Summary of Cumulative Effects on Grizzly Bear Subcomponent

Cumulative Effects	Contributing Activities* within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	IF	FR	L	L	NS	M
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.4 Moose Subcomponent

The interactions between the predicted Project residual effects and the residual effects of other past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**) are anticipated to interact cumulatively. These interactions were reviewed to determine potential cumulative effects on Moose through the alteration and/or loss of habitat, changes in mortality, and changes in movement patterns. As spatial information is not available for future projects and activities or their potential residual effects, the CEA was conducted qualitatively based on the available information. Residual effects on Moose resulting from the Project were identified and assessed as **Not Significant** in **5.4.5**. Most of the reasonably foreseeable projects and activities identified in **Table 6.1-1** may interact cumulatively with the Project effects of alteration and/or loss of habitat, change in mortality, and change in movement patterns.

Cumulative effects on Moose have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of Effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.4.1 *Alteration and/or Loss of Habitat*

The assessment of the cumulative effects of the alteration and/or loss of Moose habitat residual effect considers the direct loss of habitat and the indirect alteration of habitat which is caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. It determines if the Project-related residual effect interacts with the residual effects of other past, current, or reasonably foreseeable projects and activities in the WRSA. As described in **5.4.5**, existing habitat disturbances due to past and ongoing anthropogenic development and natural disturbances have altered the WRSA resulting in the current alteration and/or loss of habitat. The cumulative effect characteristics for the alteration and/or loss of habitat on Moose are summarized below and provided in **Table 6.3-4**.

Vegetation clearing is anticipated to be required for the Project most of the past, current, and reasonably foreseeable projects and activities; however, the amount, location and timing are unknown. Forestry is expected to be responsible for most of the habitat loss and alteration within the WRSA. The spatial and temporal nature of timber harvesting are unknown, but it is anticipated that all future forestry will be conducted with consideration of provincial and regional management guidelines (e.g., Bulkley Land and Resource Management Plan [GovBC 1998], Telkwa Landscape Unit Plan [GovBC 1999], Bulkley Valley Sustainable Resource Management Plan [BC MAL 2005]). Despite the spatial and temporal uncertainty, it is expected that the amount of timber harvested at any point in time will be within management guidelines. Therefore, the Magnitude is predicted to be Low.

The residual effects of the Project are expected to interact with the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the cumulative effect of the alteration and/or loss of habitat is predicted to be Regional in Geographic Extent.

The residual effects of the Project are expected to end following Post-closure and will cease to interact with the residual effects of other past, current, and reasonably foreseeable projects and activities. Therefore, the cumulative effect is expected to be Medium-term in Duration.

The Project and other past, current, and reasonably foreseeable projects and activities that are anticipated to require vegetation clearing (e.g., timber harvesting) are anticipated to occur as one (1)-time events at a location and habitat loss is therefore predicted to be Infrequent. Sensory disturbances (e.g., vehicle traffic) associated with reasonably foreseeable projects and activities may result in the ongoing alteration of habitat, and the cumulative effect is therefore predicted to be Frequent.

The residual effects from past, current, and reasonably foreseeable projects and activities (e.g., Bulbous Toe Project, urban development) that may result in the alteration and/or loss of habitat are expected to interact with the Project's residual effects; however, these are expected to end following the Post-closure Phase. Therefore, the Reversibility of the cumulative effect is considered Fully Reversible.

Suitable Moose habitat can be reasonably resilient to stress and regenerate within 10 years of a disturbance (e.g., vegetation clearing, forest fire); however, the variability in natural disturbances (e.g., insect outbreaks) within the WRSA is expected increase in frequency. Therefore, a Moderate rating is predicted for the Context of the cumulative alteration and/or loss of habitat.

Vegetation clearing and sensory disturbances as the result of the Project and past, current, and reasonably foreseeable projects and activities are Likely to result in the cumulative alteration and/or loss of habitat.

It is not expected that the cumulative effect of the alteration and/or loss of habitat will alter the integrity of Moose habitat within the WRSA to the point where it is not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

Cumulative habitat loss, mostly due to forestry, can be estimated over the timeframe of the assessment; however, the spatial and temporal nature of the harvesting is unknown. In addition, the amount of habitat alteration through sensory disturbances, habitat fragmentation, and revegetation of previously cleared areas is also uncertain. As a result, the Level of Confidence of the prediction for the cumulative effect of the alteration and/or loss of habitat is Low.

6.3.4.2 Change in Mortality

The assessment of the cumulative effect of change in Moose mortality considers potential direct and indirect effects on Moose mortality. The cumulative change in mortality characteristics on Moose are summarized below and are provided in **Table 6.3-4**.

Approved projects and activities have the potential to result in a change in mortality through increased vehicle activity (i.e., vehicle collisions) and ease of access (i.e., hunting). These projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are considered effective at maintaining mortality within the range of natural variability and management guidelines. Therefore, it is anticipated that the Magnitude for a cumulative change in mortality will be Low.

The Project's residual effects may interact with the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the cumulative effect is predicted to be Regional in Geographic Extent.

It is expected that the interactions between the residual effects of the Project with the residual effects of past, current, and reasonably foreseeable projects and activities will cease following the end of the Project. Therefore, the cumulative effect is expected to be Medium-term in Duration.

Collisions with vehicles and trains have been a cause of anthropogenic mortality in the WRSA. The frequency of collision mortality is not anticipated to change over the timeframe of the assessment, therefore, the cumulative change in mortality is predicted to be Infrequent.

The residual effects of the Project are anticipated to revert to baseline conditions upon completion, and as a result, interactions with the residual effects of past, current, and reasonable, foreseeable projects and activities. Therefore, the cumulative effect is considered Fully Reversible.

Moose populations in the game management unit overlapping with the Project suggest a declining population between 2006 to 2015; however, population estimates within the Bulkley Valley suggest continuing variability in the population since 1992 (Kuzyk et al. 2018). Therefore, the cumulative effect of change in mortality is predicted to have a Moderate Context.

The Project and other past, current, and reasonably foreseeable projects and activities are anticipated to require vehicle and train activity, and this may result in vehicle and train collisions. Therefore, it is predicted that it is Likely to result in a cumulative change in mortality.

It is not expected that the cumulative effect of a change in mortality will alter the integrity of Moose populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function of the population. Therefore, the cumulative effect is predicted to be **Not Significant**.

Moose mortality may change due to reasonably foreseeable projects and activities; however, Moose populations can be resilient to additional mortality, mitigation measures have been proven to be effective, and there has been considerable natural variation in the Bulkley Valley Moose population over several decades. Therefore, the Confidence of the residual effect considered the uncertainty related to Moose population characteristics to predict a Moderate rating.

6.3.4.3 Change in Movement Patterns

The CEA of change in Moose movement patterns considers potential barriers, either real or perceived that may result in altered Moose movements. The cumulative effect characteristics for change in movement patterns on Moose are summarized below and provided in **Table 6.3-4**.

The Project and other past, current, and reasonably foreseeable projects and activities are expected to result in anthropogenic disturbances that can cause changes to movement patterns. Approved projects are anticipated to minimize these changes by employing suitable mitigation measures. In addition, it is expected that approved projects and activities will follow relevant BMPs, regulations, and legislation to reduce changes in movement patterns with within natural variation. As a result, it is expected that cumulative changes in movement patterns will have a Low Magnitude.

Interactions may occur between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the cumulative effect of the change in movement patterns is predicted to be Regional in Geographic Extent.

Interactions between residual effects of past, current, and reasonably foreseeable projects and activities and the residual effects of the Project are expected to end after Post-closure. Therefore, the cumulative effect is expected to be Medium-term in Duration.

Sensory disturbances (e.g., vehicle traffic) from the Project are expected to occur on a regular basis for the life of the Project. These are anticipated to interact with regularly occurring sensory disturbances from past, current, and reasonably foreseeable projects and activities and may result in ongoing changes in movement patterns. Therefore, the cumulative effect is predicted to be Frequent.

Interactions between the residual effects of the Project and the residual effects from past, current, and reasonably foreseeable projects and activities (e.g., forestry, urban development) that may affect changes in movement patterns are expected to end following the Post-closure Phase. Therefore, the Reversibility of the cumulative effect is considered Fully Reversible.

Anthropogenic activity (e.g., vehicle traffic, human presence) may be perceived by Moose as comparable to predation risk and cause avoidance or reduced use. Forest service roads are prevalent across the WRSA and are anticipated to be used by reasonably foreseeable projects and activities and result in changes to Moose movement patterns; however, it is not anticipated that traffic volumes will increase to the point where they will restrict movement across the WRSA. The reduction in forest cover within the WRSA due to the natural disturbances (e.g., mountain pine beetle) are thought to make movement across the landscape more difficult (Kuzyk and Heard 2014, Kuzyk et al. 2018). Projected forest losses are expected to continue to increase through to 2024 (BC MFLNRO 2015b). It is anticipated that natural disturbances will increase the variability in Moose movement across the landscape, and as a result the Context of the cumulative effect is predicted to be Moderate.

Vegetation clearing and sensory disturbances are Likely to result in a cumulative change in movement patterns due to the interactions between the residual effects of the Project and past, current, and reasonably foreseeable projects and activities.

It is not expected that the cumulative effect of change in movement patterns will alter the integrity of Moose habitat or populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function of the population. Therefore, the cumulative effect is predicted to be **Not Significant**.

Moose can be adaptable and resilient to disturbances in the environment when appropriate mitigation strategies are employed. It is expected that anthropogenic activity (e.g., sensory disturbances, forest harvesting, transportation activities) will result in predictable changes in Moose movement patterns that can be minimized by the employment of appropriate mitigation measures. Therefore, the Level of Confidence of the assessment is Moderate.

6.3.4.4 Summary

The CEA process identified the following potential residual effects of the Project on the Moose subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effects due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Moose subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-4: Summary of Cumulative Effects on Moose Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	L
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	IF	FR	M	L	NS	M
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.2-1 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.5 Bats Subcomponent

Residual effects on Bats resulting from the Project were identified and assessed as **Not Significant** in **5.4.6**; however, the interactions between the predicted Project residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**) were assessed to determine the potential cumulative effects on Bats. These interactions may cumulatively affect the alteration and/or loss of habitat, changes in mortality, and changes in movement patterns of Bats. The CEA was conducted qualitatively based on the available information, as spatial information is not available for future projects and activities or their potential residual effects. Most of the past, current, and reasonably foreseeable projects and activities identified in **Table 6.1-1** may result in residual effects that interact cumulatively with the Project residual effects.

Cumulative effects on Bats have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of Effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.5.1 *Alteration and/or Loss of Habitat*

The CEA of the alteration and/or loss of Bat habitat considers the direct loss of habitat and the indirect alteration of habitat which is caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. The cumulative alteration and/or loss of habitat characteristics on Bats are summarised below and provided in **Table 6.3-5**.

Many of the past, current, and reasonably foreseeable projects and activities have or are anticipated to require vegetation clearing in addition to the vegetation clearing required for the Project. Although the amount required to be cleared is unknown, it is anticipated that some alteration and/or loss of habitat will occur. Habitat alteration (i.e., due to sensory disturbances and habitat fragmentation) is also anticipated to occur due to the Project and interactions with those residual effects of past, current, and reasonably foreseeable future projects. Forestry is expected to be responsible for most of the habitat loss and alteration within the WRSA. The spatial and temporal nature of forestry activities are unknown, but it is anticipated that all future forestry will be conducted with consideration of provincial and regional management guidelines (e.g., Bulkley Land and Resource Management Plan [GovBC 1998], Telkwa Landscape Unit Plan [GovBC 1999], Bulkley Valley Sustainable Resource Management Plan [BC MAL 2005]). Due to the spatial and temporal uncertainty, the amount of habitat alteration and/or loss at any point in time is unknown; however, it is expected that the amount will be within management guidelines and therefore the Magnitude is predicted to be Low.

The Project's residual effects are expected to interact with the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

The regeneration of suitable Bat habitat typically requires a relatively long time (i.e., >52 years) following a disturbance and the alteration of Bat habitat typically ends after the cessation of the disturbance. The alteration of habitat (i.e., through sensory disturbances) by the Project is anticipated to end following the Post-closure Phase, and interactions with past, current, and reasonably foreseeable projects and activities will cease. Cleared vegetation due to the Project or past, current, and reasonably foreseeable projects and activities are anticipated to regenerate; however, due to the time required to regenerate it is expected that the Duration of the cumulative effect will be Long-term.

Vegetation clearing for the Project and past, current, and reasonably foreseeable projects and activities are anticipated to occur as a one (1)-time event at any one location and is therefore predicted to be Infrequent. The alteration of habitat is predicted to be Frequent due to ongoing sensory disturbances (e.g., vehicle traffic) associated with the Project and past, current, and reasonably foreseeable projects and activities. Therefore, the Frequency of the cumulative effect is predicted to be Frequent.

Upon the completion of the Project, it is anticipated that the cleared vegetation will be allowed to regenerate and interactions with past, current, and reasonably foreseeable projects and activities will end. Therefore, the cumulative alteration and/or loss of habitat is considered Fully Reversible.

Habitat for some Bat species can be resilient to change; however, other species have more specialized habitat requirements. It is therefore expected that the cumulative alteration and/or loss of habitat at any point in time will be within natural variation and the Context is predicted to be Moderate.

It is predicted that vegetation clearing and sensory disturbances as the result of the Project and reasonably foreseeable projects and activities are Likely to result in the cumulative alteration and/or loss of habitat.

The alteration and/or loss of habitat is predicted to not alter the integrity of Bat habitat within the WRSA to the point where it is not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The direct effects of habitat loss are relatively well known; however, it is unknown if habitat features (e.g., hibernacula, maternity roosts) may be lost or affected due to vegetation clearing or sensory disturbances. Uncertainty also exists with respect to the extent that suitable Bat habitat may be altered (e.g., sensory disturbances, fragmentation, perceived barriers). Therefore, the Level of Confidence of this assessment is Moderate.

6.3.5.2 *Change in Mortality*

The assessment of the cumulative effect of a change in Bat mortality considers potential sources of direct mortality and potential effects stemming from landscape and other changes that could affect indirect mortality. The cumulative change in mortality characteristics on Bats are summarised below and provided in **Table 6.3-5**.

A change in mortality through increased vehicle activity (i.e., vehicle collisions) and vegetation clearing (i.e., mortality of individuals roosting in harvested trees) may occur due to the Project and past, current, and reasonably foreseeable projects and activities (e.g., forestry, Pacific Trails Pipeline). Projects and activities are expected to follow mitigation measures, BMPs, and relevant regulations and legislation that are effective at maintaining mortality within the range of natural variability. Therefore, the Magnitude for a change in mortality is predicted to be Low.

The residual effects from past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA are expected to interact with residual effects of the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

Interactions between the Project's residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities are not expected occur beyond the life of the Project (i.e., <52 years). Therefore, the cumulative effect is expected to be Medium-term in Duration.

Collisions with vehicles are considered the most likely cause of mortality from the Project and past, current, and reasonably foreseeable projects and activities, although some mortality may result from vegetation

clearing. The frequency of mortality is unknown, but research suggests it is often local, site specific factors can increase its frequency, and most mortality would occur from April through October. Therefore, the Frequency is predicted to be Infrequent.

Changes in mortality are anticipated to revert to baseline conditions upon completion of the Project and other past, current, and reasonably foreseeable projects and activities. Therefore, the cumulative change in mortality is predicted to be Fully Reversible.

Bat populations in BC are thought to be stable or their population trend is unknown (BC CDC 2015b, c). Northern myotis is a provincially blue-listed species and both species are listed as Endangered under SARA due to population crashes related to white nose syndrome which is spreading further west. As a result, the Context of the cumulative effect is a Moderate rating.

It is Likely that a cumulative change in mortality will result due to interactions between the Project's residual effects and the residual effects from past, current, and reasonably foreseeable projects and activities.

The cumulative effect of a change in mortality is not expected to alter the integrity of Bat populations within the WRSA to the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be Not Significant.

The effect of change in mortality is reasonably well known is expected to remain within the range of natural variability; however, the effectiveness of mitigation measures have not been proven on past projects and the population status of Bats in the region is unknown. Therefore, the prediction has a Moderate Confidence.

6.3.5.3 *Change in Movement Patterns*

The CEA of the change in movement for Bats considers any potential barriers, either real or perceived that may influence Bat movement patterns. The cumulative effect characteristics for change in movement patterns on Bats are summarised below and provided in **Table 6.3-5**.

Forest cover within the WRSA has been altered and reduced (i.e., creating natural forest gaps) following the mountain pine and spruce beetle outbreaks, and therefore the natural variability in Bat movement patterns is expected to have increased. Mitigation measures can be effective at minimizing the effects of a project or activity on Bat movement patterns. It is expected that projects and activities will follow mitigation measures, BMPs, and relevant regulations and legislation that are considered effective at maintaining changes in movement patterns to the range of natural variability. As a result, the Magnitude of the cumulative effect is assessed as Low and within the range of natural variability.

Past, current, and reasonably foreseeable projects and activities are located throughout the WRSA and their residual effects have the potential to interact with the residual effects of the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

The residual effects of the Project are predicted to no longer interact with the residual effects of past, current, and reasonably foreseeable projects and activities following the end of Post-closure. Therefore, the cumulative effect is expected to be Medium-term in Duration.

Ongoing sensory disturbances (e.g., vehicle traffic), from the Project and past, current, and reasonably foreseeable projects and activities, can result in changes in movement patterns and are predicted to be Frequent

Changes in movement patterns are anticipated to revert to baseline conditions following the Post-closure Phase of the Project and are subsequently not anticipated to interact with the residual effects of past, current, and reasonably foreseeable projects and activities. As a result, the effect is considered Fully Reversible.

Bat species within the WRSA include two listed species; little brown myotis an Endangered species under SARA and the northern myotis which is provincially blue-listed, and also listed as Endangered under SARA. The listings under SARA are primarily due to population crashes due to mortality from white nose syndrome, which is spreading further west. However, Bat populations in BC are thought to be stable or their population trend is unknown (BC CDC 2015b, c). Therefore, the Context of the cumulative effect is rated Moderate.

Vegetation clearing and sensory disturbances due to the Project and past, current, and reasonably foreseeable projects and activities are Likely to result in changes in movement patterns.

It is predicted that the cumulative effect of a change in movement patterns will not alter the integrity of Bat populations within the WRSA the point where they are not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The effect of change in Bat movement patterns is not well known and mitigation measures have not been proven effective on past projects; however, they are anticipated to reduce changes in movement patterns to within the range of natural variability. Therefore, the level of Confidence of this prediction is Low.

6.3.5.4 Summary

The CEA process identified the following potential residual effects of the Project on the Bats subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effect due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Bats subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-5: Summary of Cumulative Effects on Bats Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	LT	FF	FR	M	L	NS	M
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	IF	FR	M	L	NS	M
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	L

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.6 Western Toad Subcomponent

The residual effects of the Project on the alteration and/or loss of habitat, change in mortality, and change in movement patterns were all assessed as **Not Significant**, and were carried forward to determine any potential cumulative effects. The assessment to determine potential cumulative effects on Western Toad considered the interactions between the predicted Project residual effects and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.1-1**). The CEA was conducted qualitatively based on the available information, as spatial information was not available for future projects and activities or their potential residual effects. Most of the reasonably foreseeable projects and activities identified in **Table 6.1-1** are anticipated to result in residual effects that interact cumulatively with the Project effects of alteration and/or loss of habitat, change in mortality, and change in movement patterns.

Cumulative effects on Western Toad have been characterised in terms of Direction, Magnitude, Geographical Extent, Frequency, Duration, Reversibility, Context, and Likelihood of Effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in **5.4.1 Description of Evaluation Criteria**.

6.3.6.1 Alteration and/or Loss of Habitat

The CEA of the alteration and/or loss of Western Toad habitat residual effect considers the direct loss of habitat and the indirect alteration of habitat caused by a change in the quality or availability of habitat in the area surrounding a project stemming from project activities. The cumulative alteration and/or loss of habitat characteristics on Western Toad are summarized below and provided in **Table 6.3-6**.

The clearing of vegetation, fragmentation of habitat, and sensory disturbances caused by the Project and past, current, and reasonably foreseeable projects and activities are anticipated to result in the alteration and/or loss of habitat. Forestry is expected to account for most of the habitat loss and alteration within the WRSA. The spatial and temporal nature of forestry activities are unknown, but it is anticipated that all future forestry will be conducted in accordance with legislative requirements and higher-level plans (e.g., Bulkley Land and Resource Management Plan [GovBC 1998], Telkwa Landscape Unit Plan [GovBC 1999], Bulkley Valley Sustainable Resource Management Plan [BC MAL 2005]). The Magnitude of the cumulative effect is predicted to be Low.

The Project's residual effects are expected to interact with the residual effects of past, current, and reasonably foreseeable projects and activities that are located throughout the WRSA. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

The regeneration of vegetation in areas cleared for the Project and past, current, and reasonably foreseeable projects and activities can occur within a relatively short period of time (i.e., <52 years). As a result, it is anticipated that the Duration of the effects will be Medium-term.

Sensory disturbances due to the Project and past, current, and reasonable, foreseeable projects and activities are expected to interact on an ongoing basis throughout the length of the Project and are anticipated to result in the alteration of habitat. Habitat loss is expected to occur occasionally due to vegetation clearing and will occur as a one-time event at any location. As such, the cumulative effect is predicted to be Frequent.

It is anticipated that upon completion of the Project that interactions between its residual effects and the residual effects other past, current, and reasonably foreseeable projects and activities will cease, as native vegetation is expected to revert to baseline conditions. Therefore, the cumulative effect is assessed as Fully Reversible.

Natural disturbances (e.g., insect outbreaks) are expected increase in frequency within the timeframe of the Project; however, suitable Western Toad habitat (e.g., regenerating harvested areas, burns) are resilient to stress and can regenerate within 10 years of a disturbance. Projects and activities are anticipated to result in the alteration and/or loss of suitable habitat, but are expected to remain within natural variation and regenerate quickly. Hence, the Context of the cumulative effect is rated Moderate.

The Project and past, current, and reasonably foreseeable projects and activities are expected to require vegetation clearing and may cause habitat fragmentation and sensory disturbances that are Likely to result in the alteration and/or loss of habitat.

It is not expected that the cumulative effect of alteration and/or loss of habitat will alter the integrity of Western Toad habitat within the WRSA to the point where it is not sustainable or available to contribute to ecological function. Therefore, the cumulative effect is predicted to be **Not Significant**.

The amount or location of the alteration or loss of habitat is unknown due to the uncertainties of spatial and temporal nature of the anticipated natural and anthropogenic disturbance. However, it is anticipated that the effectiveness of mitigation measures and the resilient nature of suitable habitat will minimize the cumulative alteration and/or loss of habitat. Consequently, the Level of Confidence in the assessment is Moderate.

6.3.6.2 *Change in Mortality*

The CEA of a change in Western Toad mortality considers potential sources of mortality from direct interactions and potential effects that could affect indirect mortality. The cumulative effect characteristics for change in mortality on Western Toad are summarised below and provided in **Table 6.3-6**.

The cumulative change in mortality is expected to be reduced by the implementation of effective mitigation measures for past, current, and reasonably foreseeable projects and activities to maintain most anthropogenic mortality within the range of natural variability. Recreational and other activities that include vehicle traffic may not always follow guidelines or regulations and mortality events are expected to occur, typically adjacent to breeding ponds. Consequently, the Magnitude of the cumulative effect is assessed as Moderate.

Past, current, and reasonably foreseeable projects and activities are located throughout the WRSA and their residual effects have the potential to interact with residual effects from the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

It is expected that the interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities will not occur beyond the life of the Project (i.e., <52 years). Therefore, the cumulative effect is expected to be Medium-term in Duration.

Vehicle collisions and environmental contamination are anticipated to be the two (2) main sources of anthropogenic mortality in the WRSA. Although the exact number of mortalities is unknown, it is expected that mortalities from vehicle collisions occur regularly on resource roads during the growing season. As a result, the Frequency is assessed as Frequent.

Any changes in mortality due to the Project are expected to revert to baseline conditions upon completion and will no longer interact cumulatively with the residual effects of past, current, and reasonably foreseeable projects and activities. As such, the cumulative effect is predicted to be Fully Reversible.

Western Toad is listed as Special Concern under SARA, and while it is widespread and abundant across a large portion of its Canadian range, its population sizes or trends are mostly unknown (COSEWIC 2012b). The main mortality threats are vehicle collisions and the disease chytridiomycosis, spread by chytrid fungus. This species is an explosive breeder with thousands of eggs laid per female, which in combination with high adult survival, is used to sustain populations through periods of poor reproductive success. So, any threats that affect adult survival can have particularly pronounced population level effects (ECCC 2016). Due to the uncertainty related to Western Toad population characteristics, sensitivity to adult mortality, and the listing as Special Concern under SARA the Context was assessed as Moderate.

Most mortalities (i.e., mortality from vehicle collisions) that are associated with the Project and past, current, and reasonably foreseeable projects and activities are predicted to Likely result in a change in mortality.

The integrity of Western Toad populations within the WRSA are not expected change to the point where they are not sustainable or available to contribute to ecological function due to the cumulative change in mortality. Therefore, the cumulative effect is predicted to be **Not Significant**.

The effect of a change in mortality is reasonably well known, with any changes in mortality expected to be minimized due to mitigation measures and remain within the range of natural variability. As such, the Level of Confidence of this assessment is High.

6.3.6.3 Change in Movement Patterns

The CEA of the change in movement patterns for Western Toad considers potential barriers, either real or perceived that may influence movement patterns. The cumulative effect characteristics for change in movement patterns on Western Toad are summarised below and provided in **Table 6.3-6**.

The habitat suitability mapping identified the extensive distribution of suitable habitat throughout the WRSA and the use of mitigation measures are anticipated to minimize the cumulative effect that may disrupt movement patterns. Due to this the Magnitude is assessed as Low.

Past, current, and reasonably foreseeable projects and activities are located throughout the WRSA and are anticipated to result in residual effects that may interact with the residual effects of the Project. Therefore, the Geographic Extent of the cumulative effect is predicted to be Regional.

It is anticipated that the residual effects of the Project will end following Post-closure and then will not interact with the residual effects of past, current, and reasonably foreseeable projects and activities. Therefore, the cumulative effect is expected to be Medium-term in Duration.

Sensory disturbances (e.g., vehicle traffic, human presence) are expected to occur on a regular and ongoing basis for the duration of the Project and past, current, and reasonably foreseeable projects and activities. Due to this the Frequency was assessed as Frequent.

The residual effects of the Project are expected to end following the Post-closure Phase and will not interact with the residual effects of past, current, and reasonably foreseeable projects and activities after the life of the Project. Consequently, the Reversibility of the cumulative effect is predicted to be Fully Reversible.

Western Toad is listed as Special Concern under SARA, with transportation corridors and invasive species identified as the primary threats. Reasonably foreseeable projects and activities are expected to require the building of additional transportation infrastructure, which can act as a barrier to toad movement. Approved projects and activities are anticipated to utilize mitigation measures to minimize potential barriers to movement and suitable toad habitats for breeding, dispersal, and foraging habitat are widely available in

the WRSA. Chytrid fungus has been identified as the main invasive species concern, although no mass mortality events have been detected despite the fungus being widespread across BC. Western Toads are considered to have high resilience to disturbance in the absence of their primary threats and are therefore assessed as a Moderate Context.

It is anticipated that sensory disturbances, habitat fragmentation, and vegetation clearing due to the Project and past, current, and reasonably foreseeable projects and activities are Likely to result in a change in movement patterns.

Western Toad movement patterns within the WRSA are not expected to be altered to the point where they are no longer sustainable or available to contribute to the ecological function of the regional population. Therefore, the cumulative effect is predicted to be **Not Significant**.

The affect that habitat alteration and/or loss, sensory disturbances, and transportation corridors on changes in toad movement patterns are reasonably well understood. Mitigation measures anticipated for approved projects are known to be effective; however, it is not known if all activities will also employ mitigation measures to reduce the cumulative effect. As a result, the Level of Confidence of this prediction is Moderate.

6.3.6.4 Summary

The CEA process identified the following potential residual effects of the Project on the Western Toad subcomponent:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns

The assessment process characterised the potential cumulative effect due to interactions between the residual effects of the Project and the residual effects of past, current, and reasonably foreseeable projects and activities (**Table 6.3-6**). The cumulative effect is not expected to result in a change to the viability and persistence of the Western Toad subcomponent within the WRSA and is therefore predicted to be **Not Significant**.

Table 6.3-6: Summary of Cumulative Effects on Western Toad Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration and/or Loss of Habitat	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M
Change in Mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	M	RSA	MT	FF	FR	M	L	NS	H
Change in Movement Patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the WRSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	L	RSA	MT	FF	FR	M	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.4 Summary of Potential Cumulative Effects

The following Project-related residual effects on the Wildlife VC were carried forward to the CEA:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns.

The Project's residual effects, in conjunction with the residual effects of other past, present, and reasonably foreseeable future projects and activities within the Wildlife RSAs, are not expected to result in a change to the viability or persistence of the Wildlife VC within the Wildlife RSAs beyond an acceptable level (i.e., where it is not sustainable or is unavailable to contribute to biodiversity and ecosystem function). Future forestry activities are anticipated to have the greatest contribution to cumulative effects on the Wildlife VC; however, this is expected to be mitigated by the implementation of provincial and regional guidelines, including biodiversity and old growth forest management objectives under the Provincial Non-Spatial Old Growth Forest Order (GovBC 2004) and applicable land use plans (**2.4 Land Use Plans**). Consequently, the cumulative effects on the Wildlife VC are predicted to be **Not Significant (Table 6.4-1)**.

Table 6.4-1: Summary of Cumulative Effects on Wildlife Valued Component (VC)

VC Subcomponent	Potential Cumulative Effect	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effect (Yes/No)	Significant (Yes/No)
- Furbearers - Caribou - Grizzly Bear - Moose - Bats - Western Toad	Alteration and/or loss of habitat	- Existing activities¹ (e.g., agriculture, forestry, harvesting, and recreation) (C, O, D, P) - Reasonably foreseeable developments² within the WRSAs as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	Yes	No
- Furbearers - Caribou - Grizzly Bear - Moose - Bats - Western Toad	Change in mortality	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably foreseeable developments within the WRSAs as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	Yes	No
- Furbearers - Caribou - Grizzly Bear - Moose - Bats - Western Toad	Change in movement patterns	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably foreseeable developments within the WRSAs as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.1-2 (C, O, D, P).	Yes	No

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure
Project=Tenas Project; VC=Valued Component; WRSA=Wildlife Regional Study Area

¹Present projects and activities that are expected to have ongoing disturbance into the future.

²Projects and activities that are expected to occur (i.e., proposed new disturbance) in the future.

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

7. SUMMARY OF EFFECTS ASSESSMENT ON WILDLIFE VALUED COMPONENT (VC)

The following potential residual effects of the Project are predicted to occur due to the Project on the Wildlife VC and its associated subcomponents:

- ▶ alteration and/or loss of habitat;
- ▶ change in mortality; and
- ▶ change in movement patterns.

Mitigation measures employed during all Project phases are expected to eliminate, minimize, and/or control potential adverse Project residual effects on the Wildlife VC; however, it is not anticipated that all residual effects will be fully mitigated and that some are anticipated to result from the Project during the Construction, Operation, Decommissioning and Reclamation, and Post-closure phases.

The Project-related residual effects on Furbearers, Caribou, Grizzly Bear, Moose, Bats, and Western Toad subcomponents are predicted to be **Not Significant**. As such, the Project-related residual effects are not expected to result in a change to the population viability or persistence of the Wildlife VC within the Wildlife RSAs beyond an acceptable level (i.e., where it is not sustainable or is unavailable to contribute to biodiversity and ecosystem function) and are predicted to be **Not Significant**.

All Project-related adverse residual effects were carried forward into the CEA and were assessed relative to their spatial and temporal overlap with the residual effects of other past, present, and reasonably foreseeable future projects and activities within the WRSAs. The cumulative effects of the Project are not expected to result in a change to the viability or persistence of the Wildlife VC within the WRSAs beyond an acceptable level (i.e., wildlife species composition and populations are expected to remain sustainable and available to contribute to biodiversity and ecosystem function). Future forestry activities are anticipated to have the greatest contribution to cumulative effects on the Wildlife VC; however, this is expected to be mitigated with the implementation of provincial and regional guidelines and management objectives. As a result, the cumulative effects on the Wildlife VC are predicted to be **Not Significant**.

8. FOLLOW-UP STRATEGY

Monitoring and adaptive management will be used to address uncertainties with the current assessment and will work towards following goals:

- ▶ verify the accuracy of the residual effects and cumulative effects predictions; and the value of proposed mitigation measures;
- ▶ identify unexpected environmental constraints;
- ▶ assess the efficacy and value of the proposed mitigation measures;
- ▶ modify or implement additional mitigation measures, in accordance with adaptive management plans, to maintain that the effect predictions remain valid; and
- ▶ implement additional mitigation measures in accordance with adaptive management plans.

Targeted monitoring and inspections will be completed by environmental inspectors (i.e., onsite monitors) during the Construction, and Operation phases to verify that Project design and mitigation measures (**5.3 Mitigation Measures**) have been appropriately applied and maintained. Following verification environmental inspectors will evaluate the success of Project design and mitigation measures and assist in the determination if adaptive management measures are required.

Monitoring of Parameters of Potential Concern/Contaminants of Potential Concern (POPC/COPC) and Parameters of Concern/Contaminants of Concern (POC/COC) identified for aquatic life, wildlife, terrestrial vegetation, human health, and land uses will be conducted for soils, vegetation, sediment, and surface and groundwater.

Adaptive management techniques will be employed where Project design measures and mitigation measures are found to be unsuccessful. When updating mitigation measures using adaptive management techniques key stakeholders, Indigenous groups, and government agencies will be invited, where appropriate, to provide input. Management plans, including the **WMP**, will be considered living documents and updated when warranted to include input from consultations, monitoring results, regulatory or legislative changes, and any updated, improved, or revised BMPs and scientific methods. Project monitoring and adaptive management plans specific to Wildlife include:

- ▶ Wildlife will be routinely monitored throughout the life of the Project in accordance with the **WMP**; and
- ▶ Progressive reclamation and revegetation of disturbed areas (i.e., transitioning into wildlife habitat) will be monitored in accordance with the **RCP**.

Wildlife movements across the WLSA may bring it into contact with Project components and activities (i.e., vehicle traffic) which can result in mortalities and changes to movement patterns. Project design and mitigation measures (**5.3**) have been identified that are expected to minimize the likelihood of these from occurring. However, changes in wildlife habitat and movement patterns over the life of the Project and require adaptive management techniques to update Project design and mitigation measures. The potential for these changes will require environmental inspectors to continually monitor for changes in Wildlife mortality or movement patterns and assess whether adaptive management techniques are warranted. No other additional monitoring or follow-up for the Wildlife VC is proposed at this time; however, if concerns involving wildlife are noted during the life of the Project (e.g., feeding of wildlife, disturbance of wildlife), Project design measures and mitigation measures will be reviewed and adapted to minimize any effects on the Wildlife VC.

9. REFERENCES

- Abbott, I.M., Berthinussen, A., Stone, E., Boonman, M., Melber, M., and Altringham, J. 2015. Chapter 34: Bats and Roads. Pp. 290–299. *Handbook of Road Ecology*. John Wiley & Sons, Ltd. DOI: 10.1002/9781118568170.ch34. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118568170.ch34>. Accessed November 2021.
- Alexander, S., Waters, N., and Paquet, P. 2005. Traffic volume and highway permeability for a mammalian community in the Canadian Rocky Mountains. *The Canadian Geographer* 49: 321–331.
- Altringham, J. and Kerth, G. 2016. Chapter 3: Bats and Roads. Pp. 35–62. In C.C. Voigt, T. Kingston (eds.) *Bats in the Anthropocene: Conservation of Bats in a Changing World*. Springer International Publishing, Cham. DOI: 10.1007/978-3-319-25220-9_3. Available at: https://doi.org/10.1007/978-3-319-25220-9_3. Accessed November 2021.
- Anderson, M., McLellan, B.N., and Serrouya, R. 2018. Moose response to high-elevation forestry: Implications for apparent competition with endangered caribou: Moose Habitat Disturbance. *The Journal of Wildlife Management* 82(2):299–309. DOI: 10.1002/jwmg.21380.
- Andrén, H. 1994. Effects of Habitat Fragmentation on Birds and Mammals in Landscapes with Different Proportions of Suitable Habitat: A Review. *Oikos* 71: 355–366.
- Apps, C. 2010. Grizzly bear population inventory and monitoring strategy for British Columbia. Version 1.2. BC Ministry of Environment. Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/grizzly-bears/bc_griz_inventory_monitoring_strategy_-_ver_1-2.pdf. Accessed November 2021.
- Ardea Biological Consulting. 2004. Moose habitat model for Morice and Lakes Forest District IFPA. Prepared for Morice and Lakes IFPA, Smithers, British Columbia. 32 pp.
- Ardea Biological Consulting. 2014. Baseline Monitoring of Soils, Vegetation and Wildlife along the Apache Pipeline within Wet'suwet'en Territory. Overview of Phase 1 Sample Selection: Technical and Cultural Process. Prepared for David DeWitt, Office of the Wet'suwet'en, and Kristy Garnet, Chevron.
- Ardea Biological Consulting. 2020. Tenas Project Ecosystems and Vegetation Baseline Report. Prepared for Telkwa Coal Limited.
- Ashley, E. and Robinson, J. 1996. Road Mortality of Amphibians, Reptiles and Other Wildlife on the Long Point Causeway, Lake Erie, Ontario. *The Canadian Field-Naturalist* 110:403–412.
- Askins, R. 1994. Open corridors in a heavily forested landscape: Impact on shrubland and forest-interior birds. *Wildlife Society Bulletin* 22:339–347.
- Association for Mineral Exploration British Columbia, British Columbia Ministry of Energy Mines and Petroleum Resources and the Ministry of Environment, and Mining Association of British Columbia. 2008. *Handbook for Mineral and Coal Exploration in British Columbia: A Working Field Guide*. 145 pp.
- Banner, A., MacKenzie, W., Haeussler, S., Thomson, S., Pojar, J., and Trowbridge, R. 1993. *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region Part 1*. Research Branch, Ministry of Forests, Victoria, B.C.
- Barber, J.R., Crooks, K.R., and Fristrup, K.M. 2010. The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology & Evolution* 25(3):180–189. DOI: 10.1016/j.tree.2009.08.002

- Barclay, R. and Brigham, M. 1995. Bats and Forests Symposium, October 19-21, 1995, Victoria, BC. Paper 23/1996. British Columbia Ministry of Forests, Victoria, B.C.
- Bartlet, P., Klaver, R., and Porter, W. 2010. Modeling amphibian energetics, habitat suitability, and movements of western toads, *Anaxyrus (=Bufo) boreas*, across present and future landscapes. *Ecological Modelling* 221:2675–2686.
- Bartzke, G.S., May, R., Solberg, E.J., Rolandsen, C.M., and Røskoft, E. 2015. Differential barrier and corridor effects of power lines, roads and rivers on moose (*Alces alces*) movements. *Ecosphere* 6(4):art67. DOI: 10.1890/ES14-00278.1
- BC Conservation Data Centre (BC CDC). 1994. Species Summary: *Martes americana*. Available at: <https://a100.gov.bc.ca/pub/eswp/speciesSummary.do?id=34795>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2010. Conservation Status Report: *Gulo gulo luscus*. Available at: <https://a100.gov.bc.ca/pub/eswp/esr.do?id=18143>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2015a. Conservation Status Report: *Pekania pennanti*. Available at: <https://a100.gov.bc.ca/pub/eswp/esr.do?id=17481>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2015b. Conservation Status Report: *Myotis septentrionalis*. Available at: <https://a100.gov.bc.ca/pub/eswp/>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2015c. Species Summary: *Myotis lucifugus*. Available at: <https://a100.gov.bc.ca/pub/eswp/>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2018a. iMap Incident Mapping Application. Available at: <https://www.arcgis.com/home/item.html?id=f6cd52d18d894d65a1dda79c135411a7>. Accessed November 2021.
- BC Conservation Data Centre (BC CDC). 2019. Species Summary: *Alces americanus*. BC Ministry of Environment. Available at: <http://a100.gov.bc.ca/pub/eswp/reports.do?elcode=AMALC03010>. Accessed July 10, 2019.
- British Columbia Environmental Assessment Office (BC EAO). 2013. Guideline for the Selection of Valued Components and Assessment of Potential Effects. BC Environmental Assessment Office. 45 pp. Available at: <https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/eao-guidance-selection-of-valued-components.pdf>. Accessed November 2021.
- British Columbia Environmental Assessment Office (BC EAO). 2019. Environmental Assessment Project Information Centre (EPIC). Available at: <https://projects.eao.gov.bc.ca/projects-list>. Accessed November 2021.
- British Columbia Environmental Assessment Office (BC EAO). 2022. Tenas Project Application Information Requirements. Prepared by Telkwa Coal for the British Columbia Environmental Assessment Office. Vancouver, BC.
- British Columbia Ministry of Agriculture and Lands (BC MAL). 2005. Bulkley Valley Sustainable Resource Management Plan. British Columbia Ministry of Agriculture and Lands Integrated Land Management Bureau. 70 pp. Available at: <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/skeena/bulkley-lrmp/bulkleyvalley-srmp>. Accessed November 2021.
- British Columbia Ministry of Agriculture and Lands (BC MAL). 2006. Integrated Land Management Bureau. Kalum Sustainable Resource Management Plan. 61 pp. Available at: <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource->

- use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/kalum-srmp/kalum_srmp_plan.pdf. Accessed November 2021.
- British Columbia Ministry of Agriculture and Lands (BC MAL). 2007. Morice Land and Resource Management Plan. Available at: <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/skeena/morice-lrmp>. Accessed November 2021.
- British Columbia Ministry of Energy, Mines and Low Carbon Innovation (BC MEMLI) 2021. Health, Safety and Reclamation Code for Mines in British Columbia. Victoria, BC. 365 pp. Available at: <https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2009. Conservation Framework: Conservation Priorities for Species and Ecosystems Primer. Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/species-ecosystems-at-risk/species-at-risk-documents/cf_primer.pdf. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2014a. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia. Available at: http://www.env.gov.bc.ca/wld/documents/bmp/HerptileBMP_complete.pdf. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2014b. Management plan for the Western Toad (*Anaxyrus boreas*) in British Columbia. Prepared by the Provincial Western Toad Working Group, Victoria, B.C. Available at: <http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=9843>. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2014c. Policy for Mitigating Impacts on Environmental Values. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_policy_may13_2014.pdf. Accessed March 12, 2018.
- British Columbia Ministry of Environment (BC MOE). 2014d. Procedures for Mitigating Impacts on Environmental Values. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_procedures_may27_2014.pdf. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2016. Best Management Practices for Bats in British Columbia, Chapter 2: Mine Developments and Inactive Mine Habitats. BC Ministry of Environment, Victoria, B.C. Available at: <http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&repository=BDP&documentId=12460>. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE) 2018. EcoCat: The Ecological Reports Catalogue. Available at: <https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/libraries-publication-catalogues/ecocat>. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2020a. Wildlife Habitat Areas. Available at: <http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html>. Accessed March 2018.
- British Columbia Ministry of Environment (BC MOE). 2020b. Identified Wildlife Management Strategy. Available at: <http://www.env.gov.bc.ca/wld/frpa/iwms/>. Accessed March 2018.
- British Columbia Ministry of Environment (BC MOE). 2020c. Grizzly Bear Population Ranking in B.C. State of Environment Reporting. Available at: <http://www.env.gov.bc.ca/soe/indicators/plants-and-animals/grizzly-bears.html>. Accessed November 2021.

- British Columbia Ministry of Environment (BC MOE). 2020d. Species Inventory Web Explorer. Available at: http://a100.gov.bc.ca/pub/siwe/search_reset.do. Accessed November 2021.
- British Columbia Ministry of Environment (BC MOE). 2021. Ungulate Winter Ranges. Available at: <http://www.env.gov.bc.ca/wld/frpa/uwr>. Accessed April 6, 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 1995a. A Future for the Grizzly: British Columbia Grizzly Bear Conservation Strategy. Available at: <https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/grizzly-bears/futureforgrizzly1995.pdf>. Accessed November 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 1995b. Conservation of grizzly bears in British Columbia background report. Ministry of Environment, Land and Parks, Victoria, British Columbia. 70 pp. Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/grizzly-bears/grizzly_background_report.pdf. Accessed November 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 1998. Telkwa Mountains Caribou Herd Recovery Plan. Skeena Region, Smithers, BC. 27 pp. Available at: https://www.for.gov.bc.ca/ftp/HTH/external!/publish/Caribou%20Recovery%20Program/Herd%20Plans/FTP_upload_herd_plans/southern_mountain_north/Caribou%20Herd%20Plan%20Telkwa_EN_disclaimer.pdf. Accessed November 2021.
- British Columbia Ministry of Environment, Lands, and Parks (BC MELP). 2000. Moose in British Columbia ecology, conservation, and management. 6 pp. Available at: <https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/staying-safe-around-wildlife/moose.pdf>. Accessed November 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 2002. Grizzly Bears in British Columbia: Ecology, Conservation and Management. 6 pp. Available at: <https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/grizzly-bear>. Accessed November 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 2008. Standard Operating Procedures: Hygiene Protocols for Amphibian Fieldwork. Available at: <https://scitech.viu.ca/sites/default/files/interimhygieneprotocols-for-amphibian-field-staff-and-researchers.pdf>. Accessed November 2021.
- British Columbia Ministry of Environment, Lands and Parks (BC MELP). 2019. Provincial Caribou Recovery Program. 2017/18 Annual Report. 16 pp. Available at: https://www.for.gov.bc.ca/ftp/HTH/external!/publish/Caribou%20Recovery%20Program/Reports/17_18_Caribou%20Annual%20Report.pdf. Accessed November 2021.
- British Columbia Ministry of Forests (BC MOF). 1995. Forest Practices Code Biodiversity Guidebook. 99 pp. Available at: <https://www.for.gov.bc.ca/hfd/library/documents/bib19715.pdf>. Accessed November 2021.
- British Columbia Ministry of Forests and Ministry of Environment, Lands, and Parks (BC MOF and BC MELP). 1999. Landscape Unit Planning Guide. Victoria, B.C. 101 pp. Accessed November 2021.
- British Columbia Ministry of Forests, and Ranges and British Columbia Ministry of Environment. (BC MOFR and BC MOE). 2010. Field Manual for Describing Terrestrial Ecosystems, 2nd Edition. Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/conservation-data-centre/field_manual_describing_terrestrial_ecosystems_2nd.pdf. Accessed November 2021.

- British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC MFLNRO). 2003. Furbearer Management Guidelines: Marten. 11 pp. Available at: <https://www2.gov.bc.ca/assets/gov/sports-recreation-arts-and-culture/outdoor-recreation/fishing-and-hunting/hunting/trapping/marten.pdf>. Accessed November 2021
- British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO). 2014. A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia – Interim Guidance. 206 pp. Available at: <http://a100.gov.bc.ca/pub/eirs/lookupDocument.do?fromStatic=true&repository=BDP&documentId=12121>. Accessed November 2021.
- British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC MFLRNO). 2015a. Mountain Pine Beetle Projections – Province of British Columbia. Province of British Columbia. Available at: <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/bark-beetles/mountain-pine-beetle/mpb-projections>. Accessed October 2020.
- British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC MFLNRO). 2015b. Provincial Framework for Moose Management in British Columbia. British Columbia Government, Ministry of Forests, Lands and Natural Resource Operations, Fish and Wildlife Branch, Victoria, B.C. 44 pp. Available at: http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/provincial_framework_for_moose_management_bc.pdf. Accessed November 2021.
- British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLRNO). 2016. Best Management Practices for Amphibian and Reptile Salvages in British Columbia. Available at: <http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=10351>. Accessed November 2021.
- British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLRNO). 2020. Wildlife in B.C. Available at: <http://www.env.gov.bc.ca/fw/wildlife/>. Accessed March 2018.
- British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD). 2003. Furbearer Management Guidelines: Marten (*Martes americana*). Furbearer Management Guidelines. Ministry of Forests, Lands, Natural Resource Operations and Rural Development, British Columbia. Available at: <https://www2.gov.bc.ca/assets/gov/sports-recreation-arts-and-culture/outdoor-recreation/fishing-and-hunting/hunting/trapping/marten.pdf>. Accessed November 2021.
- British Columbia Ministry of Forests Lands Natural Resource Operations and Rural Development (BC MFLNRORD). 2017. BC government ends grizzly bear hunt. Available at: <https://news.gov.bc.ca/releases/2017FLNR0372-002065>. Accessed December 14, 2020.
- British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD). 2020. BC Hunting and Trapping Regulations Synopsis: Effective July 1, 2020 to June 30, 2020. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Available at: <https://www2.gov.bc.ca/assets/gov/sports-recreation-arts-and-culture/outdoor-recreation/fishing-and-hunting/hunting/regulations/2020-2022/hunting-trapping-synopsis-2020-2022.pdf>. Accessed November 2021.
- British Columbia Ministry of Sustainable Resource Management (BC MSRM). 2002. Kalum Land and Resource Management Plan. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/kalum-lrmp/kalum_lrmp.pdf. Accessed September 2021.
- British Columbia Ministry of Water, Land and Air Protection (BC MWLAP). 2004. Identified Wildlife Management Strategy – Procedures for Managing Identified Wildlife. Available at:

- <http://www.env.gov.bc.ca/wld/documents/identified/IWMS%20Procedures.pdf>. Accessed November 2021.
- BC Parks. 2019. Ecological Reserves. Available at: http://www.env.gov.bc.ca/bcparks/eco_reserve/. Accessed March 2018.
- Beazley, K.F., Snaith, T.V., MacKinnon, F., and Colville, D. 2004. Road Density and Potential Impacts on Wildlife Species Such as American Moose in Mainland Nova Scotia. *Proceedings of the Nova Scotian Institute of Science (NSIS)* 42(2). DOI: 10.15273/pnsis.v42i2.3610. Available at: <https://ojs.library.dal.ca/nsis/article/view/NSIS42-2beazleysnaithmackinnoncolville>. Accessed November 2021.
- Beier, P. 1993. Determining Minimum Habitat Areas and Habitat Corridors for Cougars. *Conservation Biology* 7(1):94–108. DOI: 10.1046/j.1523-1739.1993.07010094.x.
- Belant, J.L. 2007. Human-Caused Mortality and Population Trends of American Marten and Fisher in a U.S. National Park. *Natural Areas Journal* 27(2):155–160.
- Bennett, V. and Zurcher, A. 2012. When Corridors Collide: Road-Related Disturbance in Commuting Bats. *The Journal of Wildlife Management* 77(1):93–101.
- Bennett, V.J., Sparks, D.W., and Zollner, P.A. 2013. Modeling the indirect effects of road networks on the foraging activities of bats. *Landscape Ecology* 28(5):979–991. DOI: 10.1007/s10980-013-9874-0.
- Berger, J. 2007. Fear, human shields and the redistribution of prey and predators in protected areas. *Biology Letters* 3(6):620–623. DOI: 10.1098/rsbl.2007.0415.
- Bergerud, A.T. and Elliot, J.P. 1986. Dynamics of caribou and wolves in northern British Columbia. *Canadian Journal of Zoology* 64(7):1515–1529. DOI: 10.1139/z86-226.
- Bergerud, A.T., Jakimchuk, R.D., and Carruthers, D.R. 1984. The Buffalo of the North: Caribou (*Rangifer tarandus*) and Human Developments. *Arctic* 37(1):7–22.
- Berland, A., Nelson, T., Stenhouse, G., Graham, K., and Cranston, J. 2008. The impact of landscape disturbance on grizzly bear habitat use in the Foothills Model Forest, Alberta, Canada. *Forest Ecology and Management* 256(11):1875–1883. DOI: 10.1016/j.foreco.2008.07.019.
- Beyer, H.L., Ung, R., Murray, D.L., and Fortin, M.-J. 2013. Functional responses, seasonal variation and thresholds in behavioural responses of moose to road density. *Journal of Applied Ecology* 50(2):286–294. DOI: 10.1111/1365-2664.12042.
- Bliss-Ketchum, L., de Rivera, C., and Rappold, K. 2012. Road undercrossing use across structure sizes by a Pacific Northwest wildlife community.
- Boer, A.H. 1990. Spatial Distribution of Moose Kills in New Brunswick. *Wildlife Society Bulletin* (1973-2006) 18(4):431–434.
- Borowik, T., Ratkiewicz, M., Maślanko, W., Duda, N., and Kowalczyk, R. 2020. The level of habitat patchiness influences movement strategy of moose in Eastern Poland. *PLOS ONE* 15(3):e0230521. Public Library of Science. DOI: 10.1371/journal.pone.0230521.
- Boulanger, J., Kite, R., Campbell, M., Shaw, J., and Lee, D. 2020. Analysis of Caribou Movements Relative to the Meadowbank Mine and Roads During Spring Migration. Technical Report Series. 01–2020. 83 pp.
- Bowles, A.E. 1995. Responses of Wildlife to Noise. *Wildlife and Recreationists: Coexistence through Management and Research*. Island Press, Washington DC.

- Bowman, J., Ray, J., Magoun, A., Johnson, D., and Dawson, N. 2010. Roads, logging, and the large-mammal community of an eastern Canadian boreal forest. *Canadian Journal of Zoology* 88(5):454–467. DOI: 10.1139/Z10-019.
- Brinkman, S. 1998. Boreal toad toxicology studies. Colorado Division of Wildlife. Colorado Division of Wildlife, Fort Collins, Colorado.
- Broders, H.G. and Forbes, G.J. 2004. Interspecific and Intersexual Variation in Roost-site Selection of Northern Long-eared and Little Brown Bats in the Greater Fundy National Park Ecosystem. *Journal of Wildlife Management* 68(3):602–610. The Wildlife Society. DOI: 10.2193/0022-541X(2004)068[0602:IAIVIR]2.0.CO;2.
- Broders, H.G., Forbes, G.J., Woodley, S., and Thompson, I.D. 2006. Range Extent and Stand Selection for Roosting and Foraging in Forest-Dwelling Northern Long-Eared Bats and Little Brown Bats in the Greater Fundy Ecosystem, New Brunswick. *Journal of Wildlife Management* 70(5):1174–1184. The Wildlife Society. DOI: 10.2193/0022-541X(2006)70[1174:REASSF]2.0.CO;2.
- Buchanan, B. 2006. Observed and potential effects of artificial night lighting on anuran amphibians. Ecological consequences of artificial night lighting. Island Press, Washington.
- Bull, E. 2009. Dispersal of newly metamorphosed and juvenile western toads (*Anaxyrus boreas*) in northeastern Oregon, USA. *Herpetological Conservation and Biology* 4:236–247.
- Bull, E.L. and Heater, T.W. 2001. Survival, Causes of Mortality, and Reproduction in the American Marten in Northeastern Oregon. *Northwestern Naturalist* 82(1):1–6. Society for Northwestern Vertebrate Biology. DOI: 10.2307/3536640.
- Buskirk, S.W. and Powell, R.A. 1994. Habitat ecology of fishers and American marten. Pp. 283–296. *Martens, sables, and fishers; biology and conservation*. Cornell University Press, Ithaca, New York.
- Canadian Environmental Assessment Agency (CEAA) 2018. Canadian Environmental Assessment Archive. Available at: <https://iaac-aeic.gc.ca/052/index-eng.cfm>. Accessed November 2021.
- Carey, C. 1993. Hypothesis Concerning the Causes of the Disappearance of Boreal Toads from the Mountains of Colorado. *Conservation Biology* 7(2):355–362. [Wiley, Society for Conservation Biology].
- Carr, L.W. and Fahrig, L. 2001. Effect of Road Traffic on Two Amphibian Species of Differing Vagility. *Conservation Biology* 15(4):1071–1078. [Wiley, Society for Conservation Biology].
- CBC News. 2014. First Nation says oil firm's mulching of black bear like killing a cousin. Last updated: January 31, 2014. 8:26 PM PT. Available at: <https://www.cbc.ca/news/canada/british-columbia/black-bear-accidentally-mulched-by-oil-and-gas-company-1.2518061>. Accessed November 2021.
- Chan-McLeod, A. 2006. A review and synthesis of the effects of unsalvaged mountain-pine-beetle-attacked stands on wildlife and implications for forest management. *BC Journal of Ecosystems and Management* 7(2):119–132.
- Chapin, T.G., Harrison, D.J., and Katnik, D.D. 1998. Influence of Landscape Pattern on Habitat Use by American Marten in an Industrial Forest. *Conservation Biology* 12(6):1327–1337.
- Chen, J., Franklin, J.F., and Spies, T.A. 1995. Growing-Season Microclimatic Gradients from Clearcut Edges into Old-Growth Douglas-Fir Forests. *Ecological Applications* 5(1):74–86. DOI: <https://doi.org/10.2307/1942053>.
- Chen, W., Leblanc, S., White, H.P., Prevost, C., Milakovic, B., Rock, C., Sharam, G., O'Keefe, H., Corey, L., Croft, B., Gunn, A., Wielen, S., Football, A., Tracz, B., Pellissey, J., and Boulanger, J. 2017.

- Does Dust from Arctic Mines Affect Caribou Forage? *Journal of Environmental Protection* 08(03):258–276. DOI: 10.4236/jep.2017.83020.
- Ciarniello, L., Heard, D., Seip, D., and Boyce, M. 2004. Grizzly Bears and Forestry: Increased Mortality Leading to Lower Abundance in Heavily-roaded Landscapes. *Proceedings of the Species at Risk 2004 Pathways to Recovery Conference*. Victoria, British Columbia. Available at: [https://www.arlis.org/docs/vol1/69415913/ciarniello\(2\)_edited_final_feb_8.pdf](https://www.arlis.org/docs/vol1/69415913/ciarniello(2)_edited_final_feb_8.pdf). Accessed November 2021.
- Child, K., Barry, S., and Aitken, D. 1991. Moose mortality on highways and railways in British Columbia. *Alces* 27:41–49.
- Cichowski, D. 2014. Telkwa Caribou Population Status and Background Information Summary 2014. Unpublished Report. Prepared for B.C. Ministry of Forests, Lands and Natural Resource Operations, Smithers, BC. 110 pp.
- Clair, C.C.S., Whittington, J., Forshner, A., Gangadharan, A., and Laskin, D.N. 2020. Railway mortality for several mammal species increases with train speed, proximity to water, and track curvature. *Scientific Reports* 10(1):20476. Nature Publishing Group. DOI: 10.1038/s41598-020-77321-6.
- Clark, D. and Lamont, T. 1976. Organochlorine residues in females and nursing young of the big brown bat (*Eptesicus fuscus*). DOI: 10.1007/BF01686188.
- Clegg, S. 2011. Assessing the impacts of vehicular mortality of migrating amphibians near Ryder Lake, British Columbia. Fraser Valley Conservancy.
- Clevenger, A.P., Chruszcz, B., and Gunson, K. 2001. Drainage culverts as habitat linkages and factors affecting passage by mammals. *Journal of Applied Ecology* 38(6):1340–1349. DOI: 10.1046/j.0021-8901.2001.00678.x.
- Coady, J.W. 1974. Influence of snow on behavior of moose. *Canadian Field-Naturalist* 101:417–436.
- Colecott, J. and Gillingham, M. 1998. Reaction of moose (*Alces alces*) to snowmobile traffic in the Greys River Valley, Wyoming. *Alces* 34(2):329–338.
- Collins, W.B. and Schwartz, C.C. 1998. Logging in Alaska's boreal forest: creation of grasslands or enhancement of moose habitat. *Alces* 34(2):355–374.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. COSEWIC Assessment and Update Status Report on the Woodland Caribou *Rangifer tarandus caribou* Atlantic-Gaspésie Population Boreal Population Southern Mountain Population Northern Mountain Population Newfoundland Population in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. Available at: <http://www.registrelep-sararegistry.gc.ca/default.asp?lang=En&n=F9E5752E-1&printfullpage=true>. Accessed November 2021.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2011. Designatable Units for Caribou (*Rangifer tarandus*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. 28 pp. Available at: https://www.canada.ca/content/dam/ecccc/migration/cosewic-cosepac/4e5136bf-f3ef-4b7a-9a79-6d70ba15440f/cosewic_caribou_du_report_23dec2011.pdf. Accessed November 2021.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012a. COSEWIC assessment and status report on the grizzly bear *Ursus arctos* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. xiv + 84 pp. Available at: <https://publications.gc.ca/site/eng/421565/publication.html>. Accessed November 2021.

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012b. COSEWIC assessment and status report on the western toad, *Anaxyrus boreas*: non-calling population, calling population, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. Available at: <https://publications.gc.ca/site/eng/441951/publication.html>. Accessed November 2021.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013. COSEWIC assessment and status report on the little brown myotis, *Myotis lucifugus*, northern myotis, *Myotis septentrionalis*, tri-colored bat, *Perimyotis subflavus*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 93 pp. Available at: <https://publications.gc.ca/site/eng/9.579593/publication.html>. Accessed November 2021.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2014a. COSEWIC Assessment and Status Report on the Caribou (*Rangifer tarandus*) Northern Mountain Population, Central Mountain Population, Southern Mountain Population in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. 113 pp. Available at: <https://publications.gc.ca/site/eng/9.579879/publication.html?wbdisable=true>. Accessed November 2021.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2014b. COSEWIC assessment and status report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. 76 pp. Available at: <https://www.sararegistry.gc.ca/default.asp?lang=En&n=BE10C89C-1&offset=5>. Accessed November 2021.
- Craighead, J.J., Sumner, J.S., and Scaggs, G.B. 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources. Wildlife-wildlands Institute Monograph No. 1. University of Montana, Missoula, Montana
- Cristescu, B., Stenhouse, G.B., Symaluk, M., Nielsen, S.E., and Boyce, M.S. 2016. Wildlife habitat selection on landscapes with industrial disturbance. *Environmental Conservation* 43(4):327–336. DOI: 10.1017/S0376892916000217. Accessed November 2021.
- Crooks, K., Burdett, C., Theobald, D., King, S., Di Marco, M., Rondinini, C., and Boitani, L. 2017. Quantification of habitat fragmentation reveals extinction risk in terrestrial mammals. *Proceedings of the National Academy of Sciences* 114(29):7635–7640.
- Crossroads Cultural Resource Management (Crossroads). 2021. Tenas Project: Cultural Use Study. Prepared for Telkwa Coal Ltd.
- Danks, Z. 2007. Spatial, temporal, and landscape characteristics of moose-vehicle collisions in Maine. Available at: <https://www.proquest.com/openview/c9c917da1a5feec4fd30e3243ec57513/1?pq-origsite=gscholar&cbl=18750>. Accessed November 2021.
- Davis, T.M. 2000. Ecology of the western toad (*Bufo boreas*) in forested areas on Vancouver Island, final report. Ministry of Forests, Victoria, B.C. 28 pp. Available at: <https://www.for.gov.bc.ca/hfd/library/FRBC1999/FRBC1999MR113.pdf>. Accessed November 2021.
- Dawson, F.N., Magoun, A.J., Bowman, J., and Ray, J.C. 2010. Wolverine, *Gulo gulo*, Home Range Size and Denning Habitat in Lowland Boreal Forest in Ontario. *The Canadian Field-Naturalist* 124(2):139. DOI: 10.22621/cfn.v124i2.1052.
- DeCesare, N.J., Hebblewhite, M., Robinson, H.S., and Musiani, M. 2009. Endangered, apparently: the role of apparent competition in endangered species conservation: Apparent competition and endangered species. *Animal Conservation* 13(4):353–362. DOI: 10.1111/j.1469-1795.2009.00328.x.

- Demarchi, M.W. 2003. Migratory Patterns and Home Range Size of Moose in the Central Nass Valley, British Columbia. *Northwestern Naturalist* 84(3):135–141. Society for Northwestern Vertebrate Biology. DOI: 10.2307/3536539
- Dickie, M., McNay, S.R., Sutherland, G.D., Cody, M., and Avgar, T. 2020. Corridors or risk? Movement along, and use of, linear features varies predictably among large mammal predator and prey species. *Journal of Animal Ecology* 89(2):623–634. DOI: <https://doi.org/10.1111/1365-2656.13130>.
- Dickie, M., Serrouya, R., McNay, R.S., and Boutin, S. 2017. Faster and farther: wolf movement on linear features and implications for hunting behaviour. *Journal of Applied Ecology* 54(1):253–263. DOI: 10.1111/1365-2664.12732.
- Dodd, N. and Carswell, T. 2019. Caribou core and matrix habitat in British Columbia – mapping methods. Caribou Recovery Program, Ecosystem Information Section, Knowledge Management Branch, B.C. Ministry of Environment & Climate Change Strategy, Victoria, British Columbia. 4 pp. Available at: http://nakusprodandgunclub.com/image/BC_caribou_core_matrix_mapping_methods_v0.1.pdf. Accessed November 2021.
- Donovan et al. 1997. If changes to microclimatic conditions or vegetative structure at an edge exceed a species habitat preference or physiological tolerance, then edge habitat may result in lower occupancy or use, reduced survival, or lowered reproductive success (Donovan et al. 1997, Chen et al. 1999, Goosem 2000, Winter et al. 2000, Woodward et al. 2001, Moseley et al. 2009).
- Du Plessis, G. 2020. Killing Reindeer: A Spatial Analysis of Nordic States and Nomadic Forms of Life in the Arctic. *International Political Sociology* 14(4):347–365. DOI: 10.1093/ips/olaa008.
- Dulisse, J., Boulanger, J., and Manley, I. 2016. Summit Lake Western Toad Project 2015 Field Season. Fish and Wildlife Compensation Program and the Ministry of Forests, Lands and Natural Resource Operations, Nelson, BC. Available at: http://nakuspcommunityforest.com/wp-content/uploads/2016/08/Dulisse_Summit_Lake_2015_final.pdf. Accessed November 2021.
- Dulisse, J., Hausleitner, D., and Boulanger, J. 2012. Western Toad Migration at Summit Lake 2011 Field Season. Fish & Wildlife Compensation Program, Nelson, BC. Available at: https://www.env.gov.bc.ca/wildlife/wsi/reports/4834_WSI_4834_RPT_2011.PDF. Accessed November 2021.
- Dussault, C., Poulin, M., Courtois, R., and Ouellet, J.-P. 2006. Temporal and spatial distribution of moose-vehicle accidents in the Laurentides Wildlife Reserve, Quebec, Canada. *Wildlife Biology* 12(4):415–425. Nordic Board for Wildlife Research. DOI: 10.2981/0909-6396(2006)12[415:TASDOM]2.0.CO;2. Available at: [https://bioone.org/journals/wildlife-biology/volume-12/issue-4/0909-6396\(2006\)12%5B415%3ATASDOM%5D2.0.CO%3B2/Temporal-and-spatial-distribution-of-moose-vehicle-accidents-in-the/10.2981/0909-6396\(2006\)12\[415:TASDOM\]2.0.CO;2.full](https://bioone.org/journals/wildlife-biology/volume-12/issue-4/0909-6396(2006)12%5B415%3ATASDOM%5D2.0.CO%3B2/Temporal-and-spatial-distribution-of-moose-vehicle-accidents-in-the/10.2981/0909-6396(2006)12[415:TASDOM]2.0.CO;2.full). Accessed November 2021.
- Dyer, S.J., O'Neill, J.P., Wasel, S.M., and Boutin, S. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80(5):839–845. DOI: 10.1139/z02-060.
- Edelsparre, A., Shahid, A., and Fitzpatrick, M. 2018. Habitat connectivity is determined by the scale of habitat loss and dispersal strategy. *Ecology and Evolution* 8(11):5508–5514.
- Edie, A. 1998a. Moose Habitat Capability/Suitability Mapping, Telkwa Coal Project. Prepared for Manalta Coal Ltd., Smithers, BC.

- Edie, A. 1998b. Wildlife Assessment, Telkwa Coal Project. Prepared for Manalta Coal Ltd. Smithers, BC.
- Eidels, R., Whitaker, J., John, and Sparks, D. 2007. Insecticide residues in bats and guano from Indiana. *Proceedings of the Indiana Academy of Science* 116:50–57.
- Eldegard, K., Lyngved, J., and Hjeljord, O. 2012. Coping in a human-dominated landscape: Trade-off between foraging and keeping away from roads by moose (*Alces alces*). *European Journal of Wildlife Research* 58. DOI: 10.1007/s10344-012-0640-4. Available at: <https://www.readcube.com/articles/10.1007%2Fs10344-012-0640-4>. Accessed November 2021.
- Environment and Climate Change Canada (ECCC). 2015. Pollution and Waste. Environment and Climate Change Canada, Ottawa, Ontario. Available at: <https://www.canada.ca/en/environment-climate-change/services/managing-pollution.html>. Accessed November 2021.
- Environment and Climate Change Canada (ECCC). 2016. Management Plan for the Western Toad (*Anaxyrus boreas*) in Canada [Proposed]. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa. 38 pp. Available at: http://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/mp-western-toad-e-proposed.pdf. Accessed November 2021.
- Environment and Climate Change Canada (ECCC). 2018. Recovery strategy for the little brown myotis (*Myotis lucifugus*), the northern myotis (*Myotis septentrionalis*), and the tri-colored bat (*Perimyotis subflavus*) in Canada. Environment and Climate Change Canada, Ottawa, ON. 172 pp. Available at: <https://wildlife-species.canada.ca/species-risk->
- Environment and Climate Change Canada (ECCC). 2020. Management plan for the Western Toad (*Anaxyrus boreas*), calling and non-calling populations, in Canada. Environment and Climate Change Canada, Ottawa, ON. 39 pp. Available at: https://epe.lac-bac.gc.ca/100/201/301/weekly_acquisitions_list-ef/2020/20-46/publications.gc.ca/collections/collection_2020/eccc/En3-5-107-2020-eng.pdf. Accessed November 2021.
- Environment and Climate Change Canada (ECCC). 2021. Environment and Climate Change Canada. 2021. Federal environmental quality guidelines - aluminium. Available at: <https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/federal-environmental-quality-guidelines-aluminium.html>. Accessed November 2021.
- Environment Canada. 2004. Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada. Canadian Wildlife Service, Environment Canada. Available at: http://epe.lac-bac.gc.ca/100/200/301/environment_can/cws-scf/environmental_assessment-ef/ea_best_practices_2004_e.pdf. Accessed November 2021.
- Environment Canada. 2011. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. 2011 Update. Canadian Wildlife Service, Ottawa, Ontario. 102 pp. Available at: http://epe.lac-bac.gc.ca/100/200/301/environment_can/2011/scientific_assessment_inform-ef/CW66-296-2011-eng.pdf. Accessed November 2021.
- Environment Canada. 2012. Management plan for the Northern Mountain population of woodland caribou (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. 79 pp. Available at: https://www.sararegistry.gc.ca/virtual_sara/files/plans/mp_woodland_caribou_northern_mountain_population_e.pdf. Accessed November 2021.
- Environment Canada. 2013. Recovery strategy for the American marten (*Martes americana atrata*), Newfoundland population, in Canada. Environment Canada, Ottawa, Canada. Available at:

- http://publications.gc.ca/collections/collection_2013/ec/En3-4-143-2013-eng.pdf. Accessed November 2021.
- Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa, Ontario. 103 pp. Available at: <https://frresearch.ca/resource/recovery-strategy-woodland-caribou-southern-mountain-population-rangifer-tarandus-caribou>. Accessed November 2021.
- Environment Canada. 2015. Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. 110 pp.
- Erb, J., Coy, P., and Sampson, B. 2008. Fisher and marten demography and habitat use in Minnesota. Restoring Wildlife. Minnesota Department of Natural Resources.
- Ewacha, M. 2016. Stress response of boreal woodland caribou, moose, and wolves to disturbance in eastern Manitoba. Available at: <https://mspace.lib.umanitoba.ca/xmlui/handle/1993/31773>. Accessed November 2021.
- Fahrig, L., Pedlar, J.H., Pope, S.E., Taylor, P.D., and Wegner, J.F. 1995. Effect of road traffic on amphibian density. *Biological Conservation* 73(3):177–182. DOI: 10.1016/0006-3207(94)00102-V.
- Farley, S.D., Barboza, P., Griese, H., and Garner, C. 2014. Characterization of moose movement patterns and movement of black bears in relation to anthropogenic food sources on Joint Base Elmendorf-Richardson, Alaska. Prepared for U.S. Army Medical Research and Materiel Command, Army Corps of Engineers. 276 pp.
- Fensome, A. and Mathews, F. 2016. Roads and bats: a meta-analysis and review of the evidence on vehicle collisions and barrier effects. *Mammal Review* 46(4):311–323.
- Festa-Bianchet, M., Coulson, T., Gaillard, J.M., Hogg, J.T., and Pelletier, F. 2006. Stochastic predation events and population persistence in bighorn sheep. *Proceeding of the Royal Society B-Biological Sciences* 273(1593):1537–1543. DOI: 10.1098/rspb.2006.3467.
- Festa-Bianchet, M., Ray, J.C., Boutin, S., Côté, S.D., and Gunn, A. 2011. Conservation of caribou (*Rangifer tarandus*) in Canada: an uncertain future. *Canadian Journal of Zoology* 89:419–434. DOI: 10.1139/Z11-025.
- Flynn, R.W., Lewis, S.B., Beier, L.R., and Pendleton, W. 2007. Brown Bear Use of Riparian and Beach Zones on Northeast Chichagof Island: Implications for Streamside Management in Coastal Alaska. Alaska Department of Fish and Game, Douglas, Alaska. 98 pp.
- Gabriel, M.W., Woods, L.W., Wengert, G.M., Stephenson, N., Higley, J.M., Thompson, C., Matthews, S.M., Sweitzer, R.A., Purcell, K., Barrett, R.H., Keller, S.M., Gaffney, P., Jones, M., Poppenga, R., Foley, J.E., Brown, R.N., Clifford, D.L., and Sacks, B.N. 2015. Patterns of Natural and Human-Caused Mortality Factors of a Rare Forest Carnivore, the Fisher (*Pekania pennanti*) in California. *PLoS ONE* 10(11). DOI: 10.1371/journal.pone.0140640. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4633177/>. Accessed November 2021.
- Gangadharan, A., Pollock, S., Gilhooly, P., Friesen, A., Dorsey, B., and Clair, C.C.S. 2017. Grain spilled from moving trains create a substantial wildlife attractant in protected areas. *Animal Conservation* 20(5):391–400. DOI: <https://doi.org/10.1111/acv.12336>.
- Gardner, C.L., Ballard, W.B., and Jessup, R.H. 1986. Long distance movement by an adult wolverine. *Journal of Mammalogy* 67:603.

- Gasaway, W., Stephenson, R., Davis, J., Shepherd, P., and Burris, O. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Alaska Wildlife Monographs* 84.
- Gehr, B., Hofer, E., Pewsner, M., Ryser, A., Vimercati, E., and Vogt, K. 2018. Hunting-mediated predator facilitation and superadditive mortality in a European ungulate. *Ecology and Evolution* 8(1):109–119.
- Geiger, R. 1957. *The Climate Near the Ground*, Second Edition. Harvard University Press, Cambridge, Massachusetts.
- Gibeau, M.L., Clevenger, A.P., Herrero, S., and Wierzchowski, J. 2002. Grizzly bear response to human development and activities in the Bow River Watershed, Alberta, Canada. *Biological Conservation* 103(2):227–236. DOI: 10.1016/S0006-3207(01)00131-8.
- Gilhooly, P.S., Nielsen, S.E., Whittington, J., and Clair, C.C.S. 2019. Wildlife mortality on roads and railways following highway mitigation. *Ecosphere* 10(2):e02597. DOI: Available at: <https://doi.org/10.1002/ecs2.2597>. Accessed November 2021.
- Gillingham, M.P. and Parker, K.L. 2008. The importance of individual variation in defining habitat selection by moose in northern British Columbia. *Alces* 44:7–20. Available at: <https://alcesjournal.org/index.php/alces/article/view/33/0>. Accessed November 2021.
- Goosem, M. 2000. Effects of tropical rainforest roads on small mammals: edge changes in community composition. *Wildlife Research* 27(2):151. DOI: 10.1071/WR98091.
- Gorley, R.A. 2016. A strategy to help restore moose populations in British Columbia. Prepared for Ministry of Forests, Lands and Natural Resource Operations, Fish and Wildlife Branch. Prepared by Triangle Resources Incorporated. 36 pp. Available at: <http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/Restoring-and-Enhancing-Moose-Populations-in-BC-July-8-2016.pdf>. Accessed November 2021.
- Government of British Columbia (GovBC). 1984. Closed Areas Regulation BC Reg 76/84. Available at: <https://canlii.ca/t/54qz1>. Accessed November 2021.
- Government of British Columbia (GovBC). 1995. Riparian Management Area Guidebook. Available at: <https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/riparian/rip-toc.htm>. Accessed March 2019.
- Government of British Columbia (GovBC). 1996a. Contaminated Sites Regulations, BC Reg 375/96 (GovBC 1996). Available at: <https://canlii.ca/t/5555l>. Accessed November 2021.
- Government of British Columbia (GovBC). 1996b. *Ecological Reserve Act*, RSBC 1996, c. 103. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96103_01. Accessed March 2019.
- Government of British Columbia (GovBC). 1996c. *Land Act*, RSBC 1996, c 245, Available at: <https://canlii.ca/t/543qn>. Accessed November 2021.
- Government of British Columbia (GovBC). 1996d. Land Act Regulation, BC Reg 315/76. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/00_96245_01. Accessed May 2020.
- Government of British Columbia (GovBC). 1996e. *Mines Act*, RSBC 1996. C. 293. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96293_01. Accessed May 2020.
- Government of British Columbia (GovBC). 1996f. *Wildlife Act*, RSBC 1996. C. 488. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96488_01. Accessed May 2020.

- Government of British Columbia (GovBC). 1997. *Riparian Areas Protection Act*. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/00_97021_01. Accessed May 2020.
- Government of British Columbia (GovBC). 1998. Bulkley Land and Resource Management Plan. Prepared by Bulkley Valley Community Resources Board Interagency Planning Team. 155 pp. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/bulkley-lrmp/bulkley_lrmp.pdf. Accessed November 2021.
- Government of British Columbia (GovBC). 1999. Telkwa Landscape Unit Plan. 62 pp. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/bulkley-lrmp/telkwa_lupm.pdf. Accessed July 2021.
- Government of British Columbia (GovBC). 2002a. *Environmental Assessment Act*, SBC 2002, c. 43. Available at: <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/18051>. Accessed March 2018.
- Government of British Columbia (GovBC). 2002b. *Forest and Range Practices Act*, SBC 2002, c. 69. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/00_02069_01. Accessed March 2018.
- Government of British Columbia (GovBC). 2002c. Reviewable Projects Regulations, BC Reg 370/2002. Available at: <https://canlii.ca/t/543v4>. Accessed November 2021.
- Government of British Columbia (GovBC). 2003. *Environmental Management Act*, SBC 2003, c. 53. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_00. Accessed March 2018.
- Government of British Columbia (GovBC). 2004. Order Establishing Provincial Non-Spatial Old Growth Objectives. Government of British Columbia. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/bc-biodiversity-mngt/bc_non-spatial_old_growth_fpc_30jun2004.pdf. Accessed November 2021.
- Government of British Columbia (GovBC). 2006. Kalum Sustainable Resource Management Plan. Integrated Land Management Bureau. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/kalum-srmp/kalum_srmp_plan.pdf. Accessed August 2021.
- Government of British Columbia (GovBC). 2007. Morice Land and Resource Management Plan. Ministry of Agriculture and Lands Integrated Land Management Bureau, British Columbia. 259 pp. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/morice-lrmp/morice_lrmp_july2007.pdf. Accessed November 2021.
- Government of British Columbia (GovBC). 2009. Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia. Prepared by the Wetland Stewardship Partnership for the Province of British Columbia. Available at: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-planning-strategies/wetlands-in-bc>. Accessed November 2021.
- Government of British Columbia (GovBC). 2014b. *Water Sustainability Act*, SBC 2014, c. 15. Available at: <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015>. Accessed May 2020.

- Government of British Columbia (GovBC). 2014a. Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia: Section 4 Environmentally Valuable Resources. Available at: <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care>. Accessed November 2021.
- Government of British Columbia (GovBC). 2014c. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia. Available at: <http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=15141>. Accessed November 2021.
- Government of British Columbia (GovBC). 2014d. Protecting Vulnerable Species: A Five-Year Plan for Species at Risk in British Columbia. Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/species-ecosystems-at-risk/species-at-risk-documents/five-year-plan-for-species-at-risk-in-bc_low-res.pdf. Accessed November 2021.
- Government of British Columbia (GovBC). 2017. Interim Assessment Protocol for Old Growth Forest in BC. Available at: http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs2018/684428/interim_old_growth_protocol_v11_jan2018_final.pdf. Accessed November 2021.
- Government of British Columbia (GovBC). 2019a. DataBC. Available at: <https://www2.gov.bc.ca/gov/content/data/about-data-management/databc>. Accessed November 2021.
- Government of British Columbia (GovBC). 2019b. iMapBC. Available at: <https://maps.gov.bc.ca/ess/hm/imap4m/>. Accessed January 2019.
- Government of British Columbia (GovBC). 2020b. Laws and Rules. Available at: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules>. Accessed March 2018.
- Government of British Columbia (GovBC). 2020d. Land Use Planning for Provincial Public Land. Available at: <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning>. Accessed March 2018.
- Government of British Columbia and British Columbia, and Ministry of Water, Land, and Air Protection (GovBC and BC MWLAP). 2004. Identified Wildlife Management Strategy, Accounts and measures for managing identified wildlife: Northern Interior Forest Region. British Columbia Ministry of Water, Land and Air Protection, Victoria. Available at: <https://www.env.gov.bc.ca/wld/frpa/iwms/iwms.html>. Accessed November 2021.
- Government of Canada (GovCan). 1985a. *Canada Wildlife Act*, RSC, 1985, c. W-9. Available at: <https://laws-lois.justice.gc.ca/eng/acts/w-9/>. Accessed March 2018.
- Government of Canada (GovCan). 1985b. *Fisheries Act*, RSC, c. F-14. Available at: <https://laws-lois.justice.gc.ca/eng/acts/f-14/>. Accessed March 2019.
- Government of Canada (GovCan). 1991. The Federal Policy and Wetland Conservation. Available at: <https://publications.gc.ca/collections/Collection/CW66-116-1991E.pdf>. Accessed March 2019.
- Government of Canada (GovCan). 1995. Canadian Biodiversity Strategy: Canada's Response to the Convention on Biological Diversity. Biodiversity Convention Office, Environment Canada. Available at: https://biodivcanada.chm-cbd.net/sites/biodivcanada/files/2017-12/CBS_e.pdf. Accessed November 2021.

- Government of Canada (GovCan). 1999. *Canadian Environmental Protection Act*, SC 1999, c. 33. Available at: <https://laws-lois.justice.gc.ca/eng/acts/c-15.31/>. Accessed July 2019.
- Government of Canada (GovCan). 2002. *Species at Risk Act*, SC 2002, c. 29 (SARA). Available at: <https://laws.justice.gc.ca/eng/acts/S-15.3/>. Accessed July 2019.
- Environment and Climate Change Canada (ECCC). 2018b. Species at risk public registry. Available at: <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>. Accessed 2018.
- Govindarajulu, P.P. 2008. Literature review of impacts of glyphosate herbicide on amphibians: What risks can the silvicultural use of this herbicide pose for amphibians in B.C.? Wildlife Report No. R-28. Ministry of Environment, Victoria, B.C. Available at: <http://stopthespraybc.com/wp-content/uploads/2011/07/Literature-Review-of-Impacts-of-Glyphosate-Herbicide.pdf>. Accessed November 2021.
- Grant, L.V. 2017. Spatial factors influencing northern mountain caribou (*Rangifer tarandus*) survival and distribution in the Telkwa Range. Masters. University of Northern British Columbia. DOI: 10.24124/2017/1400. Available at: <http://unbc.arcabc.ca/islandora/object/unbc%3A17385>.
- Grindal, S. 1996. Habitat use by bats in fragmented forests. Bats and forests symposium. Research Branch, Ministry of Forests, Victoria, B.C. 260–272 pp. Available at: <https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp23.htm>. Accessed November 2021.
- Grindal, S. and Brigham, R. 1999. Impacts of forest harvesting on habitat use by foraging insectivorous bats at different spatial scales. *Ecoscience* 6:25–34. DOI: 10.1080/11956860.1999.11682526.
- Gyug, L., Hamilton, T., and Austin, M. 2004. Grizzly Bear *Ursus arctos*. Accounts and Measures for Managing Identified Wildlife – Accounts V. 2004. 21 pp.
- Hamilton, A.N., Demarchi, D.N., and Demarchi, D.A. 2018. British Columbia Grizzly Bear Habitat Classification and Rating: A multi-scale, ecosystem-based approach to evaluating Grizzly Bear habitat using British Columbia's Ecoregion, Biogeoclimatic, and Broad Ecosystem Classification systems. Ministry of Environment and Climate Change Strategy, Ecosystems Branch, Victoria, B.C. 44 pp.
- Hamr, J., Hall, M., and Popp, J.N. 2019. An Assessment of Moose and Elk Train Collisions in Ontario, Canada. *Alces* 55:1–12.
- Harding, L. and Nagy, J.A. 1980. Responses of grizzly bears to hydrocarbon exploration on Richards Island, Northwest Territories, Canada. *Bears: Their Biology and Management* :277–280.
- Harfenist, A., Power, T., and Clark, K. 2007. A Review and Evaluation of the Amphibian Toxicological Literature Canada. Available at: <https://www.semanticscholar.org/paper/A-REVIEW-AND-EVALUATION-OF-THE-AMPHIBIAN-lITERATURE-Harfenist-Power/5543645e978cd017b276d76f2221de2e1d88cf02>. Accessed July 2021.
- Hargis, C.D., Bissonette, J.A., and Turner, D.L. 1999. The influence of forest fragmentation and landscape pattern on American martens. *Journal of Applied Ecology* 36(1):157–172. DOI: <https://doi.org/10.1046/j.1365-2664.1999.00377.x>.
- Hatler, D. 1990. Wildlife North of the Telkwa River: A Stage II Assessment for the Proposed Telkwa Project. Prepared for Crows Nest Resources Ltd.
- Hatter, I. 1999. Hatter, I. W. 1999. An evaluation of moose harvest management in central and northern British Columbia. *Alces* 35:91-103. *Alces* 35.

- Henderson, L.E. and Broders, H.G. 2008. Movements and Resource Selection of the Northern Long-Eared Myotis (*Myotis septentrionalis*) in a Forest—Agriculture Landscape. *Journal of Mammalogy* 89(4):952–963. DOI: 10.1644/07-MAMM-A-214.1.
- Henderson, L.E., Farrow, L.J., and Broders, H.G. 2008. Intra-specific effects of forest loss on the distribution of the forest-dependent northern long-eared bat (*Myotis septentrionalis*). *Biological Conservation* 141(7):1819–1828. DOI: 10.1016/j.biocon.2008.04.028.
- Henry, M., Thomas, D., Vaudry, R., and Carrier, M. 2002. Foraging distances and home range of pregnant and lactating Little Brown Bats (*Myotis lucifugus*). *Journal of Mammalogy* 83(3):767–774.
- Herrero, S. 1985. Bear attacks: their causes and avoidance. Nick Lyons Books, New York.
- Hobbs, J. and Goldberg, C. 2017. Environmental DNA protocol for freshwater aquatic ecosystems, version 2.2. Prepared for BC Ministry of Environment. Prepared by Hemmera Envirochem Inc. and Washington State University.
- Hoffman, K. and Grant, L. 2019. Telkwa caribou recruitment survey: March 25, 2019. Skeena Region Technical Report. Ministry of Forests, Lands and Natural Resource Operations, and Rural Development, Smithers, British Columbia. 9 pp.
- Homan, R.N., Windmiller, B.S., and Reed, J.M. 2004. Critical thresholds associated with habitat loss for two vernal pool-breeding amphibians. *Ecological Applications* 14(5):1547–1553. DOI: 10.1890/03-5125
- Impact Assessment Agency of Canada (IAAC). 2020. Canadian Impact Assessment Registry. Available at: <https://iaac-aeic.gc.ca/050/evaluations>. Accessed November 2021.
- Ito, T., Lhagvasuren, B., Tsunekawa, A., Shinoda, M., Takatsuki, S., and Buuveibaatar, B. 2013. Fragmentation of habitat of wild ungulates by anthropogenic barriers in Mongolia. *PloS ONE* 8(e56995).
- Jones, M.S. 2000. Boreal toad Research Progress Report 1999-2000. Colorado Division of Wildlife, Fort Collins, CO.
(<https://cpw.state.co.us/Documents/Research/Aquatic/pdf/BorealToadResearchProgressReport99-00.pdf>)
- Joep, K.L. 1985. Implications of grizzly bear habituation to hikers. *Wildlife Society Bulletin* 13:32–37.
- Joyce, T. and Mahoney, S. 2001. Spatial and Temporal Distributions of Moose-Vehicle Collisions in Newfoundland. *Wildlife Society Bulletin* 29(1):281–291.
- Kannan, K., Yun, S.H., Rudd, R.J., and Behr, M. 2010. High concentrations of persistent organic pollutants including PCBs, DDT, PBDEs and PFOS in little brown bats with white-nose syndrome in New York, USA. *Chemosphere* 80(6):613–618. DOI: 10.1016/j.chemosphere.2010.04.060.
- Kasworm, W.F. and Manley, T.L. 1990. Road and Trail Influences on Grizzly Bears and Black Bears in Northwest Montana. *Bears: Their Biology and Management* 8:79–84. International Association for Bear Research and Management. DOI: 10.2307/3872905.
- Keim, J.L., DeWitt, P.D., Wilson, S.F., Fitzpatrick, J.J., Jenni, N.S., and Lele, S.R. 2019a. Designing and Monitoring the Efficacy of Functional Restoration of Linear Features for Boreal Woodland Caribou. :41.
- Keim, J.L., Lele, S.R., DeWitt, P.D., Fitzpatrick, J.J., and Jenni, N.S. 2019b. Estimating the intensity of use by interacting predators and prey using camera traps. *Journal of Animal Ecology* 88(5):690–701. DOI: 10.1111/1365-2656.12960.

- Kelsall, J. and Simpson, K. 1987. The impacts of highways on ungulates; a review and selected bibliography. BC Ministry of Environment and Parks, Kamloops, B.C.
- Kerr, G. and Dillon, K. 2018. Monitoring and Mitigation of Moose Rail Mortality in Northern BC: 2018 Report Telkwa and Fraser Subdivisions.
- Kerr, G. and Pollard, B. 2016. Monitoring and Mitigation of Moose Rail Mortality in Northern BC: 2016 Report Telkwa and Fraser Subdivisions.
- Kerr, G. and Pollard, B. 2017. Monitoring and Mitigation of Moose Rail Mortality in Northern BC: 2017 Report Telkwa and Fraser Subdivisions.
- Klein, D.R. 1971. Reaction of reindeer to obstructions and disturbances. *Science* 173(3995):393–398.
- Klinkenberg, Brian. (Editor) 2021. E-Fauna BC: Electronic Atlas of the Fauna of British Columbia. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. Available at: www.efauna.bc.ca. Accessed November 2021.
- Knight, R.L. and Gutzwiller, K.J. 1995. *Wildlife and Recreationists: Coexistence Through Management and research*. Island Press, Washington, D.C. 374 pp.
- Koen, E.L., Bowman, J., and Findlay, C.S. 2007. Fisher Survival in Eastern Ontario. *Journal of Wildlife Management* 71(4):1214–1219. DOI: 10.2193/2006-064.
- Krebs, J., Lofroth, E., Copeland, J., Banci, V., Cooley, D., Golden, H., Magoun, A., Mulders, R., and Shults, B. 2004. Synthesis of survival rates and causes of mortality in North American wolverines. *Journal of Wildlife Management* 68(3):493–502.
- Krebs, J., Lofroth, E.C., and Parfitt, I. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. *Journal of Wildlife Management* 71(7):2180–2192.
- Krebs, J.A. and Lewis, D. 1999. Wolverine ecology and habitat use in the North Columbia Mountains: progress report, Proceedings of a Conference on the biology and management of species and habitats at risk, Volume 2, 695–703 pp. University College of the Cariboo, Kamloops, British Columbia. Available at: <http://www.env.gov.bc.ca/wld/documents/ca08krebs.pdf>. Accessed November 2021.
- Krusic, R.A., Yamasaki, M., Neefus, C.D., and Pekins, P.J. 1996. Bat habitat use in White Mountain National Forest. *Journal of Wildlife Management*. 60(3): 625-631. 60(3):625–631.
- Kuzyk, Gerald, Hatter, I., Marshall, S., Procter, C., Cadsand, B., Lirette, D., Schindler, H., Bridger, M., Stent, P., Walker, A., and Klaczek, M. 2018. Moose population dynamics during 20 years of declining harvest in British Columbia. *ALCES VOL.* 54:19.
- Kuzyk, G. and Heard, D. 2014. Research design to determine factors affecting moose population change in British Columbia: testing the landscape change hypothesis. *Wildlife Bulletin B-126*. Government of British Columbia, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC. 16 pp.
- Kuzyk, G., Marshall, S., Procter, C., Schindler, H., Schwantje, H., Gillingham, M., Hodder, D., White, S., and Mumma, M. 2018. Determining factors affecting moose population change in British Columbia: testing the landscape change hypothesis, progress report: February 2012-April 2018. *Wildlife Working Report. WR-126*. B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Victoria, British Columbia. 55 pp.
- Kuzyk, G., Procter, C., Marshall, S., Hodder, D., British Columbia, and Ministry of Forests, L., Natural Resource Operations and Rural Development. 2019. Factors affecting moose population declines in British Columbia: updated research design. Available at:

- http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs2020/714674/714674_factors_affecting_moose_population_declines_in_BC2019.pdf. Accessed November 2021.
- Kyle, C.J. and Strobeck, C. 2001. Genetic structure of North American wolverine (*Gulo gulo*) populations. *Molecular Ecology* 10(2):337–347. DOI: 10.1046/j.1365-294x.2001.01222.x.
- Lamb, C.T., Mowat, G., Reid, A., Smit, L., Proctor, M., McLellan, B.N., Nielsen, S.E., and Boutin, S. 2018. Effects of habitat quality and access management on the density of a recovering grizzly bear population. *Journal of Applied Ecology* 55(3):1406–1417. DOI: 10.1111/1365-2664.13056.
- Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., and Poulin, M. 2012. Interactions between a large herbivore and a road network. *Ecoscience* 19(1):69–79.
- Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., Poulin, M., and Breton, L. 2008. Behavior of Moose Relative to a Road Network. *The Journal of Wildlife Management* 72(7):1550–1557.
- Leblond, M., Dussault, C., and Ouellet, J.-P. 2013. Avoidance of roads by large herbivores and its relation to disturbance intensity: Avoidance of roads and disturbance intensity. *Journal of Zoology* 289(1):32–40. DOI: 10.1111/j.1469-7998.2012.00959.x.
- LeFranc, M.N., Harting, A.L., and Interagency Grizzly Bear Committee (U.S.). 1987. Grizzly Bear Compendium. Washington, D.C. : National Wildlife Federation. 552 pp. Available at: <http://archive.org/details/grizzlybearcompe1987lefr>.
- LeResche, R. 1972. Migrations and population mixing of moose on the Kenai Peninsula (Alaska)., *Proceedings of the North American Moose Conference and Workshop*, Volume 8, 185–207 pp.
- Lesiński, G., Sikora, A., and Olszewski, A. 2011. Bat casualties on a road crossing a mosaic landscape | SpringerLink. *European Journal of Wildlife Research* 57(2):217–223.
- Libell, H.P. 2017. 'It Was a Blood Bath': Freight Trains Kill 110 Reindeer in Norway – The New York Times. *The New York Times*. Available at: <https://www.nytimes.com/2017/11/27/world/europe/norway-reindeer-trains.html>. Accessed November 2021.
- Limpens, H.J.G.A., Helmer, W., Van Winden, A., and Mostert, K. 1989. Bats chiroptera and linear landscape elements a review of our present knowledge of the importance of linear landscape elements to bats. Available at: <https://eurekamag.com/research/007/050/007050951.php>. Accessed November 2020.
- Lofroth, E. 1984. Scale Dependent Analyses of Habitat Selection by Marten in the Sub-Boreal Spruce Biogeoclimatic Zone, British Columbia. M.S. Thesis. University of Victoria, Victoria BC.
- Lofroth, E. 2001. Wolverine ecology in plateau and foothill landscapes, 1996-2001. 2000/01 Year end report, northern wolverine project. Forest Renewal Activity (712260).
- Lofroth, E. and Ott, P.K. 2007. Assessment of the sustainability of wolverine harvest in British Columbia, Canada. *Journal of Wildlife Management* 71:2193–2200.
- Lykkja, O.N., Solberg, E.J., Herfindal, I., Wright, J., Rolandsen, C.M., and Hanssen, M.G. 2009. The effects of human activity on summer habitat use by moose. *Alces: A Journal Devoted to the Biology and Management of Moose* 45(0):109–124.
- Magoun, A. 1985. Population characteristics, ecology, and management of wolverines in northwestern Alaska. Ph.D. Dissertation. University of Alaska Fairbanks, Fairbanks, Alaska. 197 pp.
- Maier, J.A. 1996. Ecological and Physiological Aspects of Caribou Activity and Responses to Aircraft Overflights. Ph.D. Thesis. University of Alaska Fairbanks, Fairbanks, Alaska.

- Manalta Coal Ltd. 1997. Telkwa Coal Project Application for a Project Approval Certificate. Available at: <https://data.skeenasalmon.info/el/dataset/telkwa-coal-project-application-for-a-project-approval-certificate>. Accessed November 2020.
- Manci, K.M., Gladwin, D.N., Vilella, R., and Cavendish, M.G. 1988. Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis. AFESC TR 88-14. U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, CO. 88 pp.
- May, R., Landa, A., Dijk, J. van, Linnell, J.D.C., and Andersen, R. 2006. Impact of infrastructure on habitat selection of wolverines *Gulo gulo*. *Wildlife Biology* 12(3):285–295. Nordic Board for Wildlife Research. DOI: 10.2981/0909-6396(2006)12[285:IOIOHS]2.0.CO;2
- McAlpine, D.F. 1983. Status and Conservation of Solution Caves in New Brunswick. New Brunswick Museum. 38 pp.
- McLellan, B.N. and Hovey, F.W. 2001. Habitats Selected by Grizzly Bears in a Multiple Use Landscape. *The Journal of Wildlife Management* 65(1):92. DOI: 10.2307/3803280.
- McLellan, B.N., Hovey, F.W., Mace, R.D., Woods, J.G., Carney, D.W., Gibeau, M.L., Wakkenen, W.L., and Kasworm, W.F. 1999. Rates and Causes of Grizzly Bear Mortality in the Interior Mountains of British Columbia, Alberta, Montana, Washington, and Idaho. *The Journal of Wildlife Management* 63(3):911–920. [Wiley, Wildlife Society]. DOI: 10.2307/3802805.
- McLellan, B.N., Mowat, G., Hamilton, T., and Hatter, I. 2017. Sustainability of the grizzly bear hunt in British Columbia, Canada. *The Journal of Wildlife Management* 81(2):218–229. DOI: Available at: <https://doi.org/10.1002/jwmg.21189>.
- McLellan, B.N. and Shackleton, D.M. 1988. Grizzly Bears and Resource-Extraction Industries: Effects of Roads on Behaviour, Habitat Use and Demography. *Journal of Applied Ecology* 25(2):451–460. [British Ecological Society, Wiley]. DOI: 10.2307/2403836.
- McLellan, B.N. and Shackleton, D.M. 1989. Immediate reactions of grizzly bears to human activities. *Wildlife Society Bulletin* 17:269–274.
- Medinas, D., Marques, J.T., and Mira, A. 2013. Assessing road effects on bats: the role of landscape, road features, and bat activity on road-kills. *Ecological Research* 28(2):227–237. DOI: 10.1007/s11284-012-1009-6.
- Manalta Coal Ltd. 1997. Moose Habitat Capability/Suitability Mapping. Telkwa Coal Project.
- Manalta Coal Ltd. 1998. Wildlife Assessment. Telkwa Coal Project.
- Mönkkönen, M. and Reunanen, P. 1999. On Critical Thresholds in Landscape Connectivity: A Management Perspective. *Oikos* 84(2):302. DOI: 10.2307/3546725.
- Morgan, D, M. Proctor, G. Mowat, B. McLellan, T. Hamilton, and L. Turney. 2019. Conservation Ranking of Grizzly Bear Population Units – 2019. Ministry of Environment and Climate Change Strategy, Victoria, BC.
- Moseley, K.R., Ford, W.M., and Edwards, J.W. 2009. Local and landscape scale factors influencing edge effects on woodland salamanders. *Environmental Monitoring and Assessment* 151(1–4):425–435. DOI: 10.1007/s10661-008-0286-6
- Mowat, G., Clevenger, A.P., Kortello, A.D., Hausleitner, D., Barrueto, M., Smit, L., Lamb, C., DorsEy, B., and Ott, P.K. 2019. The Sustainability of Wolverine Trapping Mortality in Southern Canada. *The Journal of Wildlife Management* 84(2):213–226. John Wiley & Sons, Ltd. DOI: 10.1002/jwmg.21787.

- Muhly, T., Serrouya, R., Neilson, E., Li, H., and Boutin, S. 2015. Influence of In-Situ Oil Sands Development on Caribou (*Rangifer tarandus*) Movement. PLOS ONE 10(9):e0136933. DOI: 10.1371/journal.pone.0136933.
- Muhly, T.B., Semeniuk, C., Massolo, A., Hickman, L., and Musiani, M. 2011. Human Activity Helps Prey Win the Predator-Prey Space Race. PLoS ONE 6(3). DOI: 10.1371/journal.pone.0017050. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3047538/>. Accessed November 2021.
- Mumma, M. and Gillingham, M. 2019a. Determining Factors that Affect Survival of Moose in Central British Columbia. Technical Report. Habitat Conservation Trust Fund, Victoria, B.C. 56 pp.
- Mumma, M. and Gillingham, M. 2019b. Habitat supply model for the Moose (*Alces alces*). Biodiversity Assessment Project. Technical Report. Habitat Conservation Trust Fund. Victoria, British Columbia. Available at: http://web.unbc.ca/~michael/Mumma_and_Gillingham_2019.pdf. Accessed November 2021.
- Mumma, M.A., Gillingham, M.P., Parker, K.L., Johnson, C.J., and Watters, M. 2018. Predation risk for boreal woodland caribou in human-modified landscapes: Evidence of wolf spatial responses independent of apparent competition. *Biological Conservation* 228:215–223. DOI: 10.1016/j.biocon.2018.09.015.
- Muths, E. 2003. Home range and movements of boreal toads in undisturbed habitat. *Copeia* 1:160–165.
- Neilson, E. and Boutin, S. 2017. Human disturbance alters the predation rate of moose in the Athabasca oil sands. *Ecosphere* 8:e01913. DOI: 10.1002/ecs2.1913.
- Neumann, W. 2009. Moose *Alces alces* Behaviour Related to Human Activity. Ph.D. Thesis. Swedish University of Agricultural Sciences, Umeå.
- Neumann, W., Ericsson, G., Dettki, H., and Radeloff, V.C. 2013. Behavioural response to infrastructure of wildlife adapted to natural disturbances. *Landscape and Urban Planning* 114:9–27. DOI: 10.1016/j.landurbplan.2013.02.002.
- Nielsen, S.E., Boyce, M.S., and Stenhouse, G.B. 2004a. Grizzly bears and forestry I. Selection of clearcuts by grizzly bears in west-central Alberta, Canada. *Forest Ecology and Management* 199(1):51–65. DOI: 10.1016/j.foreco.2004.04.014.
- Nielsen, S.E., Herrero, S., Boyce, M.S., Mace, R.D., Benn, B., Gibeau, M.L., and Jevons, S. 2004b. Modelling the spatial distribution of human-caused grizzly bear mortalities in the Central Rockies ecosystem of Canada. *Biological Conservation* 120(1):101–113. DOI: 10.1016/j.biocon.2004.02.020.
- Norquay, K.J.O., Martinez-Núñez, F., Dubois, J.E., Monson, K.M., and Willis, C.K.R. 2013. Long-distance movements of little brown bats (*Myotis lucifugus*). *Journal of Mammalogy* 94(2):506–515. DOI: 10.1644/12-MAMM-A-065.1.
- Northrup, J.M., Pitt, J., Muhly, T.B., Stenhouse, G.B., Musiani, M., and Boyce, M.S. 2012. Vehicle traffic shapes grizzly bear behaviour on a multiple-use landscape. *Journal of Applied Ecology* 49(5):1159–1167. DOI: <https://doi.org/10.1111/j.1365-2664.2012.02180.x>.
- Oikos Ecological Services. 1999. Appendix 4: Terrestrial Ecosystem Mapping, Appendix Section 4.1.1: Telkwa Coal Terrestrial Ecosystems, Volume 1: Inventory.
- O’Keefe, S. and Rea, R.V. 2012. Evaluating ICBC Animal–Vehicle Crash Statistics (2006–2010) for purposes of collision mitigation in northern British Columbia. Prepared for the Insurance Corporation of British Columbia. 94 pp.

- Olson, L.E., Sauder, J.D., Albrecht, N.M., Vinkey, R.S., Cushman, S.A., and Schwartz, M.K. 2014. Modeling the effects of dispersal and patch size on predicted fisher (*Pekania [Martes] pennanti*) distribution in the U.S. Rocky Mountains. *Biological Conservation* 169:89–98. DOI: 10.1016/j.biocon.2013.10.022.
- Owen, S.F., Menzel, M.A., Ford, W.M., Chapman, B.R., Miller, K.V., Edwards, J.W., and Wood, P.B. 2003. Home-Range Size and Habitat Used by the Northern Myotis (*Myotis septentrionalis*). *The American Midland Naturalist* 150(2):352–359. University of Notre Dame.
- Provincial Western Toad Working Group. 2014. Management plan for the Western Toad (*Anaxyrus boreas*) in British Columbia. B.C. Ministry of Environment, Victoria, B.C.
- Pauli, B.P., Zollner, P.A., Haulton, G.S., Shao, G., and Shao, G. 2015. The simulated effects of timber harvest on suitable habitat for Indiana and northern long-eared bats. *Ecosphere* 6(4):art58. DOI: 10.1890/ES14-00336.1
- Peek, J.M., Urich, D.L., and Mackie, R.J. 1976. Moose habitat selection and relationships to forest management in northeastern Minnesota. *Wildlife Monographs* 48:3–65.
- Poole, K. and Stuart-Smith, K. 2005. Fine-scale Winter Habitat Selection by Moose in Interior Montane Forests. *Alces* 41:1–8.
- Poole, K.G., Porter, A.D., de Vries, A., Maundrell, C., Grindal, S.D., and St. Clair, C.C. 2004. Suitability of a young deciduous-dominated forest for American marten and the effects of forest removal. *Canadian Journal of Zoology* 82(3):423–435. DOI: 10.1139/z04-006.
- Proctor, M.F., McLellan, B.N., Stenhouse, G.B., Mowat, G., Lamb, C.T., and Boyce, M.S. 2019. Effects of roads and motorized human access on grizzly bear populations in British Columbia and Alberta, Canada. *Ursus* 30(article e2 (2019)):16–39. DOI: 10.2192/URSUS-D-18-00016.2.
- Proctor, M.F., McLellan, B.N., Strobeck, C., and Barclay, R.M.R. 2004. Gender-specific dispersal distances of grizzly bears estimated by genetic analysis. *Canadian Journal of Zoology* 82(7):1108–1118. DOI: 10.1139/z04-077.
- Proctor, M.F., Paetkau, D., McLellan, B.N., Stenhouse, G.B., Kendall, K.C., Mace, R.D., Kasworm, W.F., Servheen, C., Lausen, C.L., Gibeau, M.L., Wakkinen, W.L., Haroldson, M.A., Mowat, G., Apps, C.D., Ciarniello, L.M., Barclay, R.M.R., Boyce, M.S., Schwartz, C.C., and Strobeck, C. 2012. Population fragmentation and inter-ecosystem movements of grizzly bears in western Canada and the northern United States. *Wildlife Monographs* 180(1):1–46. DOI: 10.1002/wmon.6.
- Rach, L. , 2020. Personal Communication. Wildlife Habitat Ecologist, TerraNiche Environmental Solutions.
- Randall, L.A., Jung, T.S., and Barclay, R.M. 2014. Roost-Site Selection and Movements of Little Brown Myotis (*Myotis lucifugus*) in Southwestern Yukon. *Northwestern Naturalist* 95(3):312–317.
- Rea, R. 2012. Road Safety Implications of Moose Inhabiting an Urban-Rural Interface. *Urban Habitats* 7. Available at: http://www.urbanhabitats.org/v07n01/moose_full.html. Accessed November 2021.
- Reimers, E. and Colman, J.E. 2006. Reindeer and caribou (*Rangifer tarandus*) response towards human activities. *Rangifer* 26(2):55–71.
- Rescan Environmental Services Ltd. 2008. Davidson Project Country Foods Baseline Assessment. Prepared for Blue Pearl Mining Ltd.
- Resources Inventory Committee (RIC). 1999a. British Columbia Wildlife Habitat Rating Standards, Version 2.0. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee, Victoria, B.C.

- Available at: <http://www.llbc.leg.bc.ca/public/PubDocs/bcdocs/335486/whrs.pdf>. Accessed November 2021.
- Resources Inventory Committee (RIC). 1998b. Ground-based Inventory Methods for Selected Ungulates: Moose, Elk and Deer. Standards for Components of British Columbia's Biodiversity No. 33. Version 2.0.
- Resources Inventory Committee (RIC). 1998c. Inventory Methods for Marten and Weasels. Standards for Components of British Columbia's Biodiversity No. 24. Version 2.0.
- Resources Inventory Committee (RIC). 1998d. Inventory Methods for Pond-breeding Amphibians and Painted Turtle. Standards for Components of British Columbia's Diversity No. 37. Version 2.0.
- Resources Inventory Committee (RIC). 1998e. Inventory Methods for Terrestrial Arthropods. Standards for Components of British Columbia's Biodiversity No. 40. Version 2.0.
- Resources Inventory Committee (RIC). 1998f. Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians and Reptiles. Standards for Components of British Columbia's Biodiversity No. 3. Version 2.0.
- Resources Inventory Committee (RIC). 1998g. Standard for Terrestrial Ecosystem Mapping in British Columbia. Prepared by Ecosystems Working Group, Terrestrial Ecosystems Task Force, Resources Inventory Committee., Vancouver, BC. 110 pp.
- Resources Inventory Committee (RIC). 1999a. Inventory Methods for Medium-sized Terrestrial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher & Badger. Standards for Components of British Columbia's Biodiversity No.25. Version 2.0.
- Resources Inventory Committee (RIC). 1999b. Inventory Methods for Plethodontid Salamanders. Standards for Components of British Columbia's Biodiversity No. 36. Version 2.0.
- Reunanen, P. and Nikula, A. 2002. Predicting Occupancy for the Siberian Flying Squirrel in Old-Growth Forest Patches. *Ecological Applications* 12(4):11.
- Reynolds, D.S. 2006. Monitoring the Potential Impact of A Wind Development Site on Bats in the Northeast. *Journal of Wildlife Management* 70(5):1219–1227. The Wildlife Society. DOI: 10.2193/0022-541X(2006)70[1219:MTPIOA]2.0.CO;2.
- Rich, C. and Longcore, T. 2013. *Ecological Consequences of Artificial Night Lighting*. Island Press. 480 pp.
- Ritchie, C. 2008. Management and challenges of the mountain pine beetle infestation in british columbia. *Alces: A Journal Devoted to the Biology and Management of Moose* 44(0):127–135.
- Roberts, A.-M., Leung, M., Turney, L., and MacLean, N. 2003. Home range and habitat selection of female caribou in the Telkwa Mountain Range, British Columbia. Ardea Biological Consulting, Smithers, British Columbia. 42 pp.
- Robbins, C., Dawson, D., and Dowell, B. 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic states. *Wildlife Monographs* 103:1–34.
- Roe, N. and Kennedy, A. 1989. Moose and deer habitat use and diet on a reclaimed mine in west-central Alberta., *American Society of Mining and Reclamation*, 127-136. Pp.
- Roever, C.L., Boyce, M., and Stenhouse, G. 2008. Grizzly bears and forestry: I: Road vegetation and placement as an attractant to grizzly bears. *Forest Ecology and Management* 256. DOI: 10.1016/j.foreco.2008.06.040.
- Rogala, J., Hebblewhite, M., Whittington, J., White, C., Coleshill, J., and Musiani, M. 2011. Human Activity Differentially Redistributes Large Mammals in the Canadian Rockies National Parks. *Ecology and*

- Society 16(3). DOI: 10.5751/ES-04251-160316. Available at: <https://www.ecologyandsociety.org/vol16/iss3/art16/>. Accessed November 2021.
- Rouse, J.D., Bishop, C.A., and Struger, J. 1999. Nitrogen pollution: an assessment of its threat to amphibian survival. *Environmental Health Perspectives* 107(10):799–803.
- Rowland, M.M., Wisdom, M.J., Johnson, D.H., Wales, B.C., Copeland, J.P., and Edelman, F.B. 2003. Evaluation of Landscape Models for Wolverines in the Interior Northwest, United States of America. *Journal of Mammalogy* 84(1):92–105. DOI: 10.1644/1545-1542(2003)084<0092:EOLMFW>2.0.CO;2.
- Ruggiero, L.F., Aubry, K.B., Buskirk, S.W., Lyon, L.J., and Zielinski, W.J. 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. General Technical Report RM-254. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. 198 pp.
- Russell, A., Butchkoski, C., Saidak, L., and McCracken, G. 2009. Road-killed bats, highway design, and the commuting ecology of bats. *Endangered Species Research* 8:49–60. DOI: 10.3354/esr00121.
- Sawyer, H., Kauffman, M.J., Middleton, A.D., Morrison, T.A., Nielson, R.M., and Wyckoff, T.B. 2013. A framework for understanding semi-permeable barrier effects on migratory ungulates. *Journal of Applied Ecology* 50(1):68–78. DOI: 10.1111/1365-2664.12013.
- Scheideman, M. 2018. Use and selection at two spatial scales by female moose (*Alces alces*) across central British Columbia following a mountain pine beetle outbreak. M.Sc. University of Northern British Columbia, Prince George, B.C. Available at: http://web.unbc.ca/~michael/Pubs/Scheideman_MSc_Thesis.pdf. Accessed November 2021.
- Schindler, H., Peard, D., and Hinchliffe, C. 2019. Bulkley Valley/Lakes District Moose Population Density and Composition Survey: January 2018. Skeena Region Technical Report.
- Schirmer, A.E., Gallemore, C., Liu, T., Magle, S., DiNello, E., Ahmed, H., and Gilday, T. 2019. Mapping behaviorally relevant light pollution levels to improve urban habitat planning. *Scientific Reports* 9(1):11925. Nature Publishing Group. DOI: 10.1038/s41598-019-48118-z.
- Schmetterling, D. and Young, M. 2008. Summer movements of boreal toads (*Bufo boreas boreas*) in two western Montana basins. *Journal of Herpetology* 42:111–123.
- Schoen, J.W., Beier, L.R., Lentfer, J.W., and Johnson, L.J. 1987. Denning Ecology of Brown Bears on Admiralty and Chichagof Islands. *Bears: Their Biology and Management* 7:293–304. DOI: 10.2307/3872636.
- Scrafford, M.A., Avgar, T., Abercrombie, B., Tigner, J., and Boyce, M.S. 2017. Wolverine habitat selection in response to anthropogenic disturbance in the western Canadian boreal forest. *Forest Ecology and Management* 395:27–36. DOI: 10.1016/j.foreco.2017.03.029.
- Serrouya, R., McLellan, B.N., van Oort, H., Mowat, G., and Boutin, S. 2017. Experimental moose reduction lowers wolf density and stops decline of endangered caribou. *PeerJ* 5:e3736. DOI: 10.7717/peerj.3736.
- Shanley, C.S. and Pyare, S. 2011. Evaluating the road-effect zone on wildlife distribution in a rural landscape. *Ecosphere* 2(2):1–16.
- Sielecki, L.E. 2010. WARS 1988-2007: Wildlife Accident Reporting and Mitigation in British Columbia Special Annual Report. British Columbia Ministry of Transportation and Infrastructure. Victoria, British Columbia.

- Silvis, A., Ford, W.M., and Britzke, E.R. 2015. Effects of Hierarchical Roost Removal on Northern Long-Eared Bat (*Myotis septentrionalis*) Maternity Colonies. PLOS ONE 10(1):e0116356. Public Library of Science. DOI: 10.1371/journal.pone.0116356.
- Skaar, D., Arnold, J., Koel, T., Ruhl, M., Skorupski, J., and Treanor, H. 2017. Effects of Rotenone on Amphibians and Macroinvertebrates in Yellowstone.
- Solberg, E., Saether, B.E., Strand, O., and Loison, A. 1999. Dynamics of a harvested moose population in a variable environment. *Journal of Animal Ecology* 68:186–204.
- Spoelstra, K., van Grunsven, R.H.A., Ramakers, J.J.C., Ferguson, K.B., Raap, T., Donners, M., Veenendaal, E.M., and Visser, M.E. 2017. Response of bats to light with different spectra: light-shy and agile bat presence is affected by white and green, but not red light. *Proceedings of the Royal Society B: Biological Sciences* 284(1855):20170075. Royal Society. DOI: 10.1098/rspb.2017.0075.
- Stephens, P. and Peterson, R. 1984. Wolf-Avoidance Strategies of Moose. *Holarctic Ecology* 7(2):239–244.
- Steventon, D. 2014. Recommendations for a multi-scale habitat analysis for the marten (*Martes americana*). Report prepared for D. Lewis, RPF. BC Ministry of Forests, Lands, and Natural Resource Operations, Thompson Okanagan Region.
- Stewart, B.P., Nelson, T.A., Wulder, M.A., Nielsen, S.E., and Stenhouse, G. 2012. Impact of disturbance characteristics and age on grizzly bear habitat selection. *Applied Geography* 34:614–625. DOI: 10.1016/j.apgeog.2012.03.001.
- Stordeur, L. 1985. Marten in British Columbia with Implications for Forest Management. Research Branch, Ministry of Forests, Victoria, B.C.
- Stronen, A.V. 2000. Habitat selection and calf survival in the Telkwa caribou herd, British Columbia, 1997-2000. M.E.D. University of Calgary, Calgary, Alberta.
- Stuart, K. 1984. Wildlife-vehicle accidents in British Columbia, April 1982 – March 1983. BC Ministry of Environment.
- Sweanor, P.Y. and Sandegren, F. 1989. Winter-range philopatry of seasonally migratory moose. *Journal of Applied Ecology* 26(1):25–33. DOI: 10.2307/2403648.
- Sweitzer, R.A., Popescu, V.D., Thompson, C.M., Purcell, K.L., Barrett, R.H., Wengert, G.M., Gabriel, M.W., and Woods, L.W. 2016. Mortality risks and limits to population growth of fishers: Mortality Risks and Fisher Population Growth. *The Journal of Wildlife Management* 80(3):438–451. DOI: 10.1002/jwmg.1020.
- Swift, T.L. and Hannon, S.J. 2010. Critical thresholds associated with habitat loss: a review of the concepts, evidence, and applications. *Biological Reviews* 85:35–53.
- TAESCO Consultants Ltd. 1984. Telkwa Project: Vegetation – Forestry – Wildlife. Report prepared for Crows Nest Resources Ltd., Vancouver, BC.
- Timberline Natural Resource Group Ltd. 2010. Predictive Ecosystem Mapping in the Bulkley Timber Supply Area. 25 pp. Available at: <http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=35971>. Accessed November 2021.
- Tischendorf, L. and Fahrig, L. 2000. On the usage and measurement of landscape connectivity. *Oikos* 90(1):7–19.
- TMAC Resources Inc. 2019. Hope Bay Wildlife Mitigation and Monitoring Plan. Hope Bay, Nunavut. Available at:

- https://www.nirb.ca/portal/dms/script/dms_download.php?fileid=327907&applicationid=123632&sessionid=3856abn2dc0s7idaia543kuuu5. Accessed November 2021.
- U.S. Fish and Wildlife Service. 2018. Species Status Assessment for the Coastal Marten (*Martes caurina*) Version 2.0. U.S. Fish and Wildlife Service Region 8, Arcata, California.
- Vertucci, F.A. and Corn, P.S. 1996. Evaluation of episodic acidification and amphibian declines in the Rocky Mountains. *Ecological Applications*. 6(2): 449-457. 6(2):449–457. DOI: 10.2307/2269382
- Viejou, R., Avgar, T., Brown, G., Patterson, B., Reid, D., Rodgers, A., Shuter, J., Thompson, I., and Fryxel, J. 2018. Woodland caribou habitat selection patterns in relation to predation risk and forage abundance depend on reproductive state. *Ecology and Evolution* 8(11):5863–5872.
- Warner, E.J. 1983. Stage I Heritage Resources Overview: Telkwa Coal Project. Prepared for Crows Nest Resources Ltd.
- Wattles, D.W. and DeStefano, S. 2013. Space Use and Movements of Moose in Massachusetts: Implications for Conservation of Large Mammals in a Fragmented Environment. *Alces: A Journal Devoted to the Biology and Management of Moose* 49(0):65–81.
- Weir, J.N., Mahoney, S.P., McLaren, B., and Ferguson, S.H. 2007. Effects of mine development on woodland caribou *Rangifer tarandus* distribution. *Wildlife Biology* 13(1):66–74. DOI: 10.2981/0909-6396(2007)13[66:EOMDOW]2.0.CO;2.
- Weir, R.D. and Corbould, F.B. 2010. Factors Affecting Landscape Occupancy by Fishers in North-Central British Columbia. *Journal of Wildlife Management* 74(3):405–410.
- Weisenberger, M.E., Krausman, P.R., Wallace, M.C., DeYoung, D.W., and Maughan, O.E. 1996. Effects of simulated jet aircraft noise on heart rate and behavior of desert ungulates. *Journal of Wildlife Management* 60(1):52–61.
- Welch, J., Barboza, P., Farley, S., and Spallinger, D. 2015. Nutritional Value of Habitat for Moose on Urban and Military Lands. *Journal of Fish and Wildlife Management* 6(1):158–175.
- Westfall, J., Ebata, T., and Bains, B. 2019. 2019 Summary of Forest Health Conditions in British Columbia. Ministry of Forests, Lands and Natural Resource Operations, and Rural Development, Victoria, BC.
- Wielgus, R.B., Vernier, P.R., and Schivatcheva, T. 2002. Grizzly bear use of open, closed, and restricted forestry roads. *Canadian Journal of Forest Research* 32:1597–1606.
- Wilson, R.R., Parrett, L.S., Joly, K., and Dau, J.R. 2016. Effects of Roads on Individual Caribou Movements During Migration. *Biological Conservation* 195(2016):2–8. DOI: 10.1016/j.biocon.2015.12.035.
- Wind, E. 2020. Guidelines for Amphibian and Reptile Conservation During Road Building and Management Activities in British Columbia. :151.
- Wind, E. and Dupuis, L.A. 2002. COSEWIC Status Report on the Western Toad, *Bufo boreas*, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 81 pp.
- Winter, M., Johnson, D., and Faaborg, J. 2000. Evidence for edge effects on multiple levels in tallgrass prairie. *The Condor* 102(2):256–266.
- Woodford, J.E., Macfarland, D.M., and Worland, M. 2013. Movement, survival, and home range size of translocated american martens (*Martes americana*) in Wisconsin: American Marten Translocations. *Wildlife Society Bulletin* :n/a-n/a. DOI: 10.1002/wsb.291.
- Woodward, A., Fink, A., and Thompson, F. 2001. Edge effects and ecological traps: effects on shrubland birds in Missouri. *Journal of Wildlife Management* 65:668–675.

- Yost, A.C. and Wright, R.G. 2001. Moose, caribou, and grizzly bear distribution in relation to road traffic in Denali National Park, Alaska. *Arctic* 54(1):41–48.
- Zurcher, A.A., Sparks, D.W., and Bennett, V.J. 2010. Why did the bat not cross the road? *Acta Chiropterologica* 12(2):337–340. DOI: 10.3161/150811010X537918.