

Appendix A Terrestrial Invertebrate Sampling Data

Table A-1: Ecology and life history summaries for listed terrestrial invertebrate species potentially occurring in the W-LSA¹.

Common Name	Habitat Requirements	Known Geographical Distribution in Northern BC	Conservation Status Rationale or Reasons for Status Review
Class Insecta: Order Coleoptera - Beetles			
Nine-spotted Lady Beetle	Broad-ranging habitat generalists; found in coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas; eat a wide variety of prey invertebrates including aphids. ²	Recorded from as far north as Quesnel, BC; historically wide-ranging across North America ¹	Decline likely related to numerous factors; competition with introduced, non-native lady beetle species; direct/indirect effect of pesticides used to control aphids, an important prey species; habitat loss due to human-caused disturbances ²
Transverse Lady Beetle	Broad-ranging habitat generalists; found in coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas; eat a wide variety of prey invertebrates including aphids from valley bottoms to alpine, wherever prey insects (e.g., aphids) prevalent ³	Formerly widespread throughout North America, including northern BC (northern extent of range included Yukon, NWT, and Nunavut) ³	Decline likely related to numerous factors; competition with introduced, non-native lady beetle species; direct/indirect effect of pesticides used to control aphids, an important prey species; habitat loss due to human-caused disturbance ³
Gypsy Cuckoo Bumble Bee	Broad-range in a diversity of habitats including boreal forest, open meadows, and montane meadows; elevations from valley bottoms to alpine grasslands; foraging habitats with abundant sun exposure and forage plants blooming throughout growing season; favoured foraging and nesting sites are open meadows, flowering grasslands, and flowering plants on forest floor; forage within 1 to 1.5 km radius of nests, which are typically found in vacant rodent burrows, grass tussocks, or tree cavities; social parasite species that does not build own nest; females lay eggs in host nest after killing or subduing host queen ⁴	Historical range in Canada widespread with records from all provinces and territories except Nunavut ^{4,5} ; species experienced large decline in relative abundance across range during the last 20 to 30 years ⁴ ; Gypsy Cuckoo Bumble Bee may occur in Project area if host species (i.e., Western Bumble Bee and Yellow-banded Bumble Bee) also occur in the area	Main threats: decline of host bumble bee species (Western Bumble Bee and Yellow-banded Bumble Bee) ⁴ ; pesticide use; pathogen spill over from infected non-native bumble bees used in commercial greenhouse pollination ⁴

¹ Based on BC CDC search for listed invertebrates in Skeena Stikine - Bulkley Forest District, Nadina Forest District, and Skeena and Omineca BC MoE Regions; COSEWIC Wildlife Species Search; and SARA Public Registry were also searched for federally-listed species with the potential to occur in the W-LSA.

² Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2016. COSEWIC assessment and status report on the Nine-spotted Lady Beetle *Coccinella novemnotata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

³ COSEWIC. 2016. COSEWIC assessment and status report on the Transverse Lady Beetle (*Coccinella transversoguttata*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

⁴ COSEWIC. 2014. COSEWIC Assessment and Status Report on the Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

⁵ Williams, P.H., R. Thorp, S.R. Colla, and L. Richardson. 2014. A Field Guide to the Bumblebees of North America. Princeton University Press.

Common Name	Habitat Requirements	Known Geographical Distribution in Northern BC	Conservation Status Rationale or Reasons for Status Review
Western Bumble Bee, <i>mckayi</i> and <i>occidentalis</i> subspecies	Broad-range of habitat types including open coniferous, deciduous, and mixed-wood forests; wet and dry meadows; meadows bordering riparian zones; montane meadows; subalpine habitats; along roadsides adjacent to wooded areas; and in isolated natural areas; found in habitat with abundant forage plants blooming throughout growing season; forage within 1 to 1.5 km radius of nests that are typically built in vacant rodent burrows, grass tussocks, or cavities in decaying wood ⁶	Formerly one of the most common bumble bee species observed in western Canada; historical range covered most of BC; species has experienced significant decline in relative abundance across historical range in western North America during last three decades ⁶ ; Western Bumble Bee observed and collected during 2014 and 2016 surveys in Bulkley Valley (Smithers) and Skeena (Hazelton) in northwestern BC ⁷	Likely causes of recent decline of <i>occidentalis</i> subspecies include pathogen spill over from commercially-managed bumble bee colonies; habitat loss and changes; and pesticide use and intensified agricultural processes ⁶ ; <i>mckayi</i> subspecies was granted Special Concern status because of the serious decline in relative abundance experienced by the southern <i>occidentalis</i> subspecies, which appears to be progressing northward ⁶ ; because specific cause(s) of <i>occidentalis</i> decline not yet known, future status of <i>mckayi</i> is unclear ⁶
Yellow-banded Bumble Bee	Broad range of habitats, including mixed woodlands, farmlands, urban areas, montane meadows, prairie grasslands and boreal habitats; recorded foraging from a variety of plants ⁸ ; favoured habitats within or adjacent to wooded areas and wetlands ⁵	Previously common throughout its range across most of Canada to southern Northwest Territories, southeastern Yukon, and eastern BC ⁸ historical range similar to Western Bumble Bee, to which is it related; specimens observed and collected during 2014 surveys in Bulkley Valley (Smithers) & Skeena (Hazelton) in northwestern BC ⁷	Pathogen spillover from managed honey bees and bumble bees; habitat loss (nesting, foraging or overwintering); pesticide exposure; interspecific competition; and climate change ⁸
<i>Class Insecta: Order Lepidoptera - Butterflies and Moths</i>			
Western Meadow Fritillary, <i>sigridae</i> subspecies	Conifer and deciduous forests; mixed forests; grasslands/shrub/meadow habitats ⁹	Northwestern corner of BC, which is the (currently known) southernmost extent of its range; current species range is based on two widely separated records; large area of unsurveyed habitat exists, therefore species range is likely larger than currently reported ¹⁰	Limited distribution in BC ¹⁰

⁶ COSEWIC. 2014. COSEWIC Assessment and Status Report on the Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

⁷ Westcott, L. Unpublished data.

⁸ COSEWIC. 2015. COSEWIC assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

⁹ BC Conservation Data Centre (BC CDC). 2018a. Species Summary: *Boloria epithore sigridae*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 15, 2018).

¹⁰ BC CDC. 2018b. Conservation Status Report: *Boloria epithore sigridae*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 15, 2018).

Common Name	Habitat Requirements	Known Geographical Distribution in Northern BC	Conservation Status Rationale or Reasons for Status Review
Large Marble, <i>ogilvia</i> subspecies	Range of habitats –coniferous forest; grassland/shrub/meadow ¹¹ - from low to alpine elevations ¹² ; <i>Arabis</i> (Family Brassicaceae) is the known host plant in BC ¹²	Subspecies occurs in far northwestern portion of BC; few records within this small range extent, but large are of unchecked habitat ¹³	Limited distribution in BC ¹³
Draco Skipper	Dry pine forests with abundant grasses ¹² ; moist alpine meadows and valley bottoms ¹⁴ ; dry mountain meadows and grassy hillsides ¹⁵ ; food plant(s) unknown ¹²	Scattered populations in far northwestern BC from north of Atlin and the Stikine River; species exhibits disjunct populations (NW BC & Hinton, AB area) ¹²	Limited distribution in BC ¹⁶
<i>Class Insecta: Order Odonata – Dragonflies and Damselflies</i>			
Kennedy's Emerald	Sedge fens and marshes; females lay eggs in shallow open pools with bottoms covered by aquatic mosses ¹⁷	Northern distribution occurring from northeast BC to Porcupine River drainage in northern Yukon ¹⁷ ; single specimens collected near Dease Lake and Fort St. James, BC ¹⁸	Rare in northern BC ¹⁹

¹¹ BC CDC. 2018c. Species Summary: *Euchloe ausonides ogilvia*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 15, 2018).

¹² Guppy, C.S., and J.H. Shepard. 2001. Butterflies of British Columbia. UBC Press and Royal BC Museum: Victoria, BC.

¹³ BC CDC. 2018d. Conservation Status Report: *Euchloe ausonides ogilvia*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 15, 2018).

¹⁴ Scott (1986) cited in BC CDC 2018e

¹⁵ Opler (1999) cited in BC CDC 2018e

¹⁶ BC CDC. 2018e. Species Summary: *Polites draco*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 15, 2018).

¹⁷ Cannings, R.A. 2002. Introducing the Dragonflies of British Columbia and the Yukon. Royal British Columbia Museum: Victoria, BC.

¹⁸ Royal BC Museum, unpublished data

¹⁹ BC CDC. 2018f. Species Summary: *Somatochlora kennedyi*. BC Ministry of Environment. Available: <http://a100.gov.bc.ca/pub/eswp/> (Accessed Feb 16, 2018).

Table A-2: Photographs of sampling methods and sites within the W-LSA.**Plate A1: Blue vane trap in meadow at S1. July 24, 2017****Plate A2: Invertebrate sampling using beating net in S2 area. July 24, 2017.****Plate A3: Malaise trap at S2, July 24, 2017.****Plate A4: Bowl trap at S2, July 24, 2017.****Plate A5: Typical roadside habitat sampled at S3 and S4. July 25, 2017.****Plate A6: Blue vane trap at S4, July 25, 2017.**



Plate A7: Roadside habitat with some flowering plants sampled along T2. July 25, 2017.



Plate A8: Alder-dominated roadside habitat sampled along T2. July 25, 2017.



Plate A9: Malaise trap set up in roadside habitat at S5. July 26, 2017.



Plate A10: Blue vane trap in 10+-year old cultblock at S5. July 26, 2017.



Plate A11: One of several fireweed patches sampled along T3. July 26, 2017.



Plate A12: Using a beating net to collect invertebrates from vegetation at S6. July 27, 2017.



Plate A13: Low abundance of blooming plants in cutblocks sampled along T5. July 27, 2017.



Plate A14: Blooming plants in 10+-year old cutblock sampled along T6. July 27, 2017.



Plate A15: Malaise Trap at S8. July 16, 2018.



Plate A16: Malaise trap at S14. July 18, 2018.



Plate A17: Wetland at S15; photo taken from Malaise trap location. July 23, 2018.



Plate A18: Blue vane trap location and habitat sampled at S16. July 23, 2018



Plate A19: Example of vegetation type sampled along 500 KV transmission line at S17 and T12. July 23, 2018.



Plate A20: Roadside vegetation and blue bowl trap at S18. July 24, 2018.



Plate A21: Roadside vegetation at S19. July 24, 2018.



Plate A22: Constructed pond on BC Hydro transmission right-of-way at S16. July 23, 2018



Plate A23: Roadside vegetation at S20.
July 24, 2018.

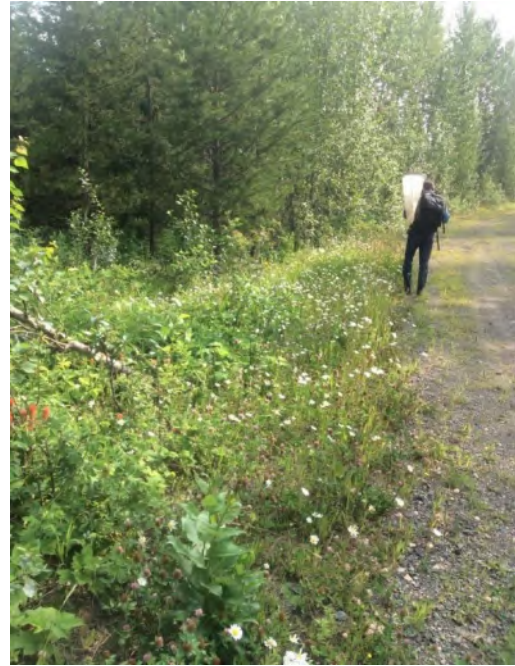


Plate A24: Roadside vegetation at S21.
July 25, 2018.



Plate A25: Sweep net sampling location at S22. July 25, 2018.



Plate A26: Blue vane trap location near wetland at S24. July 26, 2018.



Plate A27: Malaise trap location at S25.
July 27, 2018



Plate A28: Vegetation at S26. July 27, 2018.

Table A-3: Type and number of traps set, and sampling duration per trap July 24 to 27, 2017; July 16 to 18 and July 23 to 27, 2018 in the W-LSA.

Site Number	Survey Date	Blue Vane Traps		Bowl Traps		Malaise Trap
S1	July 24, 2017	3 traps	430 min	6 traps	480 min	-
S2	July 24, 2017	-		3 traps	190 min	1 trap 395 min
S3	July 25, 2017	1 trap	390 min	6 traps	360 min	1 trap 415 min
S4	July 25, 2017	-		3 traps	65 min	-
S5	July 26, 2017	1 trap	305 min	3 traps	310 min	1 trap 310 min
S6	July 27, 2017	2 traps	110 min	2 traps	110 min	-
S7	July 27, 2017	2 traps	145 min	4 traps	145 min	-
S8	July 16, 2018	3 traps	270 min	4 traps	270 min	1 trap 270 min
S9	July 16, 2018	-		-		-
S10	July 16, 2018	-		-		-
S11	July 26, 2018	-		3 traps	60 min	-
S12	July 17, 2018	3 traps	355 min	4 traps	355 min	1 trap 355 min
S13	July 17, 2018	-		4 traps	55 min	-
S14	July 18, 2018	3 traps	210 min	4 traps	210 min	1 trap 210 min
S15	July 23, 2018	-		6 traps	350 min	1 trap 350 min
S16	July 23, 2018	3 traps	120 min	5 traps	120 min	-

Site Number	Survey Date	Blue Vane Traps	Bowl Traps	Malaise Trap
S17	July 23, 2018	3 traps 120 min	5 traps 120 min	-
S18	July 24, 2018	3 traps 375 min	5 traps 375 min	1 trap 375 min
S19	July 24, 2018	-	-	-
S20	July 24, 2018	-	5 traps 210 min	-
S21	July 25, 2018	3 traps 180 min	4 traps 180 min	1 trap 180 min
S22	July 25, 2018	3 traps 110 min	6 traps 110 min	1 trap 110 min
S23	July 26, 2018	-	3 traps 270 min	1 trap 270 min
S24	July 26, 2018	3 traps 215 min	-	-
S25	July 27, 2018	3 traps 340 min	5 traps 340 min	1 trap 340 min
S26	July 27, 2018	-	3 traps 60 min	-

Table A-4: Survey time expended during invertebrate reconnaissance transects conducted July 24 to 27, 2017, July 16 to 18 and July 23 to 27, 2018 in the W-LSA.

Track Number	Survey Date	Survey Duration (minutes)	Survey Distance (m)
T1	July 24, 2017	130	1,194
T2	July 25, 2017	335	1,815
T3	July 26, 2017	280	616
T4	July 27, 2017	140	1,948
T5	July 27, 2017	85	930
T6	July 27, 2017	135	901
T7	July 16, 2018	90	771
T8	July 16, 2018	120	1,441
T9	July 17, 2018	105	1,679
T10	July 26, 2018	120	807
T11	July 18, 2018	210	4,044
T12	July 23, 2018	395	4,293
T13	July 24, 2018	375	3,394
T14	July 25, 2018	180	2,097
T15	July 25, 2018	140	2,434
T16	July 27, 2018	340	4,869

Table A-5: Terrestrial invertebrate species collected within the W-LSA July 24 to 27, 2017.

Common Name	Scientific Name	Listed Species	S1	S2	S3	S4	S5	S6	S7	T1	T2	T3	T4	T5	T6
Spiders	<i>Class Arachnida Order Araneae</i>	No	X				X								X
Goldenrod Crab Spider	<i>Misumena vatia</i>	No										X			
Globular Springtails	<i>Class Collembola Order Symphypleona Family Sminthuridae</i>	No	X	X											
Metallic Wood-boring Beetle	<i>Class Insecta Order Coleoptera Family Buprestidae</i>	No					X				X				
Longhorn Beetle	<i>Class Insecta Order Coleoptera Family Cerambycidae</i>	No			X	X					X	X		X	X
Flower-visiting Longhorn Beetle	<i>Lepturobosca chrysocoma</i>	No					X				X	X			
Leaf Beetle	<i>Class Insecta Order Coleoptera Family Chrysomelidae</i>	No			X			X	X				X	X	X
Seven-spotted Lady Beetle	<i>Coccinella septempunctata</i>	No	X	X								X			
Click Beetle	<i>Class Insecta Order Coleoptera Family Elateridae</i>	No	X								X	X			
Carrion Beetle	<i>Class Insecta Order Coleoptera Family Silphidae</i>	No												X	
Rove Beetle	<i>Class Insecta Order Coleoptera Family Staphylinidae</i>	No	X	X	X	X	X						X	X	X
Bee-like Robber Fly	<i>Laphria sp.</i>	No						X						X	
Blow Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No							X						
Long-legged Fly	<i>Class Insecta Order Diptera Family Dolichopodidae</i>	No	X	X	X	X	X								
Dance Fly	<i>Class Insecta Order Diptera Family Empididae</i>	No					X								
House Fly / Stable Fly	<i>Class Insecta Order Diptera Family Muscidae</i>	No	X	X	X	X	X		X					X	X
Fungus Gnat	<i>Class Insecta Order Diptera Family Mycetophilidae</i>	No		X											
Snipe Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No			X		X								
Flesh Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No		X	X										

Common Name	Scientific Name	Listed Species	S1	S2	S3	S4	S5	S6	S7	T1	T2	T3	T4	T5	T6
Darkwinged Fungus Gnat	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No	X	X	X	X	X								X
Marsh Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No		X	X		X							X	
Hover Fly/ Flower Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No	X	X	X	X	X		X		X			X	X
Horse Fly	<i>Hybomitra sp.-</i>	No		X	X										
Tachinid Fly	<i>Class Insecta Order Diptera Family Calliphoridae</i>	No	X						X			X			
True Bug	<i>Class Insecta Order Heteroptera</i>	No	X	X		X					X				
Plant Bug	<i>Class Insecta Order Heteroptera Family Miridae</i>	No	X	X	X					X	X	X			
Froghopper	<i>Class Insecta Order Homoptera Family Cercopidae</i>	No	X	X						X					
Leafhopper	<i>Class Insecta Order Homoptera Family Cicadellidae</i>	No	X	X	X	X	X				X				
Aphid	<i>Class Insecta Order Homoptera Family Aphididae</i>	No	X	X		X									
Ants	<i>Class Insecta Order Hymenoptera Family Formicidae</i>	No	X												
Braconid Wasp	<i>Class Insecta Order Hymenoptera Family Braconidae</i>	No	X	X	X	X									
Cuckoo Wasp	<i>Class Insecta Order Hymenoptera Family Chrysididae</i>	No		X											
Ichneumon Wasp	<i>Class Insecta Order Hymenoptera Family Ichneumonidae</i>	No	X	X	X		X				√		X	X	X
Spider Wasp	<i>Class Insecta Order Hymenoptera Family Pompilidae</i>	No	X												
Pteromalid Wasp	<i>Class Insecta Order Hymenoptera Family Pteromalidae</i>	No		X	X		X								
Thread-waisted Wasp	<i>Class Insecta Order Hymenoptera Family Sphecidae</i>	No	X	X	X										
Yellowjacket Wasp	<i>Vespula sp.</i>	No	X	X						X					
Aerial Yellowjacket Wasp	<i>Dolichovespula arenaria</i>	No		X	X										
Bald-faced Hornet	<i>Dolichovespula maculata</i>	No		X											

Common Name	Scientific Name	Listed Species	S1	S2	S3	S4	S5	S6	S7	T1	T2	T3	T4	T5	T6
Mining Bee	<i>Panurginus sp.</i>	No	X		X										
Two Form Bumble Bee	<i>Bombus bifarius</i>	No	X											X	X
Yellow Head Bumble Bee	<i>B. flavifrons</i>	No	X		X	X	X		X		X	X		X	X
Indiscriminate Cuckoo Bumble Bee	<i>B. insularis</i>	No		X											
Black Tail Bumble Bee	<i>B. melanopygus</i>	No	X								X	X			
Fuzzy-Horned Bumble Bee	<i>B. mixtus</i>	No	X	X	X		X	X	X		X	X		X	X
Half-black Bumble Bee	<i>B. vagans</i>	No	X	X						X				X	
Bumble Bee subgenus <i>Pyrobombus</i>	<i>Bombus (subgenus Pyrobombus)</i>	No					X								
Sweat Bee	<i>Halictus confusus</i>	No	X												
Sweat Bee	<i>Lasioglossum (Dialictus) sp.</i>	No	X	X											
Sweat Bee	<i>Lasioglossum (Hemihalictus) sp.</i>	No	X												
Sweat Bee	<i>Lasioglossum leucozonium sp.</i>	No	X												
Masked Bee	<i>Hylaeus sp.</i>	No	X									X		X	X
Leafcutter Bee	<i>Megachile frigida</i>	No	X												
Leafcutter Bee	<i>Hoplitis albifrons</i>	No		X											
Mason Bee	<i>Osmia (Melanosmia) sp.</i>	No	X												
Woodland Skipper	<i>Ochlodes sylvanoides</i>	No		X											
Reakirt's Copper	<i>Lycaena (Epidemia) mariposa</i>	No									X				
Greenish Blue	<i>Plebeius saepiolus</i>	No											X		
Silvery Blue	<i>Glaucopsyche lygdamus</i>	No									X				

Common Name	Scientific Name	Listed Species	S1	S2	S3	S4	S5	S6	S7	T1	T2	T3	T4	T5	T6
Northwestern Fritillary	<i>Speyeria hesperis</i>	No	X	X	X	X	X		X	X	X	X	X		X
White Admiral	<i>Limenitis arthemis</i>	No				X			X		X	X	X	X	X
Canadian Tiger Swallowtail	<i>Papilio canadensis</i>	No	X												
Margined White	<i>Pieris marginalis</i>	No									X				
Pink-edged Sulphur	<i>Colias interior</i>	No									X				
Sulphur; (observed)	<i>Colias sp.</i>	No							X					X	X
Snout Moth	<i>Class Insecta Order Lepidoptera Family Pyralidae</i>	No		X											
Langton's Forester Moth	<i>Alypia langtoni</i>	No										X			X
Clearwing Moth	<i>Class Insecta Order Lepidoptera Family Sesiidae</i>	No			X										
Green Lacewing	<i>Class Insecta Order Neuroptera Family Chrysopidae</i>	No			X										X
Darner Dragonfly	<i>Class Insecta Order Odonata Family Aeshnidae</i>	No		X		X				X	X				
Paddle-tailed Darner Dragonfly	<i>Aeshna palmata</i>	No													X
Meadowhawk (Skimmer) Dragonfly	<i>Sympetrum sp.</i>	No									X				
Damselfly	<i>Class Insecta Order Odonata</i>	No		X											
Short-horned Grasshopper	<i>Class Insecta Order Orthoptera Family Acrididae</i>	No	X												
Thrips	<i>Class Insecta Order Thysanoptera Family Phlaeothripidae</i>	No	X												X
Thrips	<i>Class Insecta Order Thysanoptera Family Thripidae</i>	No	X												X
Slug	<i>Class Gastropoda Order Stylommatophora</i>	No											X		

*Bumble bee common names from Williams et al. 2014.

Table A-6: Terrestrial insect species collected from the four taxonomic groups with listed species that could occur within the W-LSA, July 16-18 and 23-27, 2018.

Common Name	Scientific Name	Listed species	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26
Phylum Arthropoda: Class Insecta: Order Coleoptera - Beetles																					
Seven-spotted Lady Beetle	Coccinella septempunctata	No		x										x							
Lady Beetle	Hippodamia sp.	No		x																	
Phylum Arthropoda: Class Insecta: Order Hymenoptera: Superfamily Apoidea Family: Apidae Genus Bombus - Bumble Bees*																					
White-Shouldered Bumble Bee	Bombus appositus	No																		x	
Two Form Bumble Bee	B. bifarius	No	x		x		x			x	x		x	x	x	x	x		x		
Fernald Cuckoo Bumble Bee	B. flavidus	No	x				x			x	x					x					
Yellow Head Bumble Bee	B. flavifrons	No	x				x	x	x	x	x	x	x		x	x	x	x	x	x	
Indiscriminate Cuckoo Bumble Bee	B. insularis	No					x		x		x	x	x						x		
Black Tail Bumble Bee	B. melanopygus	No	x						x				x								
Fuzzy-Horned Bumble Bee	B. mixtus	No		x				x	x	x	x	x	x	x	x	x	x	x		x	
Western Bumble Bee	B. occidentalis occidentalis	Yes																		x	
Confusing Bumble Bee	B. perplexus	No						x													
Sitka Bumble Bee	B. sitkensis	No											x		x		x			x	
Yellow-Banded Bumble Bee	B. terricola	Yes		x			x		x	x	x	x		x			x	x			
Half-black Bumble Bee	B. vagans	No	x				x	x	x	x	x	x									
Phylum Arthropoda: Class Insecta: Order Lepidoptera - Butterflies and Moths – Butterflies																					
European Skipper	Thymelicus lineola	No										x									
Reakirt’s Copper	Lycaena (Epidemia) mariposa	No												x		x					
Northwestern Fritillary	Speyeria hesperis	No							x		x		x			x					
White Admiral	Limenitis arthemis	No												x		x					
Pearl Crescent	Phyciodes tharos	No											x								
Pink-edged Sulphur	Colias interior	No					x						x								
Phylum Arthropoda: Class Insecta: Order Odonata – Dragonflies and Damselflies																					
Darner Dragonfly	Unknown – damaged	No																		x	
Damselfly	Unknown - immature	No									x										

*Bumble bee common names from Williams et al. 2014.

Appendix B1 eDNA Lab Analysis Report

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Final report on eDNA analysis of water samples for the presence of Western Toad, Columbia Spotted Frog, Wood Frog, and Coastal Tailed Frog

Summary

The accompanying spreadsheet contains a summary of the data obtained from the analysis of water filter samples for the presence of Western Toad, Columbia Spotted Frog, Wood Frog and Tailed Frog eDNA. Each filter isolate was tested in triplicate, and the corresponding quantities of each replicate are reported as estimated number of DNA copies. The “A” elution was tested with an assay for each species, as well as an internal control (bacterial lambda DNA). If testing with the internal control indicated PCR inhibition (either a decreased signal or a failed amplification), the “B” elution sample was tested with all assays and also for inhibition. Western Toad DNA was detected at sites LR38, LR39, LR40, TW1, TW2, TW3 and TW8, and at low levels at sites LR37, TW5, and TW9. The Columbia Spotted Frog assay exhibited decreased amplification efficiency for this population, as well as some non-specific amplification when Western Toad DNA was present. However, there was an observable difference in amplification efficiencies between these two scenarios, so it is suspected that Columbia Spotted Frog DNA was detected at sites LR40, LR43, LR45, LR58 and TW4. Wood Frog DNA was detected at sites LR42, LR43, LR46, LR58, TW1 and TW3. The two sites tested for Coastal Tailed Frog yielded negative results.

Methods

For each site, filters were processed with an extraction control for each extraction batch. For each filter sample, a second elute “B” was collected for additional testing – after the initial sample was purified from its DNA extraction column a second volume of elution buffer was run through the same column to collect any DNA that remained bound to it. For each filter, the first elution was analyzed in triplicate for the presence of Western Toad, Columbia Spotted Frog, Wood Frog, and Coastal Tailed Frog eDNA using separate assays.

Positive control lambda DNA was added to the first elute of all filter “A” DNA extracts. All lambda specific qPCR assays were positive and in the expected quantitative range, except for LR31, LR32, LR37, LR38, and LR40. These amplifications either failed, or were slightly lower than the others. The “B” elutions of these samples were then tested against all assays (B elutions tend to be more dilute, and are thus cleaner). Further, no negative control sample, including “field blank” and lab extraction samples, yielded amplification with any assay.

Results

The summary spreadsheet “Summary” shows all sites with a positive signal detected from the first elution sample. Sites are designated “Positive” or “Likely”. For Western Toad, “Likely” sites represent those that have a low number of amplifications, but still yielded a positive signal. All results for the Wood Frog assay were either positive or negative, and neither of the two Coastal Tailed Frog assays amplified

For Columbia Spotted Frog, all amplifying sites are labelled “Likely” because of the unexpectedly low amplification efficiency for this assay. For example, Figure 1 below shows amplifications for site LR40. There is a strong Western Toad signal (in red), and a lower efficiency Columbia Spotted Frog signal (in blue).

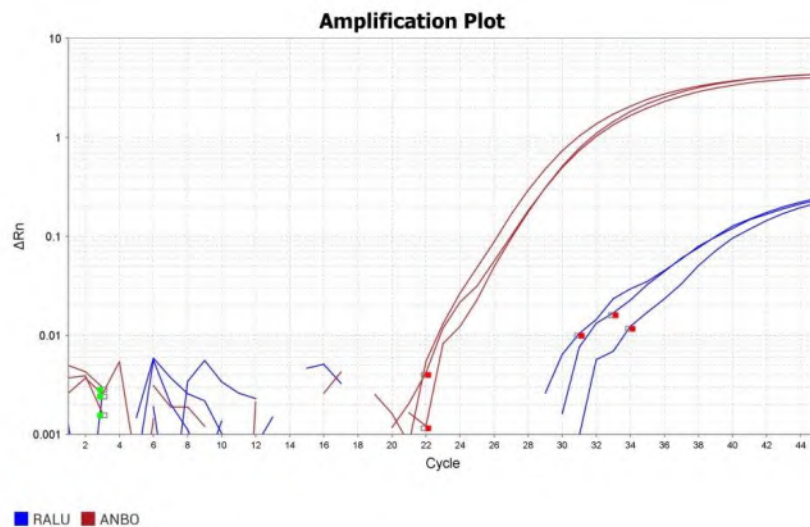


Figure 1 – Example of likely Columbia Spotted Frog amplification (blue) with a positive Western Toad signal (shown to illustrate strong amplification efficiency). Note the difference in maximum ΔRn values (y-axis) between the two assays.

We did also observe some false cross-amplification when Western Toad DNA was present, but this was at a much lower efficiency (Figure 2), distinct from the pattern in Figure 1. Because we had two sites, LR58 and TW4, that had the “positive” Columbia Spotted Frog signal without the high Western Toad DNA presence, we have further evidence that this is distinct from the lower cross-amplification signal. Future testing of Columbia Spotted Frog in this region will have to include testing of tissue from local frogs to determine if they possess a unique haplotype that is causing this kind of amplification.

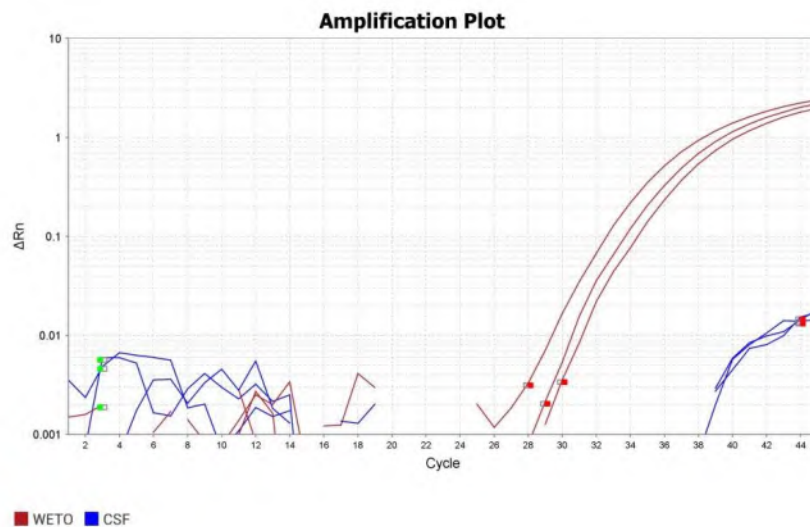


Figure 2 – Example of false cross-amplification. The false Columbia Spotted Frog signal (blue) is occurring with a maximum ΔR_n value an order of magnitude lower than that of Figure 1. This only occurs in the presence of a high Western Toad signal (red).

The “QuantSummary” spreadsheet shows the quantification data for the amplifying sites, organized by species. All values are estimated number of DNA “copies” based on the standard curves of each plate. This includes a summary of any retests that were done. All remaining spreadsheets contain the raw data for each plate. Blanks and extraction controls were tested against all assays. No blank or extraction controls amplified, indicating that proper safeguards against field, extraction and assay contamination.

Standard curves for each assay were created using dilutions of an artificial DNA block (G Block) designed with target sequences for all 4 species (Figure 3). The curve ranged from 50 to 3 DNA copies. The R^2 and efficiency of the reaction assays were all within the acceptable range for quantitative PCR. A separate standard curve was run on each plate (also serves as a positive control), and a Lambda DNA standard curve was run with the inhibitor control tests (not shown).

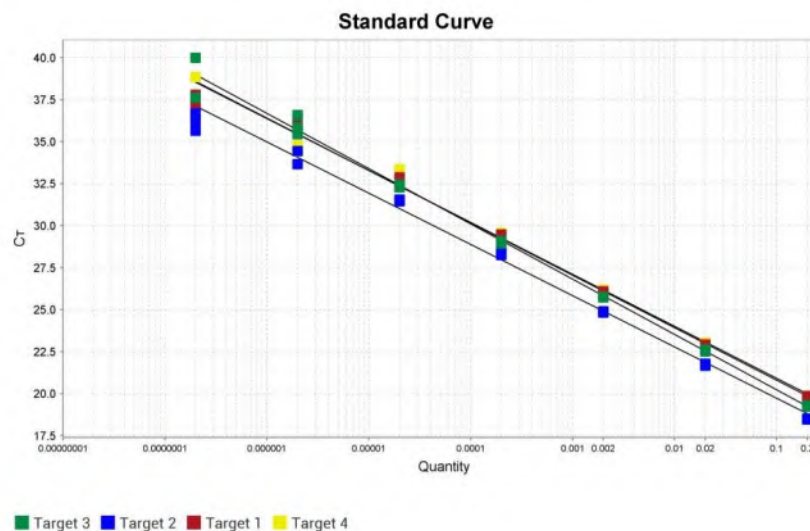


Figure 3 – Test of G Block against the four amphibian assays

Please let us know if you require further clarification of the result and interpretations present here.

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Appendix B2 Western Toad Species Account and Habitat Model Report

Tenas Project

Western Toad Species Account and Habitat Model Report

October 2021

VERSION 4.1

Submitted to:	Telkwa Coal Limited Suite 1410 – 409 Granville Street Vancouver, BC V6C 1T2
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Submitted by:	Ardea Biological Consulting Ltd. 2175 Millar Rd. Smithers, BC V0J 2N6
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Tenas Project

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1. INTRODUCTION

This report describes a habitat suitability model for Western toad, which was developed as part of the baseline information for assessment of the Tenas Project (the Project). The Project Footprint encompasses the area where the proposed mine activities will be conducted. The Wildlife Local Study Area (W-LSA) is the area that is expected to contain all direct effects and indirect effects of the Project for Western toads and will be the study area extent for the habitat model.

This species account and habitat suitability model for Western toad follows the standards outlined in RIC (1999). The ecology and habitat use of Western toad were reviewed, summarized and considered in developing the model using the most current available digital data in the region. Identification of site-specific features such as reproduction areas, upland habitats and potential movement corridors were addressed through baseline surveys within the W-LSA and were used in the development and validation of the model.

2. DISTRIBUTION AND STATUS

2.1 Distribution

Western toads can be found throughout most of British Columbia from the eastern slopes of the Rocky Mountains to the Pacific Ocean from sea level to 4,100 m (Zevit and Wind 2010, Jones 2000). Toads have not been found in the Teslin River Basin in northwest BC, and it is likely absent from extreme northeast BC (CDC 2016). Within its' range in northern BC, it is thought to be limited to permafrost-free valleys that receive early, high accumulations of snow (Cook 1977).

The list of biogeoclimatic (BGC) subzones and variants that occur within the W-LSA outlined in Table 1 **Error! Reference source not found.** were assessed for potential habitat use by forest bats in the development of the habitat suitability model.

Table 1: Summary of ecological classifications within the W-LSA.

Study Area:	Wildlife Local Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecosections:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun) Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc) Engelmann Spruce – Subalpine Fir moist-cold Parkland (ESSFmcp) Engelmann Spruce – Subalpine Fir moist-cold Woodland (ESSFmcw) Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk) Sub-Boreal Spruce dry-cool (SBSdk) Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

2.2 Threats and Status

Western toad is listed by the BC Conservation Centre (CDC) as yellow and is apparently secure in BC (Table 2). COSEWIC assessed Western toad in 2002 and again in 2012 (COSEWIC 2002 and 2012), classifying it as a species of Special Concern both times, with it receiving a SARA listing on Schedule 1 in 2018 as a species of Special Concern. A management plan for Western toad was completed in 2014 (PWTWG (2014), while a Federal plan was proposed in 2016 for the species range in BC, Alberta, Yukon and the Northwest Territories (ECCC 2016).

Provincial population estimates do not exist; however, populations have declined or become extirpated in parts of BC, notably in populated areas of Vancouver Island, the Gulf Islands, and the Lower Mainland (COSEWIC 2012). Recent declines may also be occurring on Haida Gwaii (Zevit and Wind 2010) and in the Atlin area in northwest British Columbia (Slough 2009). Population declines in southwestern BC are thought to be related to habitat loss, chytrid fungus (*Batrachochytrium dendrobatidis*), and predation by introduced species (Zevit and Wind 2010). Populations in northern BC are likely affected by habitat loss and habitat fragmentation due to logging, agriculture, and oil and gas development (COSEWIC 2012). PWTWG 2014).

Table 2: Conservation status of Western toad within the W-LSA.

Common Name	Western Toad
Species Name	Anaxyrus boreas
Species Code	A-ANBO
Provincial Status¹	S4 (2016)
B.C. List	Yellow
Identified Wildlife	No
COSEWIC Status	Special Concern
Species at Risk Act (SARA) Status	Special Concern

Note: 1) S4 = apparently secure

3. GENERAL ECOLOGY

Western toads are characterized by its' bumpy and dry skin, noticeable parotid glands behind the head, and a yellowish, gray or green colouring with few to many dark spots. Reddish warts extend over the back and down the legs which contain poison glands that secrete a fluid to deter predators. Their pupils are horizontal and a cream-coloured or white dorsal stripe. Like all toads, western toads have horny tubercles used for burrowing (Corkran and Thoms 2006, Wind and Dupuis 2002).

The western toad is active from early spring until late fall and hibernates through winter. Adults typically emerge from hibernation and travel to breeding ponds in spring to mate and lay eggs. The eggs and tadpoles develop in the spring and summer, and metamorphosis occurs in late summer/early fall (Muths 2003, Corkran and Thoms 2006, Wind and Dupuis 2002). The breeding period varies with local conditions, beginning as early as January in warmer areas of the province (e.g. southern areas such as Victoria and in warm springs along the north coast) and as late as July in areas of higher elevation and northern BC (Thompson 2004, Elliot et al. 2009). In north-western BC, toads were found to congregate shortly after ice breakup (Slough and Mennell 2006). Gyug (2000) found toad breeding to coincide with the time when average daily minimum temperatures rose above freezing and maximum daily temperatures rose above 10°C. The daily activity of toads has been found to vary by region and elevation (Davis 2000, Carey 1978, Russell and Bauer 1993, Sullivan 1994). At low elevations, they are more nocturnal in summer and more diurnal in early spring. At higher elevations, they tend to be active both day and night, which may be in response to the activity patterns of their principal food sources (Carey 1978, Russell and Bauer 1993, Sullivan 1994).

4. HABITAT REQUIREMENTS

4.1 Life Requisites and Seasons

4.1.1 Living

Suitable western toad terrestrial habitat typically includes a mix of terrestrial types including forest/woodland, shrubland/chaparral, savannah, cropland/hedgerow, grassland/herbaceous cover, fields, and suburban/orchard (BC CDC 2019). Adult toads can live in drier habitats than most amphibians because of their thick skin which protects them against desiccation, while metamorphs and smaller juveniles are more vulnerable to desiccation (BC CDC 2019). Adults require areas with a higher shrub and complex ground cover to provide a more humid environment and higher prey densities (BC CDC 2019). Western toads are frequently found in clearcuts and burned areas that provide moist microsites (Zevit and Wind 2010, Wind and Dupuis 2002, Guscio et al. 2008). Suitable microsites consisting of thermal/security cover and moist soil patches are used repeatedly and represent a critical feature for western toad (PWTWG 2014). This critical habitat feature likely limits their use of dense young forest stands which are characterized by an undeveloped or sparse understory (Franklin 1988, Wind and Dupuis 2002).

Feeding

Feeding habitat provides adult western toads the ability to forage for invertebrates. Optimal habitat is provided by terrestrial habitats, typically mature forests (structural stage 6 or 7), recently cleared forest, or burned areas (structural stage <4), that have dense shrub cover, complex ground cover, and moderate to high ground humidity levels. Newly logged areas with a high cover of woody debris and stumps can provide optimal feeding and security habitat (COSEWIC 2012).

Security/Thermal

Security and thermal habitat for the western toad is defined by protection from predators and adverse weather conditions. Western toads spend a significant amount of time under the cover of rocks, woody and vegetative debris, and inside burrows to avoid predation and desiccation (COSEWIC 2012, Davis 2002). In terrestrial habitats, toads are frequently found under logs and root wads, in existing burrows, or under rocks (L. Rach unpublished data). They may also dig their own burrow in loose soil (Erhardt 1996, Davis 2000).

Optimal security/thermal habitat is provided by suitable terrestrial habitats that are connected to preferred breeding habitats through naturally vegetated corridors. These habitats are typically mature forests (structural stage 6 or 7) or recently cleared or burned areas (structural stage <4), that have dense shrub cover, complex ground cover, and moderate to high ground humidity levels. Dense, low-lying vegetation is preferred over closed canopy forests (COSEWIC 2012, Zevit and Wind 2010).

4.1.2 Reproduction Habitats

Western toads, exhibit high site fidelity to natal breeding ponds, returning to the same breeding sites year after year, even when other potential sites are available (Carpenter 1954, Davis 2000, Jones and Goettl 1998, Bartelt and Peterson 1994). Females produce an average of 12,000 eggs each clutch (Blaustein et al. 1995). Eggs are laid in double strands, attached to submerged vegetation or the bottom of vegetated pools and hatch in three to twelve days depending on water temperature (Leonard et al. 1993, Hengeveld 2000). Emerging tadpoles are small and black with squared snouts that jut forward from their oval body (Corkran and Thoms 2006). Larval metamorphosis takes place after one to three months, depending on temperature, and occurs before winter of the same year (Slough 2009, Stebbins 1951).

Toads require standing water (e.g., ponds, marshes, and wet meadows) or running water (e.g., permanent creeks and small streams) to successfully reproduce (PWTWG 2014, Davis 2002). Although it is frequently

reported that Western toads reproduce in small, shallow, warm, and fish-free waterbodies, studies have shown that they use aquatic habitats occupied by fish when there is emergent vegetation and woody debris for cover (COSEWIC 2012).

Suitable breeding habitat provides a favourable environment to find a mate, lay and hatch eggs, with aquatic longevity for larvae to metamorphosize. Breeding sites include wetlands, shallow, sandy margins of lakes, ponds, streams, river backchannels, beaver ponds, ditch-ponds, and water reservoirs. Ditch lines, road ruts, tailings ponds, and borrow pits are also used, but may result in a wasted reproductive effort due to their ephemeral nature and/or poor water quality (COSEWIC 2012).

Clear, silty, or brackish water with organic, silty, or sandy substrates are used. Sites may be open and unprotected by riparian or aquatic vegetation, or by other structural components such as woody debris, rocks, or undercut banks. A key breeding site feature is water temperature, with warmer water accelerating the growth of the tadpoles (COSEWIC 2012, Zevit and Wind 2010).

4.1.3 Hibernating Habitats

Hibernating habitat is required for overwintering toads and is assumed to include a subset of general living terrestrial habitat. Hibernacula are located in areas with loose soils and existing burrows (Jones and Goettl 1998). These areas are generally underground and deep enough (30-150cm) to avoid freezing and where they have contact with water all winter to prevent desiccation (Zevit and Wind 2010, Wind and Dupuis 2002). Early deep snow accumulation has been suggested to be essential for the survival of western toads in northern BC as it provides early insulation to hibernation sites (Slough 1999, Cook 1977).

Known hibernating habitat features include willow clumps, peat hummocks, squirrel middens, natural crevices, decayed root channels, abandoned beaver lodges and small mammal burrows and tunnels (Browne et al. 2009). Toads also use forestry debris piles (L. Rach, unpublished data) for hibernation sites. These features are found in mature forests (structural stage 6 or 7), in cut-blocks, wetlands, streams, ponds, and shrub habitats. Key feature attributes include high humidity and above freezing temperatures (COSEWIC 2012, Browne et al. 2009).

5. HOME RANGE AND MOVEMENTS

The home range of western toads varies in size according to habitat quality and includes aquatic breeding sites, foraging habitat, and hibernacula (Campbell 1970). Average home ranges for toads in Colorado ranged from 25.96 ha to 24.60 ha for females and 1.33 ha to 5.83 ha for males (Jones 2000, Muths 2003), while home ranges reported on Vancouver Island are as small as 0.1 ha (Davis 2000).

Western toads exhibit a strong annual site fidelity to breeding or overwintering sites and are capable of significant overland movement between breeding ponds, upland ranges, and overwintering areas (Davis 2010, Zevit and Wind 2010). Following breeding, adults may remain to forage in the vicinity of their breeding site or disperse to other wetland, riparian, and upland habitats (Muths 2003). Although commonly found within 2 km of breeding sites, long-distance movements up to 7.2 km have been noted (Davis 2000). Daily movements have been reported to be up to 500 m, with females tending to move farther than males. Female toads have larger home ranges and tend to move farther from breeding sites than males. (Muths 2003).

They have been observed to repeatedly return to specific microsites within their home range (Bartelt and Peterson 1994, Jones and Goettl 1998, Davis 2000), with Davis (2000) reporting toads frequently returning to small moist soil patches that they had created. Davis (2000) also observed that Western toads did not move only small distances the majority of the time, but that occasional long-distance movements were made. Little is known about toadlet dispersal distances, but they have been found several hundreds of metres away from breeding sites (Davis 2000). Migration and dispersal corridors connecting wetland and upland habitats within the home range are considered key for the survival of a population and movement

corridors that connect populations are required for this species' survival (COSEWIC 2012, Wind and Dupuis 2002).

Extensive movements and long distances between breeding, hibernation, and foraging areas increase the vulnerability of western toads in fragmented habitats (COSEWIC 2002). Suitable movement corridor habitat includes suitable living terrestrial habitats, and may include drainages, road edges, wet draws, fields, grass/dirt roads and trails, and right-of-ways for infrastructure (e.g., transmission lines, pipelines) (Adams et al 2005, Rach unpublished data). The use of roads can be conflicting because although road travel can make movements easier and allow longer distances to be travelled, many toads are also killed by traffic or predators. Both thermal and security habitat patches must be available to facilitate successful movement (COSEWIC 2012).

6. MODEL DEVELOPMENT

The RIC (1999) standard for wildlife habitat suitability mapping was developed to provide ratings for wildlife habitats based on ecological mapping. Although the RIC (1999) standard is primarily based on ecosystem attributes found in Terrestrial Ecosystem Mapping (TEM), for Western toad model, additional information for road and stream networks was used to identify key habitat attributes that affect their habitat use. The development of those layers for use in the model are outlined under Section 6.1.

The life requisites that will be rated in this model include **Living** in the **Growing** season, **Reproduction** in the **Spring/Summer** seasons, and **Hibernating** in the **Winter** season. **Living** combines *Feeding*, *Security* and *Thermal* life requisites, which can be satisfied within the same mapping polygon.

6.1 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the Western toad model are described in Table 3. Provincial Vegetation Resource Inventory (VRI) datasets were merged and updated with fire, cutblock, and forest reserve layers to better represent current conditions.

Two existing ecosystem mapping projects have been completed historically within V-RSA. In 1999, Oikos Consulting Ltd., produced a 1:20,000 scale TEM (Oikos TEM) for the Manalta Coal Ltd. Telkwa Coal Project (Oikos 1999). In 2010, Predictive Ecosystem Mapping (PEM) was completed by Timberline Natural Resources Group Ltd. for the Bulkley Timber Supply Area (Bulkley PEM) (Timberline 2010).

Table 3: Datasets used in the development of the forest bat model.

Dataset Name	Description	Source
Telkwa Terrestrial Ecosystem Mapping	TEM created during baseline program for current Telkwa Coal project	Ardea (2020)
Manalta Coal Terrestrial Ecosystem Mapping	TEM created during baseline program for Manalta Coal project	Oikos (1993) - update with new harvest areas from VRI dataset (see below)
Timberline Predictive Ecosystem Mapping	PEM created for the Bulkley Valley Timber Supply Area.	Timberline (2010)

Dataset Name	Description	Source
Vegetation Resource Inventory	Polygons representing vegetated and non-vegetated land classifications combined with VRI, wildfire, harvested area, and forest reserve layers	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-historical https://catalogue.data.gov.bc.ca/dataset/harvested-areas-of-bc-consolidated-cutblocks https://catalogue.data.gov.bc.ca/dataset/recreation-sites-reserves-and-interpretive-forests-details-and-closures-fully-attributed
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow
Freshwater Atlas Stream Network	Streams within the Freshwater Atlas standardized dataset	https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-stream-network
Slope (derived from Digital Elevation Model)	Polygons representing slopes greater than 40 degrees	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain

The updated forestry mapping for ages and new harvesting was used to update both the Oikos TEM and the Bulkley PEM to reflect changes in structural stages and polygon outlines due to harvesting. Ecosystem names and codes were also updated for consistency across the data sets. These ecosystem mapping products were added to the TEM that was completed for the Telkwa Coal Project area as part of the Baseline program (Ardea 2021a) to provide a comprehensive ecosystem map for the W-LSA for the Western toad modelling.

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop ver. 9.3.1 or ver. 10.3.

6.2 Model Rating Scheme

There is moderate level of knowledge of the habitat requirements of Western toad in BC, with additional knowledge of their requirements from other jurisdictions in Canada and the United States. For all of the modelled life requisites a 4-class rating scheme was applied as there was sufficient knowledge and detail in the mapping to effectively rate those habitats (Table 4).

Provincial Benchmark

There are no known provincial benchmarks for Western toad as the benchmarking of habitats for this species has not been completed at this time. It is assumed that there is a full range of habitats for toads is available in the W-LSA.

Table 4: Habitat suitability rating scheme used for life requisites modelled for Western toad (from RIC 1999).

Living Ratings			
% of Provincial Benchmark	Rating	Code	HSI Value
76 to 100%	High	1	1.00
26 to 75%	Moderate	2	0.75
1 to 25%	Low	3	0.25
0%	Nil	4	0.00

Seasonal Use Summary

Western toads are assumed to be present in the W-LSA year round, based observations of reproduction and living during the growing season (Ardea 2021b), although hibernation sites have not been identified. Table 5 summarizes the seasonal life requisite requirements that will be modelled for marten bats based on the seasons outlined in RIC (1999) for the Central Interior ecoprovince.

Table 5. Seasonal chronology for American marten model habitat use in the W-LSA.

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Season ¹	Winter						Spring	Summer		Fall		
Life Requisite	Hibernating (HI-W)						Reproduction (RE-P/S)					
							Living (LI - G)					

Note: 1) Seasons defined for the W-RSA based on RIC (1999)

6.3 Habitat Requirements Summary

The following summary of the habitat attributes required to satisfy the life requisites of the western toad (Table 6) is based on the assumption that use of habitats within the VW-RSA will be comparable to those used in similar habitats in other areas of British Columbia.

Table 6: Summary of habitat requirements for Western toad in the W-LSA.

Life Requisite	Season	Specific Attributes Required	Structural Stages
Living	Growing (Spring/ Summer/Fall)	Mature forests with dense undergrowth, clearings, wetlands, clearcuts, burns, and grasslands that contain high shrub cover and/or woody debris or other features that provide cover.	2-7
		Adequate connectivity (migration/dispersal corridor) between terrestrial and aquatic habitats that contain dense undergrowth or high shrub cover that provide thermal and security cover.	2-7
Reproduction	Spring/Summer	Sufficient aquatic permanence to allow development from egg to metamorphosis.	0 (1-7)
		Presence of emergent vegetation (sedges and grasses) or woody debris within water bodies that are shallow or contain shallow areas (some aquatic habitats don't have sedges and grasses but will have a moderate abundance of algae).	
		Permanent or temporarily inundated water bodies.	0 (1-7)
Hibernating	Winter	Forested habitats with thicker (30 cm to 1.5 m) soils that allow juvenile and adult toads to burrow below the frost line.	5-7
		Moist habitats that contain large coarse woody debris, interstitial spaces in boulder piles and bedrock or existing cavities/rodent burrows that protect this species from freezing and desiccation.	2-7

Life Requisite	Season	Specific Attributes Required	Structural Stages
		Areas with early snow accumulation (determined by Site Series) that contain large coarse woody debris, boulders, or crevices that provide protected spaces (rocky outcroppings generally do not have crevices usable by western toad).	2-7

6.4 Model Assumptions

The Western toad habitat ratings are based on the assumption that the site series / structural stage descriptions provided for the mapping and within available literature adequately describe the attributes of ecosystems that are important to toads. Small ephemeral wetlands and other suitable breeding sites such as ditch lines are generally not mapped at the TEM, PEM, or VRI mapping scales resulting in many very small potential breeding sites that may not be identified within the ecosystem mapping. Table 7 summarizes the ratings assumptions made for each general habitat type within the W-LSA. In addition, the following general assumptions have been made:

- Ecosystems units with dense vegetation understory provide a higher quality habitat than units that have an open understory.
- Data on CWD within the W-LSA is undocumented and mapping is not available. For this model, the presence of CWD is assumed to correspond to the age and productivity of forested ecosystems. Studies conducted in BC have shown that there is a U-shaped relationship with forest age and a linear relationship to productivity (Stevens 1997, Sturtevant et al 1997, Lloyd *et al.* 2007, Feller 2011). Other studies conducted in the same ecosystem types found in the W-LSA have determined general CWD levels by forest type and age (Stevens 1997, Lloyd 2009). Using this information, CWD levels are assumed to increase directly after a disturbance (e.g., timber harvesting, fire) for about 5 years, then decrease as the CWD rots, and increase again after 80 years. With this in mind, newly harvested sites and mature to old forests (Structural Stage 6 and 7) are assumed to contain higher amounts of CWD.
- Habitats that contain red squirrel (*Tamiasciurus hudsonicus*) middens and CWD are considered to provide higher value hibernating habitat. Red squirrel habitat is provided by spruce or pine dominated coniferous and mixed mature forests that show both vertical and ground complexity (Steele 1998). It is assumed that forests of structural stages 6 and 7 (as described above) and with a greater than 30% canopy closure show a degree of structural complexity required for hibernating toads.
- Aquatic ecosystems expected to show a degree of seasonal water permanence and vegetation coverage provide a higher quality breeding habitat than an aquatic habitat where these features are absent. Seasonal water permanence is determined through known documented permanence by wetland type and/or the presence of obligate and facultative wetland plants observed during field visits and extrapolated across the study area.
- Moist habitats (Soil Moisture Regime ≥ 5) that provide spaces (e.g., CWD, boulders, existing cavities/rodent burrows) to protect this species from freezing and desiccation provide the best quality Hibernation habitat.

Table 7: Ecosystem assumptions for Western toad habitat requirements.

General Habitat Type	Assumptions
Wetland ecosystems	All wetland habitats may be used for general Living. Non-ephemeral wetlands are used for Reproducing. Reproducing habitat quality in ephemeral wetland habitats is less than non-ephemeral habitats, depending on water permanency.
Aquatic ecosystems	Aquatic ecosystems are not used for general Living. Pond and lake habitats have a higher value for Reproducing than low gradient stream and backchannel habitats. High gradient streams are not used for Reproducing, but may be used to facilitate migration movements and are therefore useful as Living habitats.
Forested ecosystems	Mature structural stages 6 and 7 receive moderate to high use, depending upon stand productivity. Habitat quality in structural stage 5 is lower due to a general lack of security and thermal cover. Pole/sapling structural stage 4 generally receive low to moderate use, depending upon the stand productivity of the site. Shrub-herb structural stages 2 to 3 generally receive low to moderate use. Cutblocks 0-4 years following forestry harvesting are moderately used due to the assumed levels of CWD and shrub/herb cover that provides thermal and security cover, and food.
Non-forested ecosystems	Vegetated areas are moderately used for living and travelling due to the assumed thermal and security cover and food.
Non-vegetated ecosystems	Non-vegetated areas are not used due to a lack of security and thermal attributes.
Elevation	Higher elevation ecosystems are rated Low for all life requisites due to a shorter growing season and cooler climates.
Anthropogenic polygons	Breeding habitat quality of tailings ponds, and borrow pits is Nil to Low depending on water permanence and water quality. Vegetated areas such as road edges, grass/dirt roads, trails, and right-of-ways for infrastructure (e.g., transmission lines, pipelines) are used as movement corridors and are rated Low for Living. These corridors may increase the value of breeding or hibernating habitat based on accessibility.

6.5 Model Procedure

Each ecosystem component, structural stage and stand composition combination within the W-LSA was applied a final rating value based on the requirements provided in Table 6 and the assumptions outlined in Table 7. The final ratings for ecosystem, structural stage and stand composition combinations for the modeled life requisites are provided in Appendix B2-A. For each ecosystem component/structural stage/stand component combination the rating was assigned the appropriate HIS value from Table 4 and a Preliminary HSI was calculated for the polygon using the formula below:

$$\text{Preliminary HSI} = \frac{\text{Dec1(HSI)} + \text{Dec2(HSI)} + \text{Dec3(HSI)}}{10} \quad \text{Example: } \frac{5(.5) + 3(.25) + 2(.50)}{10} = 0.43$$

6.6 Ratings Adjustments

Adjustments to the suitability ratings were made due to factors that can limit or facilitate the suitability or use by western toad. Suitable habitat that is close to particular anthropogenic features typically provide a

lower value than those adjacent to natural features. Similarly, the proximity of seasonal habitats can increase or decrease the suitability of those habitats.

Factors including stream gradient, distance between breeding and hibernating habitats, barriers (e.g., high velocity streams and rivers, high use roads, rails) and other anthropogenic features not identified in the ecosystem mapping (e.g., grazing leases, reservoirs, buildings) were determined using forest cover, land use, BC Fresh Water Atlas and digital elevation layers. The HSI value applied to the adjustment factors was used to reduce or increase the preliminary suitability values. Zones of influence (ZOI) were determined based on literature and author knowledge.

Adjustments are summarised below and detailed in Table 8.

- Mapped forestry, mine exploration, and agricultural features that create temporary aquatic habitat are considered reproductive sinks. Ratings in this case will result in a decrease in a value of 0.75.
- If highly rated reproducing (HSI ≥ 0.50) are not adjacent or connected with living habitat (HSI > 0), ratings for reproducing habitats will be reduced based on proximity. Those more than 50 m apart will result in a corresponding decrease with increased distance between the two habitat types. The distance is based on the assumption that there is a higher chance of not getting safely from one habitat to another when there is no security habitat.
- Terrestrial ecosystem polygons rated for Hibernating that are connected with dispersal habitat to high-rated Reproducing habitat, are rated higher than those lacking dispersal habitat. These ratings will result in a corresponding adjustment in value with an increased distance between the two habitat types.
- Ratings for high gradient ($>5\%$) stream segments are considered unusable as Reproducing habitat by western toads and rated 0 (Nil). Stream segments with low gradient are rated higher to reflect the use of slow-moving backchannels on flatter terrain for breeding. These low gradient segments are rated to a maximum of 0.50 to reflect potential changes in water flow that could alter breeding habitat.
- Lake edges are considered usable as Reproducing habitat by western toads. A general 10 m (5 m inside and 5 m outside the lake perimeter) zone was rated higher to reflect the use of this area for breeding. Lake edge values were not decreased for some anthropogenic features due to this species' breeding site fidelity. The rating for the 5 m outside of the lake perimeter was increased for existing Living and Hibernating habitat. The inside/outside 5 m zones are a low overall estimate of the area known to be influenced by the fluctuating water levels of lakes and higher water temperatures associated with the shallower water at lake edges.
- If suitable habitat was located within 50 m of a railroad, major or minor road, industrial facility, or select anthropogenic features (e.g., dwellings, industrial facilities), the rating was decreased in value by 0.50.

Table 8: Ratings adjustments for Western toad habitat suitability mapping values.

Life Requisite	Description	ZOI (m)	HSI Adjustment Value	Layer
Living Habitat	Terrestrial Living habitat (LI-G > 0) that is adjacent to lakes is increased	5	+0.50	Outside buffer on lake margins <u>A ANBO Aquatic</u> ; Analysis layer Fields: Lake_Adj = 10 and Type = B
Living Habitat	Terrestrial Living habitat (LI-G > 0) that is adjacent to Railroads, highways and higher use roads	50	-0.50	Outside buffer on select anthro features <u>A ANBO Anthro2</u> ; Analysis layer Field: Anth_Buff = 1

Life Requisite	Description	ZOI (m)	HSI Adjustment Value	Layer
Reproduction Habitat	Gaps (LI-G=0) between higher value breeding (RE-G >0.49) and living habitat (LI-G>0) reduce the value of breeding habitat (to a minimum of low)	50 to 100	-0.20	RE-G buffer layer intersected with LI-G Re_Adj_Buffs; Analysis layer Field: RE_Adj
		101 to 500	-0.30	
		501 to 1000	-0.40	
		1001 to 3000	-0.50	
Reproduction Habitat	Lake margins are considered usable for breeding	10	+0.50	Full buffer on lake margins <u>A ANBO Aquatic</u> ; Analysis layer Field: Lake_Adj = 10
Reproduction Habitat	Stream segments with a gradient =< 5% are considered usable for breeding	0	+0.25	<u>A ANBO Aquatic</u> Fields: TYPE = S and GRIDCODE = 1
Hibernating Habitat	Dispersal distance between higher value breeding (RE-G > 0.49) and moderate to higher value hibernating habitat (LI-W); increase is limited to the SBSdk and SBSmc2	0 to 500	+1.00	LI-W layer intersected with RE-G buffers Re_Adj_Buffs; Analysis layer Field: WI_Adj
		501 to 1000	+0.50	
		1001 to 3000	+0.25	
Hibernating Habitat	Hibernating habitat (LI-W > 0) that is adjacent to lakes is increased	5	+0.25	Outside buffer on lake margins <u>A ANBO Aquatic</u> ; Analysis layer Fields: Lake_Adj = 10 and Type = B

The Preliminary HSI values were adjusted to reflect current anthropogenic and aquatic feature layers that may not be visible in the ecosystem data layers using the following formula.

$$\text{Final HSI} = \frac{(\text{Preliminary HSI} + \text{Adjustment HSI})}{\# \text{HSI values}} \quad \text{Example: } \frac{0.43 + -.25 + .50}{3} = 0.68$$

The final polygon HSI value was then translated back to the RIC 4-Class code and rating (Table 4) for map display purposes.

6.7 Model Evaluation

Data obtained during the amphibian terrestrial and aquatic surveys, eDNA amphibian sampling (Ardea 2021b) and wetland function assessments (Ardea 2021a) provided data that was used to develop and evaluate the Reproduction as well as the Living model. Ecosystem, vegetation and soils information collected during the development of the TEM baseline mapping (Ardea 2021a) was used to develop and evaluate the Living and Hibernation models.

7. LIMITATIONS/CONFIDENCE

The western toad terrestrial habitat ratings for ecosystems within the Project W-LSA are considered to be of moderate to high reliability. Field assessments (Ecosystem Mapping, Wetland Function and Wildlife Habitat Assessments) (Ardea 2021b) were conducted over a large portion of the mapped area, providing knowledge and information on ratings and adjustments.

Some features relevant and important for rating western toad reproduction habitat are difficult to identify through TEM, PEM, and VRI as they are too small to be mapped at 1:20,000; the scale that much of the W-LSA was mapped at (Ardea 2021a). As well, TEM polygons are quite often composed of up to three ecosystems, and can include more ecosystems if they are less than 10% of the polygon area (RIC 1998). Since high quality toad reproductive habitat is not dependent on the size of the aquatic feature, it is likely that some Reproduction habitat was not captured by the model, although all known breeding habitats for Western toad have been documented within the Wildlife Baseline report (Ardea 2021b).

Ratings for some anthropogenic features (e.g., roads, trails, access roads and right of ways) are considered to be of moderate reliability, primarily due to the level of mapping detail and interpretations of these features within the digital data. For example, many of the older logging road features are mapped as having an existing right-of-way that is assumed to be accessible by vehicles, when they are in fact roads that can not be currently driven on due to being grown-in. It is likely that the effects of these roads are not as constraining as modelled and over-estimate lower ratings.

8. SUMMARY OF MODEL RESULTS

The results of the Western toad models for Baseline conditions within the W-LSA are shown in Table 9, and the habitat suitability maps are provided in Appendix B2-B.

The Living model approximately 7,705 ha (21.6% of W-LSA) of high value and 5,431 ha (15.2% of W-LSA) of moderate value habitats in the W-LSA, primarily within the SBSmc2 and SBSdk BGC subzones (Appendix B2-B, Figure B-1), while the majority of the W-LSA was modelled as low value (56.1% of W-LSA).

Table 9: Summary of the results of the Western toad habitat suitability models within the W-LSA under Baseline conditions.

Model	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)
Living in the Growing Season	High	7,704.7	21.6%
	Moderate	5,431.4	15.2%
	Low	20,055.5	56.1%
	Nil	2,532.4	7.1%
	Total	35,724.1	100.0%
Reproduction in the Spring/Summer Seasons	High	329.0	0.9%
	Moderate	337.4	0.9%
	Low	886.3	2.5%
	Nil	34,171.4	95.7%
	Total	35,724.1	100.0%
Hibernation in the Winter Season	High	4,703.4	13.2%
	Moderate	58.2	0.2%
	Low	8,115.7	22.7%
	Nil	22,846.7	64.0%
	Total	35,724.1	100.0%

There was a limited amount of area within the W-LSA identified as high or moderate value Reproduction habitat (0.9 % of the W-LSA for each rating), with almost 96% of the W-LSA identified as nil value (Table 9). Most of the high and moderate value Reproduction habitat was identified within the SBSdk BGC subzone (Appendix B2-B, Figure B-2).

A total of 4,703 ha (13% of W-LSA) was identified as high value Hibernation habitat (Table 9), primarily within the SBSdk, followed by the SBSmc2 BGC subzones (Appendix B2-B, Figure B-3). There was limited amounts of area identified as moderate value Hibernation habitat (0.2%), with approximately 23% identified as low value and 64% identified as nil value (Table 9).

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Appendix B2-A Western Toad Habitat Suitability Model - Final Ecosystem Lookup Tables

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
BAFAun	BAFAunHG2d	3	4	4	ESSFmc	ESSFmcFB7C	3	4	4
BAFAun	BAFAunHG2dC	3	4	4	ESSFmc	ESSFmcFB7M	3	4	4
BAFAun	BAFAunHM2a	3	4	4	ESSFmc	ESSFmcFC3	3	4	4
BAFAun	BAFAunHM2aC	3	4	4	ESSFmc	ESSFmcFC3C	3	4	4
BAFAun	BAFAunPF3b	3	4	4	ESSFmc	ESSFmcFC4	3	4	4
BAFAun	BAFAunPF3bC	3	4	4	ESSFmc	ESSFmcFC4C	3	4	4
BAFAun	BAFAunRO1	4	4	4	ESSFmc	ESSFmcFC4M	3	4	4
BAFAun	BAFAunRO1C	4	4	4	ESSFmc	ESSFmcFC5	3	4	4
ESSFmc	ESSFmcAW3bC	3	4	4	ESSFmc	ESSFmcFC5C	3	4	4
ESSFmc	ESSFmcBW3a	3	4	4	ESSFmc	ESSFmcFC5M	3	4	4
ESSFmc	ESSFmcCB1	4	4	4	ESSFmc	ESSFmcFC6	3	4	4
ESSFmc	ESSFmcES1	4	4	4	ESSFmc	ESSFmcFC6C	3	4	4
ESSFmc	ESSFmcES3	4	4	4	ESSFmc	ESSFmcFC6M	3	4	4
ESSFmc	ESSFmcFB	3	4	4	ESSFmc	ESSFmcFC7	3	4	4
ESSFmc	ESSFmcFB3	3	4	4	ESSFmc	ESSFmcFD	3	4	4
ESSFmc	ESSFmcFB3C	3	4	4	ESSFmc	ESSFmcFD3	3	4	4
ESSFmc	ESSFmcFB4	3	4	4	ESSFmc	ESSFmcFD3C	3	4	4
ESSFmc	ESSFmcFB4C	3	4	4	ESSFmc	ESSFmcFD4	3	4	4
ESSFmc	ESSFmcFB5	3	4	4	ESSFmc	ESSFmcFD5	3	4	4
ESSFmc	ESSFmcFB5C	3	4	4	ESSFmc	ESSFmcFD5C	3	4	4
ESSFmc	ESSFmcFB5M	3	4	4	ESSFmc	ESSFmcFD5M	3	4	4
ESSFmc	ESSFmcFB6	3	4	4	ESSFmc	ESSFmcFD6	3	4	3
ESSFmc	ESSFmcFB6B	3	4	4	ESSFmc	ESSFmcFD6C	3	4	3
ESSFmc	ESSFmcFB6C	3	4	4	ESSFmc	ESSFmcFD6M	3	4	3
ESSFmc	ESSFmcFB6M	3	4	4	ESSFmc	ESSFmcFD7	3	4	3
ESSFmc	ESSFmcFB7	3	4	4	ESSFmc	ESSFmcFD7C	3	4	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
ESSFmc	ESSFmcFD7M	3	4	3	ESSFmc	ESSFmcFT6C	3	4	4
ESSFmc	ESSFmcFH	3	4	4	ESSFmc	ESSFmcFT7C	3	4	4
ESSFmc	ESSFmcFH3	3	4	4	ESSFmc	ESSFmcFT7	3	4	4
ESSFmc	ESSFmcFH3C	3	4	4	ESSFmc	ESSFmcFV	3	4	4
ESSFmc	ESSFmcFH4	3	4	4	ESSFmc	ESSFmcFV3	3	4	4
ESSFmc	ESSFmcFH5C	3	4	4	ESSFmc	ESSFmcFV3C	3	4	4
ESSFmc	ESSFmcFH5	3	4	4	ESSFmc	ESSFmcFV4	3	4	4
ESSFmc	ESSFmcFH6C	3	4	3	ESSFmc	ESSFmcFV5	3	4	4
ESSFmc	ESSFmcFH6	3	4	3	ESSFmc	ESSFmcFV6	3	4	3
ESSFmc	ESSFmcFH7	3	4	3	ESSFmc	ESSFmcFV6C	3	4	3
ESSFmc	ESSFmcFH7C	3	4	3	ESSFmc	ESSFmcFV7	3	4	3
ESSFmc	ESSFmcFH7M	3	4	3	ESSFmc	ESSFmcHG3	3	4	4
ESSFmc	ESSFmcFO	3	4	4	ESSFmc	ESSFmcHG3bC	3	4	4
ESSFmc	ESSFmcFO3	3	4	4	ESSFmc	ESSFmcHG3C	3	4	4
ESSFmc	ESSFmcFO3C	3	4	4	ESSFmc	ESSFmcHG4C	3	4	4
ESSFmc	ESSFmcFO4	3	4	4	ESSFmc	ESSFmcHG5	3	4	4
ESSFmc	ESSFmcFO5	3	4	4	ESSFmc	ESSFmcHG6	3	4	3
ESSFmc	ESSFmcFO5C	3	4	4	ESSFmc	ESSFmcHG6C	3	4	3
ESSFmc	ESSFmcFO5M	3	4	4	ESSFmc	ESSFmcHG7	3	4	3
ESSFmc	ESSFmcFO6C	3	4	3	ESSFmc	ESSFmcHG7M	3	4	3
ESSFmc	ESSFmcFO6	3	4	3	ESSFmc	ESSFmcHH3	3	4	4
ESSFmc	ESSFmcFO7	3	4	3	ESSFmc	ESSFmcHH3C	3	4	4
ESSFmc	ESSFmcFO7C	3	4	3	ESSFmc	ESSFmcHH4C	3	4	4
ESSFmc	ESSFmcFO7M	3	4	3	ESSFmc	ESSFmcHH5	3	4	4
ESSFmc	ESSFmcFT3C	3	4	4	ESSFmc	ESSFmcHH5C	3	4	4
ESSFmc	ESSFmcFT6M	3	4	4	ESSFmc	ESSFmcHH5M	3	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
ESSFmc	ESSFmcHH6	3	4	4	ESSFmc	ESSFmcSS3C	3	3	3
ESSFmc	ESSFmcHH6C	3	4	4	ESSFmc	ESSFmcSS5C	3	3	3
ESSFmc	ESSFmcHH6M	3	4	4	ESSFmc	ESSFmcSS6C	3	3	3
ESSFmc	ESSFmcHH7	3	4	4	ESSFmc	ESSFmcSW2	3	4	4
ESSFmc	ESSFmcHH7C	3	4	4	ESSFmc	ESSFmcTA1	4	4	4
ESSFmc	ESSFmcHH7M	3	4	4	ESSFmc	ESSFmcWE3a	3	4	4
ESSFmc	ESSFmcLC3	3	4	4	ESSFmc	ESSFmcWF2	2	2	3
ESSFmc	ESSFmcLC3C	3	4	4	ESSFmc	ESSFmcWF4	2	2	3
ESSFmc	ESSFmcLC4C	3	4	4	ESSFmc	ESSFmcRO1	4	4	4
ESSFmc	ESSFmcLC5	3	4	4	ESSFmc	ESSFmcRZ0	4	4	4
ESSFmc	ESSFmcLC5C	3	4	4	ESSFmc	ESSFmcSL3a	3	4	4
ESSFmc	ESSFmcLC5M	3	4	4	ESSFmc	ESSFmcSL3bC	3	4	4
ESSFmc	ESSFmcLC6	3	4	4	ESSFmc	ESSFmcSL3b	3	4	4
ESSFmc	ESSFmcLC6C	3	4	4	ESSFmc	ESSFmcSS3C	3	3	4
ESSFmc	ESSFmcLC6M	3	4	4	ESSFmc	ESSFmcSS5C	3	3	4
ESSFmc	ESSFmcLC7	3	4	4	ESSFmc	ESSFmcSS6C	3	3	3
ESSFmc	ESSFmcLC7C	3	4	4	ESSFmc	ESSFmcSW2	3	4	4
ESSFmc	ESSFmcLC7M	3	4	4	ESSFmc	ESSFmcSW3a	3	4	4
ESSFmc	ESSFmcOW0	3	3	4	ESSFmc	ESSFmcTA1	4	4	4
ESSFmc	ESSFmcPD0	3	3	4	ESSFmc	ESSFmcTA1C	4	4	4
ESSFmc	ESSFmcLS2	3	4	4	ESSFmc	ESSFmcWE3a	3	4	4
ESSFmc	ESSFmcLS3aC	3	4	4	ESSFmc	ESSFmcWE3aC	3	4	4
ESSFmc	ESSFmcLS3a	3	4	4	ESSFmc	ESSFmcWE3aM	3	4	4
ESSFmc	ESSFmcRZ0	4	4	4	ESSFmc	ESSFmcWF2	2	2	3
ESSFmc	ESSFmcSL3b	3	4	4	ESSFmcp	ESSFmcpHG2d	3	4	4
ESSFmc	ESSFmcSS3bC	3	3	3	ESSFmcp	ESSFmcpHG2dC	3	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
ESSFmcp	ESSFmcpHM2	3	4	4	ESSFmcw	ESSFmcwFJ6	3	4	4
ESSFmcp	ESSFmcpHM2a	3	4	4	ESSFmcw	ESSFmcwFJ7	3	4	4
ESSFmcp	ESSFmcpHM2aC	3	4	4	ESSFmcw	ESSFmcwFL	3	4	4
ESSFmcp	ESSFmcpLA0	3	3	4	ESSFmcw	ESSFmcwFL3	3	4	4
ESSFmcp	ESSFmcpPF3b	3	4	4	ESSFmcw	ESSFmcwFL4	3	4	4
ESSFmcp	ESSFmcpPF3bC	3	4	4	ESSFmcw	ESSFmcwFL5	3	4	4
ESSFmcp	ESSFmcpRO1	4	4	4	ESSFmcw	ESSFmcwFL6	3	4	4
ESSFmcp	ESSFmcpRO1C	4	4	4	ESSFmcw	ESSFmcwFL7	3	4	4
ESSFmcp	ESSFmcpWL3	3	4	4	ESSFmcw	ESSFmcwFV3	3	4	4
ESSFmcp	ESSFmcpWL3a	3	4	4	ESSFmcw	ESSFmcwFV4	3	4	4
ESSFmcp	ESSFmcpWM2b	3	4	4	ESSFmcw	ESSFmcwFV5	3	4	4
ESSFmcw	ESSFmcwCB	4	4	4	ESSFmcw	ESSFmcwFV6	3	4	3
ESSFmcw	ESSFmcwCB1	4	4	4	ESSFmcw	ESSFmcwFV7	3	4	3
ESSFmcw	ESSFmcwFC	3	4	4	ESSFmcw	ESSFmcwHM	3	4	4
ESSFmcw	ESSFmcwFC3	3	4	4	ESSFmcw	ESSFmcwHM2a	3	4	4
ESSFmcw	ESSFmcwFC4	3	4	4	ESSFmcw	ESSFmcwPD0	3	4	4
ESSFmcw	ESSFmcwFC5	3	4	4	ESSFmcw	ESSFmcwPD0C	3	4	4
ESSFmcw	ESSFmcwFC6	3	4	4	ESSFmcw	ESSFmcwRO	4	4	4
ESSFmcw	ESSFmcwFC7	3	4	4	ESSFmcw	ESSFmcwRO1	4	4	4
ESSFmcw	ESSFmcwFG4	3	4	4	ESSFmcw	ESSFmcwRO1C	4	4	4
ESSFmcw	ESSFmcwFG5	3	4	4	ESSFmcw	ESSFmcwTA	4	4	4
ESSFmcw	ESSFmcwFG6	3	4	3	ESSFmcw	ESSFmcwTA1	4	4	4
ESSFmcw	ESSFmcwFG7	3	4	3	ESSFmcw	ESSFmcwWE	3	4	4
ESSFmcw	ESSFmcwFJ4	3	4	4	ESSFmcw	ESSFmcwWE3a	3	4	4
ESSFmcw	ESSFmcwFJ	3	4	4	SBSdk	SBSdkAM5B	1	4	3
ESSFmcw	ESSFmcwFJ5	3	4	4	SBSdk	SBSdkAM5M	1	4	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkAM6B	1	4	3	SBSdk	SBSdkAtpw6M	1	4	2
SBSdk	SBSdkAM6M	1	4	2	SBSdk	SBSdkAtss3a	1	4	4
SBSdk	SBSdkAN3b	1	4	3	SBSdk	SBSdkAtss4B	1	4	4
SBSdk	SBSdkAN4B	1	4	3	SBSdk	SBSdkAtss5B	1	4	4
SBSdk	SBSdkAP0	4	4	4	SBSdk	SBSdkBS3D	2	2	4
SBSdk	SBSdkAtcv3aB	2	4	3	SBSdk	SBSdkBS3M	2	2	4
SBSdk	SBSdkAtcv5B	2	4	3	SBSdk	SBSdkBS4M	2	2	4
SBSdk	SBSdkAtcv5M	1	4	3	SBSdk	SBSdkBS5C	2	2	3
SBSdk	SBSdkAtcv6B	2	4	3	SBSdk	SBSdkBS6C	2	2	3
SBSdk	SBSdkAtcv6M	1	4	3	SBSdk	SBSdkBS7M	2	2	3
SBSdk	SBSdkAtha4M	2	4	3	SBSdk	SBSdkBW2b	3	4	4
SBSdk	SBSdkAtha5M	2	4	3	SBSdk	SBSdkBW2bD	3	4	4
SBSdk	SBSdkAtki3b	3	4	4	SBSdk	SBSdkBW2bM	3	4	4
SBSdk	SBSdkAtki3bM	3	4	4	SBSdk	SBSdkBW3a	3	4	4
SBSdk	SBSdkAtki4M	3	4	4	SBSdk	SBSdkCA2a	1	4	3
SBSdk	SBSdkAtlf5B	1	4	3	SBSdk	SBSdkCA3a	1	4	3
SBSdk	SBSdkAtlf5M	1	4	3	SBSdk	SBSdkCB1	4	4	4
SBSdk	SBSdkAtlf6M	1	4	3	SBSdk	SBSdkCB1D	4	4	4
SBSdk	SBSdkAtpw3aB	1	4	3	SBSdk	SBSdkCB1M	4	4	4
SBSdk	SBSdkAtpw3bB	1	4	3	SBSdk	SBSdkCD	1	3	4
SBSdk	SBSdkAtpw4B	1	4	3	SBSdk	SBSdkCD3	1	3	4
SBSdk	SBSdkAtpw4M	1	4	3	SBSdk	SBSdkCD3C	1	3	4
SBSdk	SBSdkAtpw5	1	4	3	SBSdk	SBSdkCD3M	1	3	4
SBSdk	SBSdkAtpw5B	1	4	3	SBSdk	SBSdkCD4	1	3	4
SBSdk	SBSdkAtpw5M	1	4	3	SBSdk	SBSdkCD4C	1	3	4
SBSdk	SBSdkAtpw6B	1	4	3	SBSdk	SBSdkCD4D	1	3	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkCD4M	1	3	4	SBSdk	SBSdkFm025M	1	3	3
SBSdk	SBSdkCD5	1	3	4	SBSdk	SBSdkFm026B	1	3	2
SBSdk	SBSdkCD5B	1	3	4	SBSdk	SBSdkFm026C	1	3	2
SBSdk	SBSdkCD5M	1	3	4	SBSdk	SBSdkFm026M	1	3	2
SBSdk	SBSdkCD6	1	3	3	SBSdk	SBSdkGB	4	4	4
SBSdk	SBSdkCD6B	1	3	3	SBSdk	SBSdkGB1	3	4	4
SBSdk	SBSdkCD6M	1	3	3	SBSdk	SBSdkGB1a	3	4	4
SBSdk	SBSdkCD7C	1	3	3	SBSdk	SBSdkGP1	4	4	4
SBSdk	SBSdkCD7	1	3	3	SBSdk	SBSdkGP1C	4	4	4
SBSdk	SBSdkCD7M	1	3	3	SBSdk	SBSdkGP1D	4	4	4
SBSdk	SBSdkCF2	3	4	4	SBSdk	SBSdkGP1M	4	4	4
SBSdk	SBSdkCF2b	3	4	4	SBSdk	SBSdkGP2b	4	4	4
SBSdk	SBSdkCF2C	3	4	4	SBSdk	SBSdkLA0	3	4	4
SBSdk	SBSdkCF2D	3	4	4	SBSdk	SBSdkLA0D	3	4	4
SBSdk	SBSdkCF2M	3	4	4	SBSdk	SBSdkLA0M	3	4	4
SBSdk	SBSdkDM3b	2	4	3	SBSdk	SBSdkLC	3	4	4
SBSdk	SBSdkEpdM4B	3	4	4	SBSdk	SBSdkLC2	3	4	4
SBSdk	SBSdkEpdM5B	3	4	4	SBSdk	SBSdkLC3	3	4	4
SBSdk	SBSdkEpdM5M	3	4	4	SBSdk	SBSdkLC3a	3	4	4
SBSdk	SBSdkES1	4	4	4	SBSdk	SBSdkLC3b	3	4	4
SBSdk	SBSdkFI013a	1	3	4	SBSdk	SBSdkLC3aC	3	4	4
SBSdk	SBSdkFI013b	1	3	4	SBSdk	SBSdkLC3C	3	4	4
SBSdk	SBSdkFI013bB	1	3	4	SBSdk	SBSdkLC3B	3	4	4
SBSdk	SBSdkFm023bB	1	3	3	SBSdk	SBSdkLC3M	3	4	4
SBSdk	SBSdkFm024M	1	3	3	SBSdk	SBSdkLC4B	3	4	4
SBSdk	SBSdkFm025B	1	3	3	SBSdk	SBSdkLC4C	3	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkLC4	3	4	4	SBSdk	SBSdkLJ6C	3	4	4
SBSdk	SBSdkLC4M	3	4	4	SBSdk	SBSdkLJ6	3	4	4
SBSdk	SBSdkLC5	3	4	4	SBSdk	SBSdkLJ6M	3	4	4
SBSdk	SBSdkLC5C	3	4	4	SBSdk	SBSdkLJ7C	3	4	4
SBSdk	SBSdkLC5B	3	4	4	SBSdk	SBSdkLJ7	3	4	4
SBSdk	SBSdkLC5M	3	4	4	SBSdk	SBSdkLJ7M	3	4	4
SBSdk	SBSdkLC6C	3	4	4	SBSdk	SBSdkLS3a	1	2	3
SBSdk	SBSdkLC6	3	4	4	SBSdk	SBSdkOW0	3	1	4
SBSdk	SBSdkLC6M	3	4	4	SBSdk	SBSdkPA2	3	4	4
SBSdk	SBSdkLC7C	3	4	4	SBSdk	SBSdkPA2a	3	4	4
SBSdk	SBSdkLC7D	3	4	4	SBSdk	SBSdkPA2b	3	4	4
SBSdk	SBSdkLC7	3	4	4	SBSdk	SBSdkPA3	3	4	4
SBSdk	SBSdkLC7M	3	4	4	SBSdk	SBSdkPA3a	3	4	4
SBSdk	SBSdkLCC	3	4	4	SBSdk	SBSdkPD0	3	1	4
SBSdk	SBSdkLJ	3	4	4	SBSdk	SBSdkPD0C	3	1	4
SBSdk	SBSdkLJ3	3	4	4	SBSdk	SBSdkPD0D	3	1	4
SBSdk	SBSdkLJ3C	3	4	4	SBSdk	SBSdkPD0M	3	1	4
SBSdk	SBSdkLJ3D	3	4	4	SBSdk	SBSdkRI	4	4	4
SBSdk	SBSdkLJ3M	3	4	4	SBSdk	SBSdkRI_RIP0C	2	3	4
SBSdk	SBSdkLJ4C	3	4	4	SBSdk	SBSdkRI_RIP0D	2	3	4
SBSdk	SBSdkLJ4	3	4	4	SBSdk	SBSdkRI_RIP0M	2	3	4
SBSdk	SBSdkLJ4M	3	4	4	SBSdk	SBSdkRI0	4	4	4
SBSdk	SBSdkLJ5C	3	4	4	SBSdk	SBSdkRI0D	4	4	4
SBSdk	SBSdkLJ5	3	4	4	SBSdk	SBSdkRI0M	4	4	4
SBSdk	SBSdkLJ5B	3	4	4	SBSdk	SBSdkRN0	4	4	4
SBSdk	SBSdkLJ5M	3	4	4	SBSdk	SBSdkRW0	4	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkRW0M	4	4	4	SBSdk	SBSdkSF2	3	4	4
SBSdk	SBSdkRW2b	4	4	4	SBSdk	SBSdkSF3	3	4	4
SBSdk	SBSdkRW3	4	4	4	SBSdk	SBSdkSF3C	3	4	4
SBSdk	SBSdkRW3a	4	4	4	SBSdk	SBSdkSF3D	3	4	4
SBSdk	SBSdkRZ0	4	4	4	SBSdk	SBSdkSF3M	3	4	4
SBSdk	SBSdkRZ1	4	4	4	SBSdk	SBSdkSF4	3	4	4
SBSdk	SBSdkRZ0C	4	4	4	SBSdk	SBSdkSF4C	3	4	4
SBSdk	SBSdkRZ0D	4	4	4	SBSdk	SBSdkSF4B	3	4	4
SBSdk	SBSdkRZ0M	4	4	4	SBSdk	SBSdkSF4M	3	4	4
SBSdk	SBSdkRZ1	3	4	4	SBSdk	SBSdkSF5	3	4	4
SBSdk	SBSdkRZ1a	3	4	4	SBSdk	SBSdkSF5C	3	4	4
SBSdk	SBSdkRZ2a	3	4	4	SBSdk	SBSdkSF5B	3	4	4
SBSdk	SBSdkSD3	1	4	3	SBSdk	SBSdkSF5M	3	4	4
SBSdk	SBSdkSD3C	1	4	3	SBSdk	SBSdkSF6C	3	4	4
SBSdk	SBSdkSD4	1	4	3	SBSdk	SBSdkSF6B	3	4	4
SBSdk	SBSdkSD4M	1	4	3	SBSdk	SBSdkSF6	3	4	4
SBSdk	SBSdkSD3M	1	4	3	SBSdk	SBSdkSF6C	3	4	4
SBSdk	SBSdkSD5B	1	4	2	SBSdk	SBSdkSF6M	3	4	4
SBSdk	SBSdkSD5C	1	4	2	SBSdk	SBSdkSF7C	3	4	4
SBSdk	SBSdkSD5M	1	4	2	SBSdk	SBSdkSF7	3	4	4
SBSdk	SBSdkSD6	1	4	1	SBSdk	SBSdkSF7M	3	4	4
SBSdk	SBSdkSD6C	1	4	1	SBSdk	SBSdkSH	1	4	3
SBSdk	SBSdkSD7B	1	4	1	SBSdk	SBSdkSH3	1	4	3
SBSdk	SBSdkSD7C	1	4	1	SBSdk	SBSdkSH3aC	1	4	3
SBSdk	SBSdkSD6M	1	4	1	SBSdk	SBSdkSH3C	1	4	3
SBSdk	SBSdkSF	3	4	4	SBSdk	SBSdkSH3D	1	4	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkSH3M	1	4	3	SBSdk	SBSdkSP3aC	3	4	4
SBSdk	SBSdkSH4	1	4	3	SBSdk	SBSdkSP3bC	3	4	4
SBSdk	SBSdkSH4C	1	4	3	SBSdk	SBSdkSP3b	3	4	4
SBSdk	SBSdkSH4B	1	4	3	SBSdk	SBSdkSP3C	3	4	4
SBSdk	SBSdkSH4M	1	4	3	SBSdk	SBSdkSP3B	3	4	4
SBSdk	SBSdkSH5	1	4	3	SBSdk	SBSdkSP3M	3	4	4
SBSdk	SBSdkSH5B	1	4	3	SBSdk	SBSdkSP4	3	4	4
SBSdk	SBSdkSH5C	1	4	3	SBSdk	SBSdkSP4C	3	4	4
SBSdk	SBSdkSH5D	1	4	3	SBSdk	SBSdkSP4B	3	4	4
SBSdk	SBSdkSH5M	1	4	3	SBSdk	SBSdkSP4M	3	4	4
SBSdk	SBSdkSH6	1	4	2	SBSdk	SBSdkSP5	3	4	4
SBSdk	SBSdkSH6C	1	4	2	SBSdk	SBSdkSP5B	3	4	4
SBSdk	SBSdkSH6B	1	4	2	SBSdk	SBSdkSP5C	3	4	4
SBSdk	SBSdkSH6M	1	4	2	SBSdk	SBSdkSP5D	3	4	4
SBSdk	SBSdkSH7	1	4	2	SBSdk	SBSdkSP5M	3	4	4
SBSdk	SBSdkSH7aC	1	4	2	SBSdk	SBSdkSP6	3	4	4
SBSdk	SBSdkSH7C	1	4	2	SBSdk	SBSdkSP6C	3	4	4
SBSdk	SBSdkSH7D	1	4	2	SBSdk	SBSdkSP6B	3	4	4
SBSdk	SBSdkSH7M	1	4	2	SBSdk	SBSdkSP6M	3	4	4
SBSdk	SBSdkSL3b	2	4	4	SBSdk	SBSdkSP7	3	4	4
SBSdk	SBSdkSP	3	4	4	SBSdk	SBSdkSP7C	3	4	4
SBSdk	SBSdkSP1	3	4	4	SBSdk	SBSdkSP7D	3	4	4
SBSdk	SBSdkSP2	3	4	4	SBSdk	SBSdkSP7M	3	4	4
SBSdk	SBSdkSP2b	3	4	4	SBSdk	SBSdkSS	2	2	3
SBSdk	SBSdkSP3	3	4	4	SBSdk	SBSdkSS3	2	2	3
SBSdk	SBSdkSP3a	3	4	4	SBSdk	SBSdkSS3bC	2	2	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkSS3C	2	2	3	SBSdk	SBSdkST4	1	4	3
SBSdk	SBSdkSS3M	2	2	3	SBSdk	SBSdkST4M	1	4	3
SBSdk	SBSdkSS4C	2	2	3	SBSdk	SBSdkST5	1	4	3
SBSdk	SBSdkSS4D	2	2	3	SBSdk	SBSdkST5C	1	4	3
SBSdk	SBSdkSS4	2	2	3	SBSdk	SBSdkST5B	1	4	3
SBSdk	SBSdkSS4M	2	2	3	SBSdk	SBSdkST5M	1	4	3
SBSdk	SBSdkSS5C	2	2	3	SBSdk	SBSdkST6C	1	4	1
SBSdk	SBSdkSS5D	2	2	3	SBSdk	SBSdkST6B	1	4	1
SBSdk	SBSdkSS5	2	2	3	SBSdk	SBSdkST6	1	4	1
SBSdk	SBSdkSS5M	2	2	3	SBSdk	SBSdkST6M	1	4	1
SBSdk	SBSdkSS6C	2	2	2	SBSdk	SBSdkST7C	1	4	1
SBSdk	SBSdkSS6	2	2	2	SBSdk	SBSdkST7B	1	4	1
SBSdk	SBSdkSS6M	2	2	2	SBSdk	SBSdkST7	1	4	1
SBSdk	SBSdkSS7C	2	2	2	SBSdk	SBSdkST7M	1	4	1
SBSdk	SBSdkSS7	2	2	2	SBSdk	SBSdkSW3a	3	4	4
SBSdk	SBSdkSS7M	2	2	2	SBSdk	SBSdkSW3b	3	4	4
SBSdk	SBSdkST	1	4	3	SBSdk	SBSdkSW3bB	3	4	4
SBSdk	SBSdkST3	1	4	3	SBSdk	SBSdkTA1C	4	4	4
SBSdk	SBSdkST3b	1	4	3	SBSdk	SBSdkTA1	4	4	4
SBSdk	SBSdkST3a	1	4	3	SBSdk	SBSdkTL2b	2	4	4
SBSdk	SBSdkST3aC	1	4	3	SBSdk	SBSdkTL3a	2	4	4
SBSdk	SBSdkST3C	1	4	3	SBSdk	SBSdkTL2	2	4	4
SBSdk	SBSdkST3B	1	4	3	SBSdk	SBSdkTL3	2	4	4
SBSdk	SBSdkST3M	1	4	3	SBSdk	SBSdkUR0	4	4	4
SBSdk	SBSdkST4C	1	4	3	SBSdk	SBSdkUR0C	4	4	4
SBSdk	SBSdkST4B	1	4	3	SBSdk	SBSdkUR0D	4	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSdk	SBSdkUR0M	4	4	4	SBSmc2	SBSmc2Atcv5B	2	4	3
SBSdk	SBSdkWE3b	1	1	2	SBSmc2	SBSmc2Atha3a	1	4	4
SBSdk	SBSdkWE3bC	1	1	2	SBSmc2	SBSmc2Atha3aB	1	4	4
SBSdk	SBSdkWE3bD	1	1	2	SBSmc2	SBSmc2Atha3aC	1	4	4
SBSdk	SBSdkWE3bM	1	1	2	SBSmc2	SBSmc2Atha3bB	1	4	4
SBSdk	SBSdkWF2	1	1	3	SBSmc2	SBSmc2Atha3bM	1	4	4
SBSdk	SBSdkWF3a	1	1	3	SBSmc2	SBSmc2Atha4B	1	4	4
SBSdk	SBSdkWF3b	1	1	3	SBSmc2	SBSmc2Atha4M	1	4	4
SBSdk	SBSdkWm012b	1	1	3	SBSmc2	SBSmc2AW3bC	3	4	4
SBSdk	SBSdkWm013a	1	1	3	SBSmc2	SBSmc2AW3bM	3	4	4
SBSdk	SBSdkWm022a	1	1	3	SBSmc2	SBSmc2BF3C	2	4	4
SBSdk	SBSdkWm023a	1	1	3	SBSmc2	SBSmc2BF3bC	2	4	4
SBSdk	SBSdkWs033b	1	1	2	SBSmc2	SBSmc2BF4C	2	4	4
SBSdk	SBSdkWm052b	1	1	4	SBSmc2	SBSmc2BF4M	2	4	4
SBSdk	SBSdkWs023bM	1	1	2	SBSmc2	SBSmc2BF6C	2	4	3
SBSdk	SBSdkWs033b	1	1	2	SBSmc2	SBSmc2BF6M	2	4	3
SBSdk	SBSdkWs043a	1	1	2	SBSmc2	SBSmc2BF7aC	2	4	3
SBSdk	SBSdkWT3a	2	4	4	SBSmc2	SBSmc2BF7C	2	4	3
SBSdk	SBSdkWT3b	2	4	4	SBSmc2	SBSmc2BF7	2	4	3
SBSdk	SBSdkWT3bB	2	4	4	SBSmc2	SBSmc2BM3	3	4	4
SBSdk	SBSdkWT5	2	4	4	SBSmc2	SBSmc2BM3aC	3	4	4
SBSdk	SBSdkWT5B	2	4	4	SBSmc2	SBSmc2BM3bC	3	4	4
SBSdk	SBSdkWT5M	2	4	4	SBSmc2	SBSmc2BM3bM	3	4	4
SBSdk	SBSdkWT6M	2	4	4	SBSmc2	SBSmc2BM3C	3	4	4
SBSdk	SBSdkXs3a	3	4	4	SBSmc2	SBSmc2BM3M	3	4	4
SBSmc2	SBSmc2AN3b	2	4	3	SBSmc2	SBSmc2BM4C	3	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSmc2	SBSmc2BM4	3	4	4	SBSmc2	SBSmc2PD0D	3	1	4
SBSmc2	SBSmc2BM4M	3	4	4	SBSmc2	SBSmc2PD0M	3	1	4
SBSmc2	SBSmc2BM5C	3	4	4	SBSmc2	SBSmc2PH3	3	4	4
SBSmc2	SBSmc2BM5	3	4	4	SBSmc2	SBSmc2PH3bC	3	4	4
SBSmc2	SBSmc2BM5M	3	4	4	SBSmc2	SBSmc2PH3C	3	4	4
SBSmc2	SBSmc2BM6C	3	4	4	SBSmc2	SBSmc2PH3M	3	4	4
SBSmc2	SBSmc2BM6	3	4	4	SBSmc2	SBSmc2PH4	3	4	4
SBSmc2	SBSmc2BM6M	3	4	4	SBSmc2	SBSmc2PH4C	3	4	4
SBSmc2	SBSmc2BM7aC	3	4	4	SBSmc2	SBSmc2PH4M	3	4	4
SBSmc2	SBSmc2BM7C	3	4	4	SBSmc2	SBSmc2PH5C	3	4	4
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SBSmc2	SBSmc2BM7M	3	4	4	SBSmc2	SBSmc2PH5	3	4	4
SBSmc2	SBSmc2BW3	3	4	4	SBSmc2	SBSmc2PH5M	3	4	4
SBSmc2	SBSmc2BW3a	3	4	4	SBSmc2	SBSmc2PH6C	3	4	4
SBSmc2	SBSmc2CB1	4	4	4	SBSmc2	SBSmc2PH6D	3	4	4
SBSmc2	SBSmc2CF2C	3	4	4	SBSmc2	SBSmc2PH6	3	4	4
SBSmc2	SBSmc2DM3b	2	4	4	SBSmc2	SBSmc2PH6M	3	4	4
SBSmc2	SBSmc2ES1	4	4	4	SBSmc2	SBSmc2PH7C	3	4	4
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SBSmc2	SBSmc2OW	3	1	4	SBSmc2	SBSmc2RI_RIP0D	2	3	4
SBSmc2	SBSmc2OW0	3	1	4	SBSmc2	SBSmc2RI_RIP0M	2	3	4
SBSmc2	SBSmc2PA2	3	4	4	SBSmc2	SBSmc2RI0	4	4	4
SBSmc2	SBSmc2PD0	3	1	4	SBSmc2	SBSmc2RO1	4	4	4
SBSmc2	SBSmc2PD0C	3	1	4	SBSmc2	SBSmc2RS3b	3	4	4

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
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SBSmc2	SBSmc2SB3aC	3	4	4	SBSmc2	SBSmc2SD3	1	4	3
SBSmc2	SBSmc2SB3aM	3	4	4	SBSmc2	SBSmc2SD3bC	1	4	3
SBSmc2	SBSmc2SB3bC	3	4	4	SBSmc2	SBSmc2SD3C	1	4	3
SBSmc2	SBSmc2SB3b	3	4	4	SBSmc2	SBSmc2SD3D	1	4	3
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SBSmc2	SBSmc2SB3B	3	4	4	SBSmc2	SBSmc2SD4D	1	4	3
SBSmc2	SBSmc2SB3M	3	4	4	SBSmc2	SBSmc2SD4	1	4	3
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SBSmc2	SBSmc2SB4M	3	4	4	SBSmc2	SBSmc2SD5B	1	4	3
SBSmc2	SBSmc2SB5C	3	4	4	SBSmc2	SBSmc2SD5M	1	4	3
SBSmc2	SBSmc2SB5B	3	4	4	SBSmc2	SBSmc2SD6C	1	4	2
SBSmc2	SBSmc2SB5	3	4	4	SBSmc2	SBSmc2SD6B	1	4	2
SBSmc2	SBSmc2SB5M	3	4	4	SBSmc2	SBSmc2SD6	1	4	2
SBSmc2	SBSmc2SB6C	3	4	4	SBSmc2	SBSmc2SD6M	1	4	2
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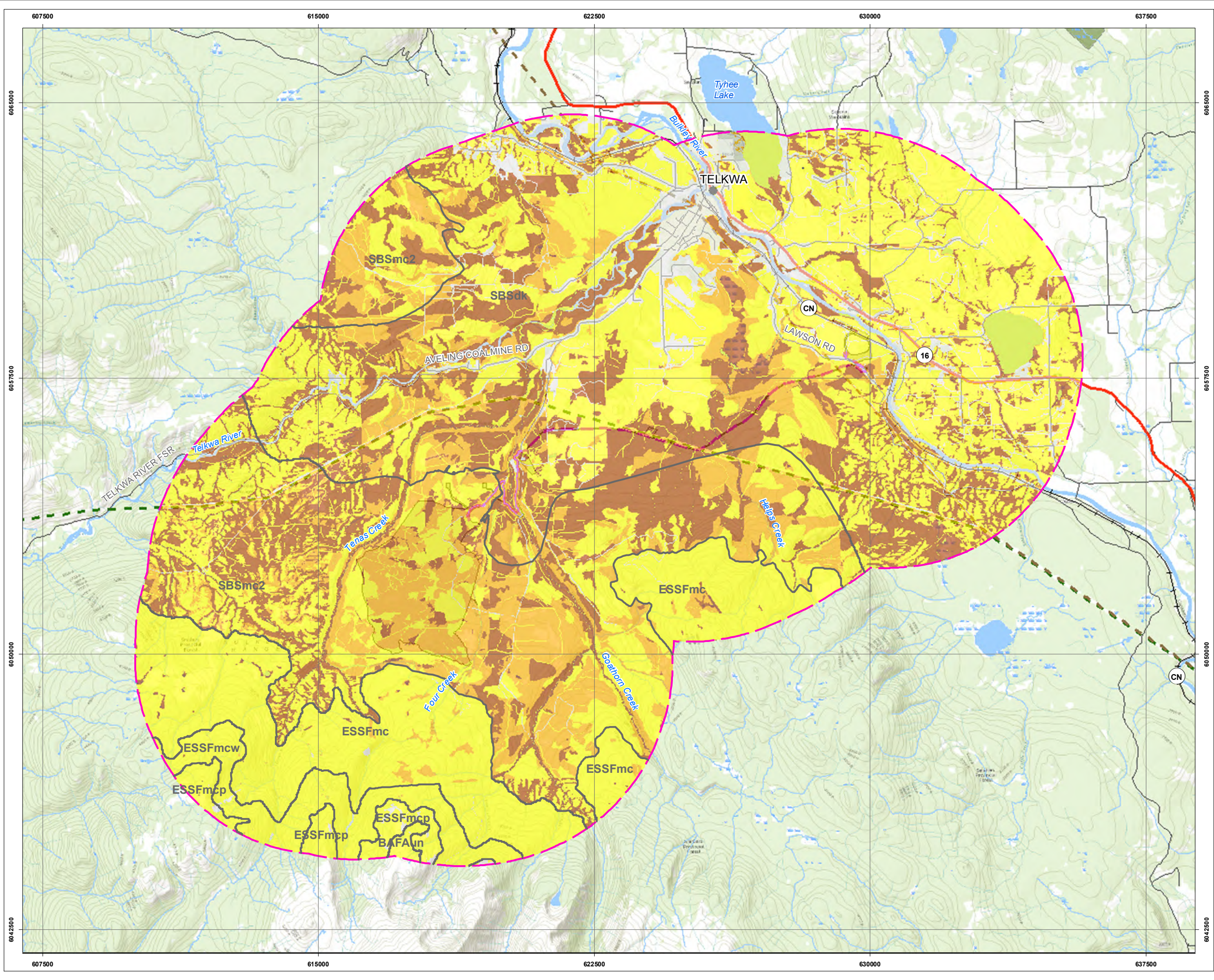
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SBSmc2	SBSmc2SD7M	1	4	2	SBSmc2	SBSmc2SO	2	4	4
SBSmc2	SBSmc2SH	1	4	4	SBSmc2	SBSmc2SO3	2	4	4
SBSmc2	SBSmc2SH3	1	4	4	SBSmc2	SBSmc2SO3aC	2	4	4
SBSmc2	SBSmc2SH3aC	1	4	4	SBSmc2	SBSmc2SO3aM	2	4	4
SBSmc2	SBSmc2SH3bC	1	4	4	SBSmc2	SBSmc2SO3bC	2	4	4
SBSmc2	SBSmc2SH3C	1	4	4	SBSmc2	SBSmc2SO3bM	2	4	4
SBSmc2	SBSmc2SH3D	1	4	4	SBSmc2	SBSmc2SO3C	2	4	4
SBSmc2	SBSmc2SH3M	1	4	4	SBSmc2	SBSmc2SO3D	2	4	4
SBSmc2	SBSmc2SH4B	1	4	4	SBSmc2	SBSmc2SO3M	2	4	4
SBSmc2	SBSmc2SH4C	1	4	4	SBSmc2	SBSmc2SO4B	2	4	4
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SBSmc2	SBSmc2SH4M	1	4	4	SBSmc2	SBSmc2SO4	2	4	4
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SBSmc2	SBSmc2SH5C	1	4	3	SBSmc2	SBSmc2SO5C	2	4	3
SBSmc2	SBSmc2SH5	1	4	3	SBSmc2	SBSmc2SO5D	2	4	3
SBSmc2	SBSmc2SH5M	1	4	3	SBSmc2	SBSmc2SO5	2	4	3
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SBSmc2	SBSmc2SH6C	1	4	3	SBSmc2	SBSmc2SO6C	1	4	3
SBSmc2	SBSmc2SH6M	1	4	3	SBSmc2	SBSmc2SO6	1	4	3
SBSmc2	SBSmc2SH7aC	1	4	3	SBSmc2	SBSmc2SO6M	1	4	3
SBSmc2	SBSmc2SH7C	1	4	3	SBSmc2	SBSmc2SO7aC	1	4	3
SBSmc2	SBSmc2SH7	1	4	3	SBSmc2	SBSmc2SO7aM	1	4	3
SBSmc2	SBSmc2SH7M	1	4	3	SBSmc2	SBSmc2SO7C	1	4	3
SBSmc2	SBSmc2SL3	2	4	4	SBSmc2	SBSmc2SO7	1	4	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI	BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
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SBSmc2	SBSmc2SS3bC	2	2	4	SBSmc2	SBSmc2TC6B	1	4	2
SBSmc2	SBSmc2SS3b	2	2	4	SBSmc2	SBSmc2TC6	1	4	2
SBSmc2	SBSmc2SS3C	2	2	4	SBSmc2	SBSmc2TC6M	1	4	2
SBSmc2	SBSmc2SS3bC	2	2	4	SBSmc2	SBSmc2TC7aC	1	4	2
SBSmc2	SBSmc2SS4C	2	2	4	SBSmc2	SBSmc2TC7aM	1	4	2
SBSmc2	SBSmc2SS5C	2	2	3	SBSmc2	SBSmc2TC7C	1	4	2
SBSmc2	SBSmc2SS5M	2	2	3	SBSmc2	SBSmc2TC7	1	4	2
SBSmc2	SBSmc2SS6C	2	2	3	SBSmc2	SBSmc2TC7M	1	4	2
SBSmc2	SBSmc2SS7C	2	2	3	SBSmc2	SBSmc2TL2	3	4	4
SBSmc2	SBSmc2SW3a	3	4	4	SBSmc2	SBSmc2TL3	3	4	4
SBSmc2	SBSmc2TC	2	4	3	SBSmc2	SBSmc2UR0	4	4	4
SBSmc2	SBSmc2TC3	2	4	3	SBSmc2	SBSmc2UR0C	4	4	4
SBSmc2	SBSmc2TC3aC	2	4	3	SBSmc2	SBSmc2UR0D	4	4	4
SBSmc2	SBSmc2TC3C	2	4	3	SBSmc2	SBSmc2UR0M	4	4	4
SBSmc2	SBSmc2TC3B	2	4	3	SBSmc2	SBSmc2Wb013a	2	3	4
SBSmc2	SBSmc2TC3bB	2	4	3	SBSmc2	SBSmc2Wb016	2	3	3
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SBSmc2	SBSmc2TC4C	2	4	3	SBSmc2	SBSmc2Wb017aC	2	3	3
SBSmc2	SBSmc2TC4B	2	4	3	SBSmc2	SBSmc2Wb01C	2	3	4
SBSmc2	SBSmc2TC4	2	4	3	SBSmc2	SBSmc2Wb053	2	3	4
SBSmc2	SBSmc2TC4M	2	4	3	SBSmc2	SBSmc2Wb053aC	2	3	4
SBSmc2	SBSmc2TC5C	2	4	3	SBSmc2	SBSmc2Wb053bC	2	3	4
SBSmc2	SBSmc2TC5B	2	4	3	SBSmc2	SBSmc2Wb057aC	2	3	3
SBSmc2	SBSmc2TC5	2	4	3	SBSmc2	SBSmc2WE3b	2	2	3
SBSmc2	SBSmc2TC5M	2	4	3	SBSmc2	SBSmc2WE3bC	1	2	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSmc2	SBSmc2WE3bM	1	2	3
SBSmc2	SBSmc2Wf012b	1	2	3
SBSmc2	SBSmc2WF2	1	2	3
SBSmc2	SBSmc2WF3a	1	2	3
SBSmc2	SBSmc2WF3b	1	2	3
SBSmc2	SBSmc2Wm022b	1	2	3
SBSmc2	SBSmc2Ws023b	1	2	3
SBSmc2	SBSmc2Ws023bM	1	2	3

BGC	LABEL	ANBO_LI	ANBO_RE	ANBO_HI
SBSmc2	SBSmc2Ws033bB	1	2	3
SBSmc2	SBSmc2WT3b	2	4	4
SBSmc2	SBSmc2WT3bM	2	4	4
SBSmc2	SBSmc2WT4M	2	4	4
SBSmc2	SBSmc2WT5B	2	4	4
SBSmc2	SBSmc2WT5M	2	4	4
SBSmc2	SBSmc2WT6M	2	4	4

Appendix B2-B Western Toad Habitat Suitability Maps - Baseline Conditions



Tenas Project

Western Toad Habitat Suitability
Living in the Growing Season
(Baseline Conditions)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

Wetland

Waterbody

Park or Protected Area

Municipal Area

Project Area

Wildlife LSA

Western Toad Suitability
Living (Growing Season)

High

Moderage

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, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Model: Terraniche Environmental Solutions & Ardea Biological Consulting Ltd.

- Mapping: Ardea Biological Consulting Ltd.

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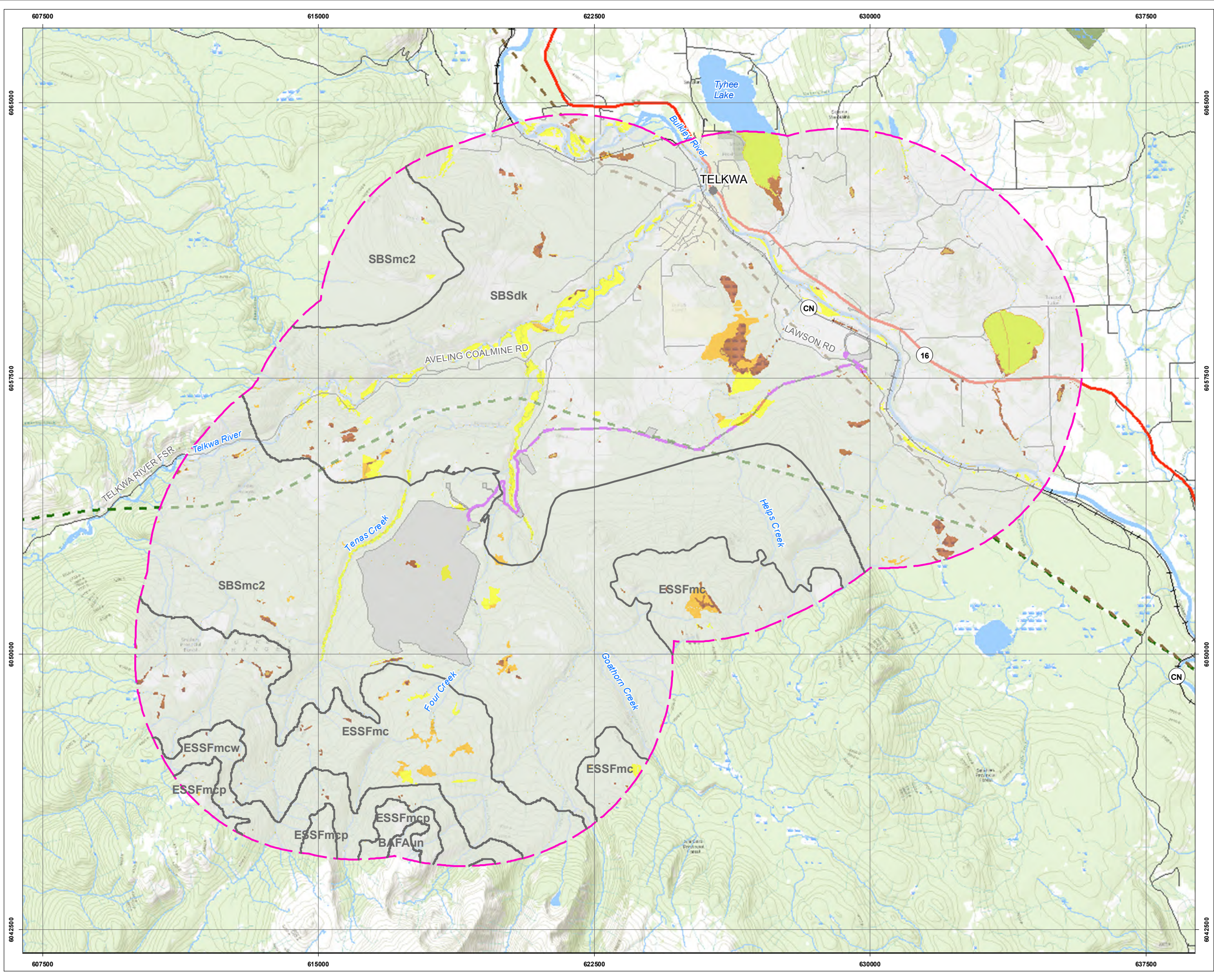
Figure B-1

TELKWA COAL

100%

ARDEA BIOLOGICAL CONSULTING

100%



Tenas Project

Western Toad Habitat Suitability
Reproduction in the Spring/Summer Seasons
(Baseline Conditions)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

Wetland

Waterbody

Park or Protected Area

Municipal Area

Project Area

Wildlife LSA

Western Toad Suitability
Reproduction (Spring/Summer)

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, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Model: Terraniche Environmental Solutions & Ardea Biological Consulting Ltd.

- Mapping: Ardea Biological Consulting Ltd.

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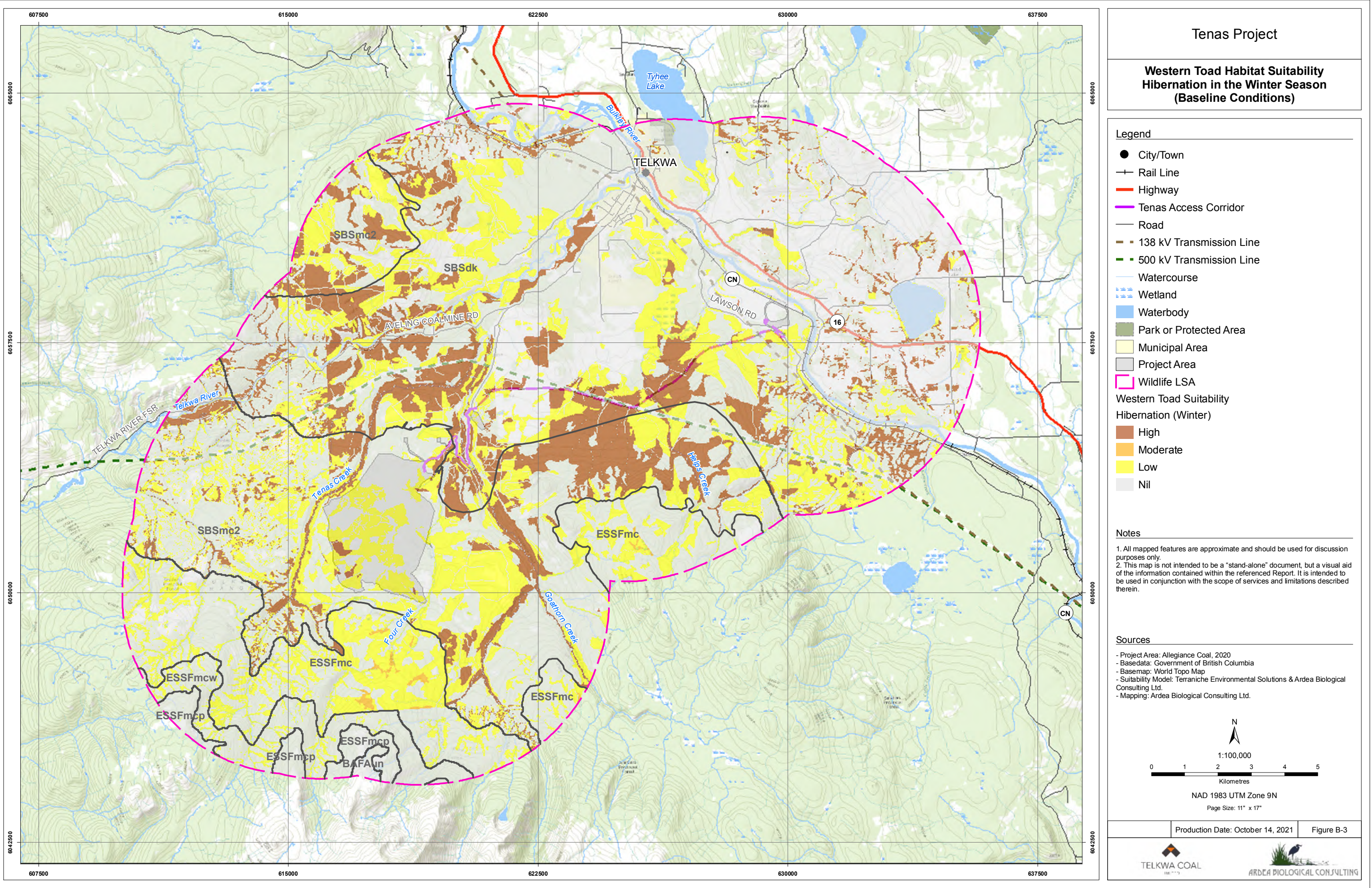
Figure B-2

TELKWA COAL

100%

ARDEA BIOLOGICAL CONSULTING

100%

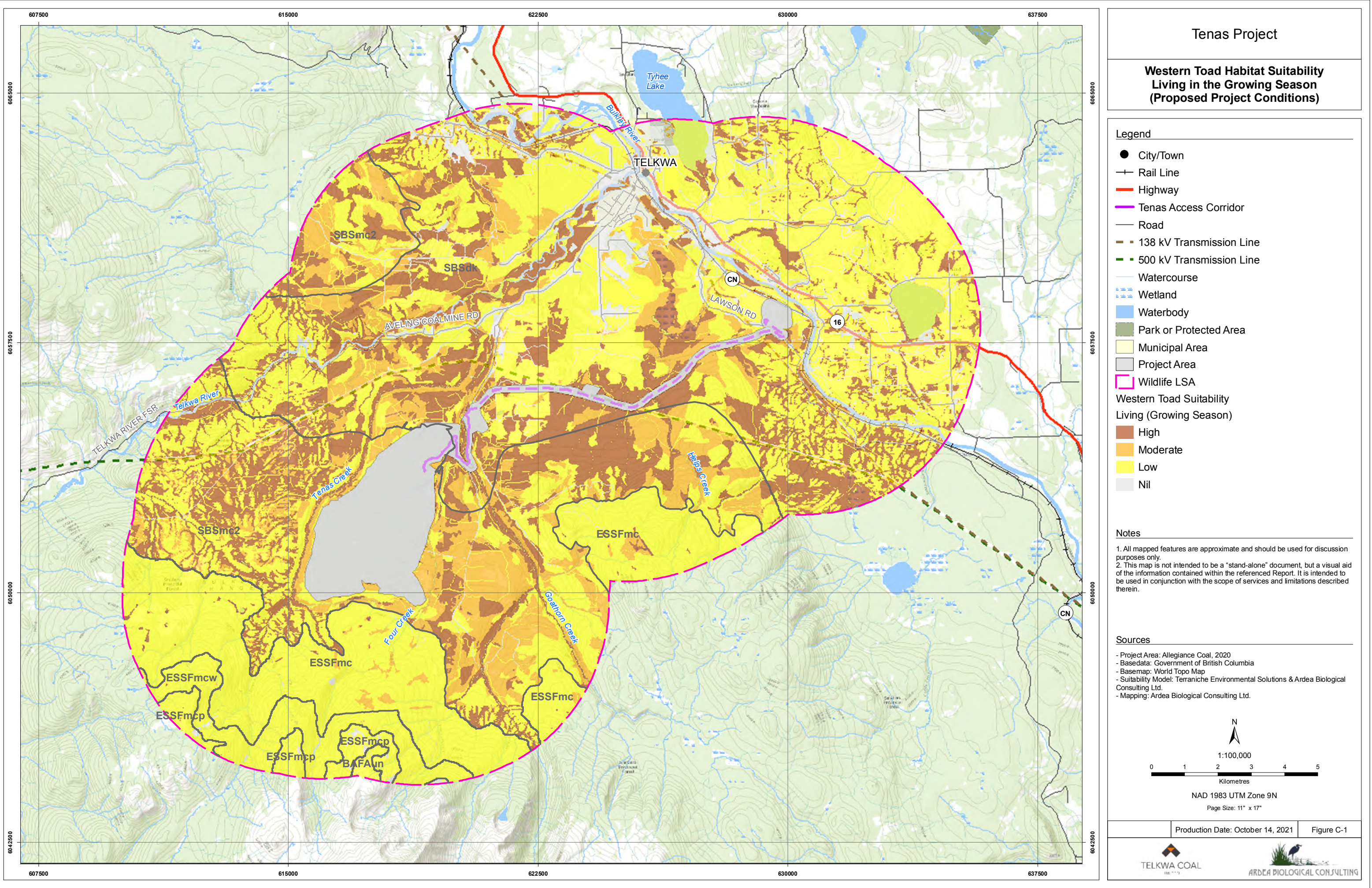


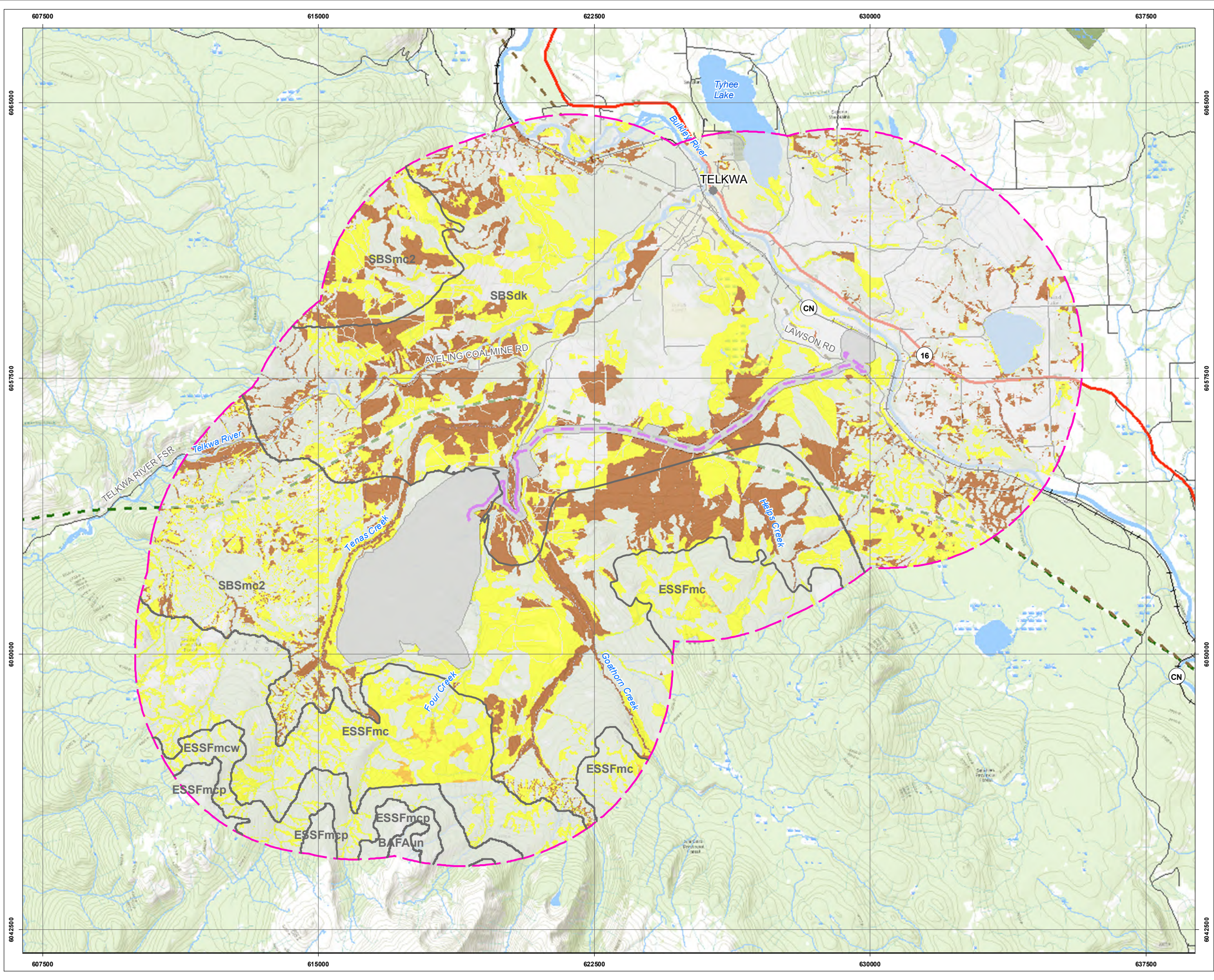
Appendix B2-C Western Toad Habitat Suitability Results and Maps - Proposed Project Conditions

Table C-1: Summary of the results of the Western toad habitat suitability models within the W-LSA under the proposed Project conditions.

Model	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)
Living in the Growing Season	High	7,412.7	20.7%
	Moderate	4,650.8	13.0%
	Low	19,322.7	54.1%
	Nil	4,337.9	12.1%
	Total	35,724.1	100.0%
Reproduction in the Spring/Summer Seasons	High	324.2	0.9%
	Moderate	334.0	0.9%
	Low	848.6	2.4%
	Nil	34,217.2	95.8%
	Total	35,724.1	100.0%
Hibernation in the Winter Season	High	4,555.3	12.8%
	Moderate	58.2	0.2%
	Low	7,485.2	21.0%
	Nil	23,625.4	66.1%
	Total	35,724.1	100.0%

Under the proposed Project conditions, the western toad Living model identified approximately 7,413 ha of high value and 4,551 ha of moderate value habitats (Table C-1) in the W-LSA, a reduction of 4% to 14% respectively of those habitats identified from the baseline model (Table 9). For the Reproduction model, there was a minor reduction in those habitats, with approximately 324 ha of high value and 334 ha of moderate value habitats identified under the proposed Project conditions scenario a reduction of 4.8 ha and 3.4 ha (approximately 1% reduction) respectively. High value hibernation habitats were reduced by approximately 148 ha (3%) to 4,555 ha under the proposed Project conditions scenario from the baseline conditions; while moderate value habitats were not affected.





Tenas Project

Western Toad Habitat Suitability Hibernation in the Winter Season (Proposed Project Conditions)

Legend

- City/Town
- +— Rail Line
- Highway
- Tenas Access Corridor
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- Project Area
- Wildlife LSA

**Western Toad Suitability
Hibernation (Winter Season)**

- 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, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map
- Suitability Model: Terraniche Environmental Solutions & Ardea Biological Consulting Ltd.
- Mapping: Ardea Biological Consulting Ltd.

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Kilometres

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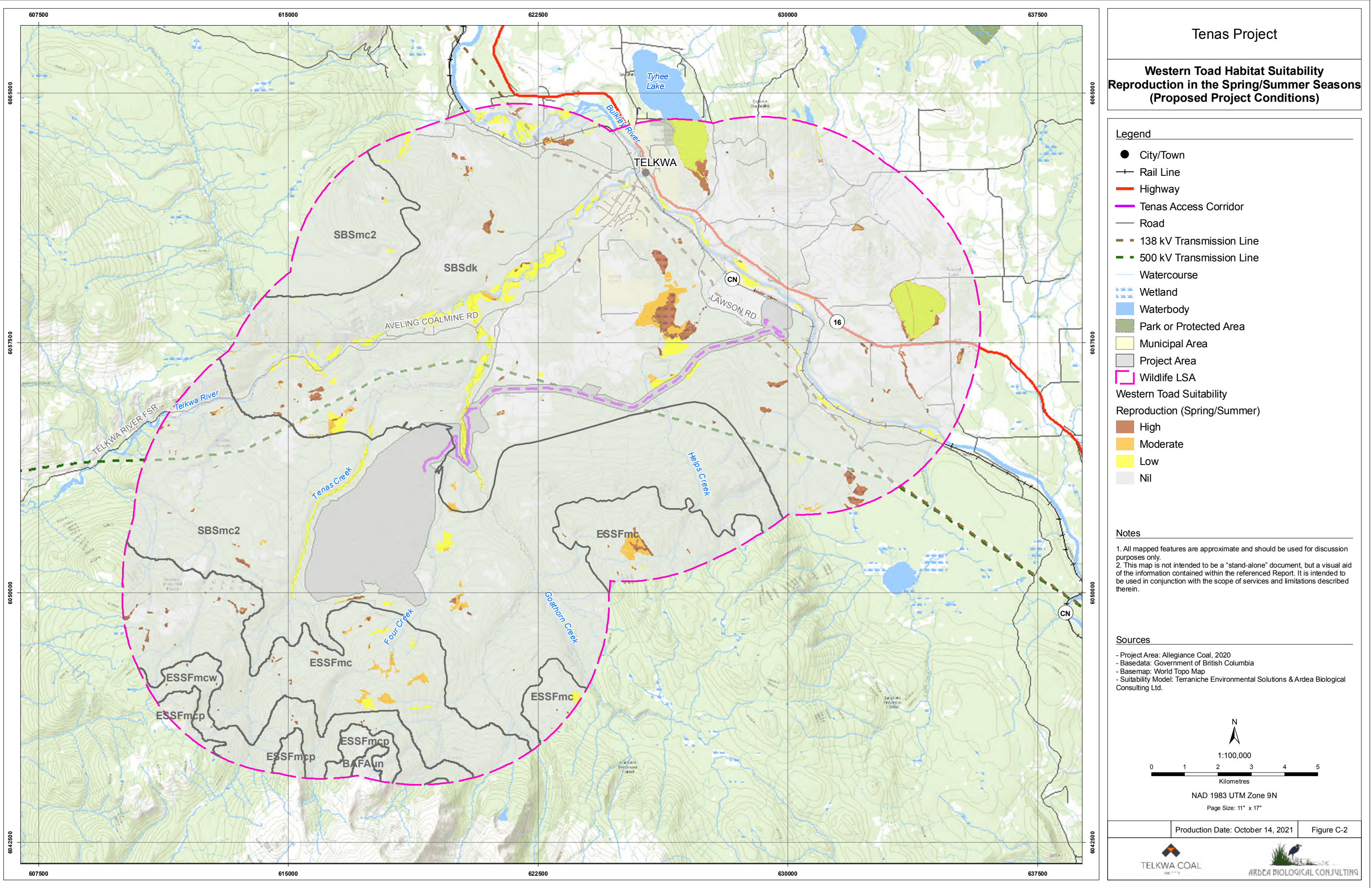
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Production Date: October 14, 2021

Figure C-3

TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING



Appendix B3 Amphibian and Reptile Additional Information

Amphibian and Reptile Habitat Summary

Minesite Area

The minesite area is the largest area within the W-LSA and provides less than 25 ha of natural amphibian breeding habitat in the form of river backchannels and wetlands. These habitats are especially limited in the higher elevation mine area and confined to relatively small wetland areas. Although still somewhat limited, most of the larger naturally occurring wetlands are located within the lower elevation water pipeline route along Goathorn Creek and Telkwa River.

Numerous anthropogenic waterbodies, such as ditches, ditch-ponds, ponds and flooded areas are found throughout the mine area along old roads, mine exploration digs and forestry skid roads. While some of these may support amphibian populations most are vulnerable to drying out, creating population sinks.

Approximately 500 ha of fresh to wet ecosystems exist in this area, providing suitable living habitat for western toad, long-toed salamander and wood frog. Overwintering habitats for these species likely exist within these ecosystems. Aquatic overwintering habitat for Columbia spotted frog is limited to a few deep ditch-ponds and ponds dispersed throughout the mine area, and a <2 ha wetland complex (Wf/Wm/Ow) located at the south mine area boundary.

Potential snake nesting habitats, associated with warm exposure rocky areas located close to wetland habitats, are limited to deep road cuts and exposed rocky cliffs found along Four and Tenas creeks in the higher elevation areas of the mine area. Several potential areas are located within the lower elevation water pipeline route along Goathorn Creek and Telkwa River. These consist of the grass/shrub covered rock slopes near the Goathorn Creek crossing.

High Value Amphibian/Reptile Habitats

AR-55 is one of a group of four kettled ponds located near the top of the steep bank of Goathorn Creek. This 0.02 ha pond is >2 m deep and was found to have high wildlife use including western toad, Columbia spotted frog and long-toed salamander. This pond provides breeding habitat for these species as well as overwintering habitat for Columbia spotted frog and any other larval stage amphibian. The upland habitat provides adequate living and overwintering habitat for western toad, wood frog and long-toed salamander. This pond is located less than 100 m from potential snake nesting/hibernaculum and may be used for hunting.

The AR-68 is located in a wetland classified as Ws01/Ws02/OW/Wb05. This complex is the only one of this type in the W-LSA and is located southwest of the minesite. It is a 5.2 ha complex situated on a small beaver flooded creek. It is shallow at the east end and >1 m deep at the west, providing breeding and overwintering amphibian habitat.

Rail Infrastructure Area

The rail infrastructure area is located near the Bulkley River and in the W-LSA and provides less than 2.5 ha of natural amphibian breeding habitat in the form of river backchannels and wetlands.

Several anthropogenic waterbodies, such as ditches, ditch-ponds and ponds (water reservoirs) are found in the rail loadout area and are associated with farms and agriculture. These areas likely support amphibian breeding and overwintering but are vulnerable to desiccation due to the fluctuating water table. Old floodplain back-channels also seasonally flood during the early spring due to snow melt and freshet, but do not remain as viable breeding habitats due to drying up before May.

Approximately 33 ha of fresh to wet ecosystems currently exist in this area, providing suitable living habitat for western toad, long-toed salamander and wood frog. Overwintering habitats for these species likely exist within these ecosystems. Aquatic overwintering habitat is limited to farm ponds and reservoirs, which are susceptible to drying out or low water levels, creating a population sink.

High Value Amphibian/Reptile Habitats

There were no high value amphibian or reptile habitats identified in the rail infrastructure area.

Access Corridor

The access corridor crosses Goathorn creek which has less than 2 ha of natural small shallow water pond, bog, marsh, swamp and ephemeral stream habitats on the nearby forested floodplain.

Numerous anthropogenic waterbodies, such as ditches, ditch-ponds, ponds and flooded areas are found throughout the access corridor area. These are mostly natural wetland/stream habitats that have been severed by access roads. A hydro ROW crosses the access corridor at the east end, and a road, running approximately 1.7 km over the access corridor area was built to provide access during the construction of a natural gas pipeline that crosses the access corridor. This road has created many very small breeding areas that support amphibian populations in wetter years. The western portion of the access corridor runs along 2.7 km of hydro ROW. In this section the amphibian habitat is limited to seven stream crossings. An additional 1.6 km of the access corridor runs over private farm land and in this area there are natural features that support amphibian breeding and living, most have been altered over years of farming activities.

Approximately 270 ha of fresh to wet ecosystems currently exist in this area, providing suitable living habitat for western toad, long-toed salamander and wood frog. Overwintering habitats for these species likely exist within these ecosystems. Aquatic overwintering habitat is limited to farm ponds and reservoirs, which are susceptible to low water levels during the summer, creating a potential population sink. A forested island bog is located on a privately owned cultivated field that provides 0.33 ha of suitable amphibian breeding habitat within this island. This area may also provide a secure migration stopover for amphibians and snakes migrating through this cultivated area.

Snake nesting habitat, which could potentially contain hibernacula, were identified at a bedrock knoll with south facing grass/shrub slopes, vertically fractured rock and rock/boulder piles associated with land clearing.

High Value Amphibian/Reptile Habitats

AR-22 is a 1 ha swamp (Ws03) located between Lawson Road and a BC Hydro ROW. Three species, including western toad, long-toed salamander and Columbia spotted frog were identified in this area in 2017 and 2018. A small pond <30 m from this swamp was used by these species for breeding in 2017 and 2018. This pond is also used by local cows, creating an unsafe environment for the amphibians tied to it. The larger wetland/pond is likely an important feature in this disturbed area, providing viable breeding and overwintering habitat.

AR-35 is a forested island situated in a cultivated field on private farmland. A 0.32 ha wetland classified as Wm05, is situated within the 1 ha forested patch. Thousands of long-toed salamander larvae were present in the >1 m deep water at the west end of the patch and western toad toadlets were identified dispersing from the shallow inflow to the east. Terrestrial salamanders were not observed in the June or August visits, suggesting this is primarily a breeding area. This wetland is a suitable overwintering habitat for amphibians. The location of this wetland and moist forest makes this a valuable feature in the otherwise disturbed landscape.

AR-44 is a 0.7 ha kettled pond supporting amphibian breeding, living and overwintering habitat. The wetland (Wm05) is located adjacent to a BC Hydro ROW on the east and rock outcroppings to the north. The rock outcropping/wetland combination provides adequate snake nesting habitat and potential hibernacula.

AR-45 is a 0.6 ha marsh (Wm01) surrounded by a moist mixed forest. This wetland provides high value wildlife habitat including shallow and deep water providing breeding and overwintering habitat for amphibians. Columbia spotted frog juveniles were identified here during the wetland function surveys in June. There are few wetlands of this size that provide this type of habitat on the access corridor.

AR-57 is a unique wetland complex providing breeding, living and overwintering habitat to western toad and Columbia spotted frog. Several age classes of larvae, juveniles and adults were identified here. This wetland complex (Wm01/Ws04) is situated on an existing trail (old pipeline access road) in a moist mixed forest. The access road is situated on the outflow end of the wetland and works as a dam to hold the water year-round.

Goathorn Creek

Goathorn Creek is located on an active floodplain that has experienced several flood events in 2013 and 2017 that have altered the channel significantly and caused movements of fluvial materials (Ardea 2021b). The impacts from these recent floods have impacted stream side channels through gravel infilling as well as changing the water regimes in side-channel wetlands that are used by several amphibian species for breeding.

High Value Amphibian/Reptile Habitats

AR-24 potentially provides snake nesting/overwintering on the rocky slopes on the east side of the proposed water pipeline and within 20 m of the wetland. A garter snake was identified in this location during 2017 and 2018 field work.

Remaining W-LSA Area

A wide range of habitats exist outside of the Project areas in the W-LSA, providing habitat for both amphibians and reptiles, with lower elevation areas providing more potential habitats than higher elevations. Portions of this area are highly anthropogenic with numerous roads, trails, fields and reservoirs, rural farms and housing neighbourhoods.

The Helps Creek wetland complex, is a 200 ha area containing a range of wetland types (e.g. Wm, Ww, Wb, 07, PD, LK) and is located 0.5 to 1.5 km north of the access corridor. This wetland receives surface water from the surrounding landscape and drains into the Bulkley River south of the rail infrastructure area upstream of the Telkwa River confluence.

The W-LSA contains portions of the Telkwa and Bulkley rivers and their confluence, and these rivers provide important riparian and floodplain habitats. These habitats are likely used for amphibian breeding, feeding and overwintering.

A snake hibernaculum is located within a 1 ha bedrock outcropping at the Telkwa and Bulkley river confluence near the railway bridge. This site consists of weathered and fractured bedrock, and garter snakes have been documented to overwinter in this site for many years (Lis Rach, pers. Comm., 2020). Snake sheds were identified here during surveys in 2017 and 2018.

High Value Amphibian/Reptile Habitats

AR-30 is a low bench wetland situated in the Telkwa River floodplain. This wetland has high value wildlife habitat for amphibians, birds, bears and moose. Amphibian breeding, living and overwintering habitat was identified here for western toad and Columbia spotted frog. Both larvae and juveniles were identified in this wetland in 2018.

Amphibian and Reptile Survey Data

A summary of the amphibian and reptile survey data is provided in Table B3-1, while the results of the eDNA analysis are provided in Table B3-2.

Table B3-1: Summary of amphibian and reptile field sampling results within the W-LSA.

Site ID	General Area	Date	Northing	Easting	Survey Group	Location / Description	Habitat Type
AR-01	Minesite	2017-07-06	6052344	617418	Amphibian	Seepage ditch at culvert adjacent to a treed bog	Ditch-line ponding
AR-02	Minesite	2017-07-06	6052463	617616	Amphibian	Tree/shrub bog complex	Wetland - bog
AR-03	Minesite	2017-07-06	6052505	617672	Amphibian	Ditch line/Depressions/old road in shrub bog complex	Ditch-line ponding/Wetland bog
AR-04	Minesite	2017-07-06	6052509	617685	Amphibian	Ditchline/Depressions/old road in shrub bog complex	Ditch-line ponding/Wetland bog
AR-05	Minesite	2017-07-06	6052542	618043	Amphibian	Ditchline/Depressions/old road seepage bog	Ditch-line ponding/Wetland bog
AR-06	Minesite	2017-07-06	6054053	618955	Amphibian	Ditchline with failed culverts adjacent to swamp	Ditch-line ponding/Wetland swamp
AR-07	Minesite	2017-07-06	6053978	619056	Amphibian	Ditchline with failed culverts adjacent to swamp	Ditch-line ponding/Wetland swamp
AR-08	Minesite	2017-07-06	6054063	618936	Amphibian	Ditchline with failed culverts adjacent to swamp	Ditch-line ponding/Wetland swamp
AR-09	Minesite	2017-07-06	6052703	618131	Amphibian	Ditchline with failed culverts	Ditch-line ponding
AR-10	Minesite	2017-07-06	6052527	616561	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-11	Minesite	2017-07-06	6052559	616444	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-12	Minesite	2017-07-06	6051666	616706	Amphibian	Ditchline ponds	Ditch-line ponding
AR-13	Minesite	2017-07-07	6049705	618297	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-14	Minesite	2017-07-07	6049718	618334	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-15	Minesite	2017-07-07	6049732	618357	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-16	Minesite	2017-07-07	6049734	618359	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-17	Minesite	2017-07-07	6049804	618485	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-18	Minesite	2017-07-07	6049977	617945	Amphibian	Ditchline with failed culverts adjacent to bog	Ditch-line ponding
AR-19	Minesite	2017-07-07	6049960	617535	Amphibian	Ditchline with failed culverts adjacent to bog	Ditch-line ponding
AR-20	Minesite	2017-07-07	6050843	616160	Amphibian	Depression adjacent to creek draw	Pond
AR-21	Minesite	2017-07-07	6051657	616701	Amphibian	Ditchline with failed culverts adjacent to creek draw	Ditch-line ponding
AR-22	Rail Infrastructure	2017-07-10	6057596	629956	Amphibian	Pond used by cows for water. Attached at hi water to swamp across the road	Wetland - swamp
AR-23	W-LSA	2017-07-10	6058128	628649	Amphibian	Creek draw/ephemeral stream	Fluvial - Ephemeral stream
AR-24	Goathorn Creek	2017-07-10	6054040	620390	Amphibian	Fluvial wetland Complex near Goathorn bridge crossing and core shack	Wetland - marsh/swamp
AR-25	Minesite	2017-07-25	6052526	619587	Amphibian	Four Creek	River
AR-26	Minesite	2017-07-25	6053651	617090	Amphibian	Tenas Creek	River/Floodplain
AR-27	Minesite	2018-07-03	6054050	618951	Amphibian	Ditch pond in youn PI stand adjacent to swamp	Ditch-line ponding/Wetland swamp
AR-28	Minesite	2018-07-03	6054382	618138	Amphibian	Wet draw	Wetland - swamp
AR-29	Goathorn Creek	2018-07-04	6058114	620669	Amphibian	Stream Tenas/Goathorn creeks confluence	River
AR-30	Goathorn Creek	2018-07-04	6058798	621418	Amphibian	Wetland/stream	Floodplain
AR-31	Goathorn Creek	2018-07-04	6055312	620492	Amphibian	River floodplain	Riparian Floodplain
AR-32	Goathorn Creek	2018-07-04	6055170	620482	Amphibian	River floodplain	Riparian Floodplain
AR-33	Goathorn Creek	2018-07-04	6055395	620426	Amphibian	River floodplain	Riparian Floodplain
AR-34	Access Corridor	2018-07-05	6056174	623238	Amphibian	Deep machined pond for cows	Pond/Wetland - shallow water
AR-35	Access Corridor	2018-07-05	6056260	622731	Amphibian	Wetland in forested island in agricultural field	Pond/Wetland - bog/marsh
AR-36	Access Corridor	2018-07-05	6056260	622731	Amphibian	Wetland in forested island in agricultural field	Pond/Wetland - bog/marsh

Site ID	General Area	Date	Northing	Easting	Survey Group	Location / Description	Habitat Type
AR-37	Minesite	2018-07-06	6050380	616833	Amphibian	Stream	Fluvial - Ephemeral stream
AR-38	Minesite	2018-07-06	6050694	617037	Amphibian	Wet draw along cat road	Fluvial - Ephemeral stream
AR-39	Minesite	2018-07-06	6050729	618015	Amphibian	Creek draw / Ephemeral stream	Fluvial - Ephemeral stream
AR-40	Minesite	2018-07-06	6050731	618250	Amphibian	Ditchpond in road ditchline	Ditch-line ponding
AR-41	Minesite	2018-07-06	6050880	618637	Amphibian	Ephemeral stream / flooded area	Fluvial - Ephemeral stream
AR-42	Minesite	2018-07-06	6051761	618887	Amphibian	Forested wetland pond on wet draw (trib to Four Crk)	Fluvial - Ephemeral stream
AR-43	Access Corridor	2018-07-09	6057383	628424	Amphibian	Ephemeral stream	Fluvial - Ephemeral stream
AR-44	Access Corridor	2018-07-09	6057581	629089	Amphibian	Wetland complex / Marsh	Wetland - marsh
AR-45	Access Corridor	2018-07-09	6056528	626485	Amphibian	Wetland complex / Marsh	Wetland - marsh
AR-46	Access Corridor	2018-07-09	6057339	627359	Amphibian	Small pond associated with a shallow kettled area / ephemeral streams	Pond
AR-47	W-LSA	2018-07-10	6054524	620899	Amphibian	Pond (man dug and strong smell of decomposition) in mature mixed forest previously highly disturbed	Pond
AR-48	Goathorn Creek	2018-07-10	6055205	620568	Amphibian	Wetland (man made -All top soil layers removed) in mature Act/shrub adjacent to disturbed hydro ROW close to gravel pit	Wetland - marsh
AR-49	Access Corridor	2018-07-11	6055979	623900	Amphibian	Pond at culvert on ephemeral stream	Pond
AR-50	Access Corridor	2018-07-11	6056266	623168	Amphibian / Reptile	Rocky outcropping with vertical fractures	Rock Outcrop
AR-51	Goathorn Creek	2018-07-11	6054040	620390	Amphibian / Reptile	Swamp/marsh adj to Goathorn Creek	Wetland - marsh/swamp
AR-52	Access Corridor	2018-07-11	6055912	625855	Amphibian	Stream with riffle pool morphology S3/S5	Fluvial - Ephemeral stream
AR-53	Access Corridor	2018-07-11	6055757	624575	Amphibian	Stream in gully with culvert S6	Fluvial - Ephemeral stream
AR-54	Access Corridor	2018-07-11	6055788	624397	Amphibian	Stream S6	Fluvial - Ephemeral stream
AR-55	Minesite	2018-07-12	6054452	619932	Amphibian	Kettled Pond	Pond
AR-56	Minesite	2018-07-12	6051324	617859	Amphibian	Ditch wetland	Ditch-line ponding
AR-57	Access Corridor	2018-07-13	6057178	627216	Amphibian	Wetland complex / pond	Wetland - marsh/swamp
AR-58	Access Corridor	2018-07-13	6056869	627008	Amphibian	Ws (Wetland swamp)	Wetland - swamp
AR-59	Access Corridor	2018-07-13	6056844	626995	Amphibian	Ws (Wetland swamp)	Wetland - swamp
AR-60	Access Corridor	2018-07-13	6056926	627031	Amphibian	Wet depression/pond	Pond
AR-61	Goathorn Creek	2018-08-30	6054411	620033	Reptile	Rock cliffs	Rock Outcrop/Cliffs
AR-62	Goathorn Creek	2018-08-31	6054087	619998	Amphibian	Four Creek S4	Fluvial - River
AR-63	Helps Creek Wetland	2018-08-31	6058661	627532	Amphibian	Large regional wetland drainage at Lawson Road S4/S5	Fluvial - Stream
AR-64	W-LSA	2018-08-31	6062697	625398	Reptile	Rocky outcrop. Regional - Historically known nesting & hibernacula	Rock Outcrop
AR-65	Goathorn Creek	2018-09-28	6057357	621106	Amphibian / Reptile	Goathorn Creek rock face	Rock Outcrop
AR-66	Access Corridor	2018-08-01	6057677	629333	Wetland Function		Wetland - marsh
AR-67	Helps Creek Wetland	2018-08-09	6058273	625910	Wetland Function	Regional receiving wetland	Pond/Wetland - marsh
AR-68	Minesite	2018-08-07	6049700	616428	Wetland Function		Wetland - marsh/swamp
AR-69	Minesite	2018-08-10	6054167	618633	Wetland Function		Wetland - bog
AR-70	Minesite	2018-08-10	6054960	619398	Wetland Function	Wet area that is waterlogged in spring with ponding. Used to be connected to wetland on south side of raised man-made trail/rd.	Pond

Table B3-1: Summary of amphibian and reptile field sampling results within the W-LSA (cont'd).

Site ID	Survey Type ¹	Search Time	Long-toed Salamander		Western Toad		Wood Frog		Columbia Spotted Frog		Common Garter Snake	
			Age Class ²	Breeding	Age Class	Breeding	Age Class	Breeding	Age Class	Breeding	Age Class	Breeding
AR-01	TCS	45	E, L	Confirmed	A			A				
AR-02	TCS	25										
AR-03	VIS	15										
AR-04	TCS	25										
AR-05	VIS	45										
AR-06	TCS	35										
AR-07	VIS	15										
AR-08	VIS	15										
AR-09	VIS	15										
AR-10	TCS	20										
AR-11	TCS	25										
AR-12	TCS	25										
AR-13	TCS	15										
AR-14	TCS	15										
AR-15	TCS	15										
AR-16	TCS	15										
AR-17	TCS	15										
AR-18	TCS	40										
AR-19	TCS	40										
AR-20	TCS	15										
AR-21	TCS	15										
AR-22	TCS	40	E, L, M, J	Confirmed	E, L, M, J	Confirmed		E, L, M, J	Confirmed			
AR-23	TCS	15	L	Confirmed	A		A	J	Likely			
AR-24	TCS	60										
AR-25	VIS	15										
AR-26	VIS	15										
AR-27	TCS	30										
AR-28	TCS	80										
AR-29	VIS	30	E	Confirmed				A, J	Likely			
AR-30	TCS	65										
AR-31	VIS	15										
AR-32	TCS	40	L	Confirmed	J	Likely						
AR-33	TCS	60	L	Confirmed	A							
AR-34	SYST	55										
AR-35	VIS	15										
AR-36	TCS	60										

Site ID	Survey Type ¹	Search Time	Long-toed Salamander		Western Toad		Wood Frog		Columbia Spotted Frog		Common Garter Snake									
			Age Class ²	Breeding	Age Class	Breeding	Age Class	Breeding	Age Class	Breeding	Age Class	Breeding								
AR-37	TCS	50	E	Confirmed	L	Confirmed														
AR-38	TCS	45																		
AR-39	TCS	45																		
AR-40	TCS	50																		
AR-41	TCS	30																		
AR-42	TCS	45	L	Confirmed	A															
AR-43	VIS	20																		
AR-44	TCS	30																		
AR-45	TCS	56																		
AR-46	TCS	22																		
AR-47	TCS	36	L	Confirmed	L, M	Confirmed			L, M	Confirmed	A (pregnant)	Likely								
AR-48	TCS	54	L	Confirmed																
AR-49	TCS	30	L	Confirmed																
AR-50	TCS	55	L	Confirmed									A				A, J	Likely		
AR-51	TCS	40																		
AR-52	TCS	30																		
AR-53	TCS	20																		
AR-54	VIS	10																		
AR-55	TCS	40	L	Confirmed	A	J	Likely	L, M, J, A	Confirmed											
AR-56	TCS	40	L	Confirmed	L															
AR-57	TCS, VIS	60			A															
AR-58	TCS	50			J								Likely							
AR-59	TCS	25			J								Likely							
AR-60	TCS	20	L	Confirmed	A															
AR-61	TCS	40																		
AR-62	TCS	40																		
AR-63	VIS	10																		
AR-64	VIS	15																		
AR-65	VIS	15						A												
AR-66	VIS	15																		
AR-67	VIS	15																		
AR-68	VIS	15																		
AR-69	VIS	15																		
AR-70	VIS	15	L	Confirmed	A	A	Adult	L, M, A	Confirmed											
					A															

Note: 1) TCS = Time Constrained Search; VIS = Visual Encounter Search; SYST = Systematic Search
 2) E = Eggs or egg casings; L = Larvae / Tadpole; M = Metamorphosing; J = Juvenile;; A = Adult

Table B3-2: Summary of eDNA sampling results within the W-LSA.

Site ID	Coastal Tailed Frog	Columbia Spotted Frog	Western Toad	Wood Frog	Site ID	Coastal Tailed Frog	Columbia Spotted Frog	Western Toad	Wood Frog
AR-01			Neg		AR-38			Neg	Neg
AR-03			Pos		AR-39		Neg	Pos	Neg
AR-06			Pos		AR-40			Pos	Neg
AR-10			Pos		AR-41		Neg	Pos	Neg
AR-11			Neg		AR-42		Pos	Pos	Neg
AR-16	Neg		Neg		AR-43		Neg	Neg	Neg
AR-18			Pos		AR-44		Neg	Neg	Pos
AR-19			Neg		AR-45		Neg	Pos	Pos
AR-21			Neg		AR-46		Neg	Pos	Neg
AR-22			Neg		AR-47		Neg	Pos	Pos
AR-24	Neg		Pos		AR-48		Pos	Neg	Neg
AR-25	Neg		Neg		AR-49		Pos	Neg	Pos
AR-26			Pos		AR-51		Neg	Neg	Neg
AR-27		Neg	Neg	Neg	AR-52		Neg	Pos	Neg
AR-28		Neg	Neg	Neg	AR-54		Neg	Neg	Neg
AR-29	Neg		Neg	Neg	AR-55		Pos	Neg	Neg
AR-30		Neg	Neg	Neg	AR-56		Neg	Pos	Neg
AR-33		Neg	Neg	Neg	AR-57		Neg	Neg	Pos
AR-34		Neg	Neg	Neg	AR-58		Neg	Pos	
AR-35		Neg	Neg	Neg	AR-62	Neg			
AR-37		Neg	Neg	Neg	AR-63		Pos	Neg	Pos

Appendix C1 Forest Bat Species Account and Habitat Model Report

Tenas Project

Forest Bats Species Account and Habitat Model Report

October 2021

VERSION 2.1

Submitted to: Telkwa Coal Limited
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Tenas Project

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1. INTRODUCTION

This report describes a habitat suitability model for forest bats: little brown myotis (*Myotis lucifugus*) and northern myotis (*M. septentrionalis*), which was developed as baseline information for assessment of the Tenas Project (the Project). The Project Footprint encompasses the area where the proposed mine activities will be conducted. The Wildlife Local Study Area (W-LSA) is the area that is expected to contain all direct effects of the Project. The Wildlife Regional Study Area (W-RSA) for wildlife is the area that will be used to assess the context of the direct and indirect effects of the Project on forest bats and is the extent of the habitat model.

This species account and habitat suitability model for forest bats follows the standards outlined in RIC (1999). The ecology and habitat use of little brown and northern myotis were reviewed, summarized and considered in developing the model using the most current available digital data in the region. Identification of site-specific features such as potential maternal and day/night roost sites were addressed through baseline surveys within the W-LSA and were used in the development and validation of the model.

2. DISTRIBUTION AND STATUS

2.1 Distribution

Little brown myotis are widespread throughout mainland BC and on several islands, including Vancouver Island and Haida Gwaii, and can be found in all biogeoclimatic (BGC) zones, except Alpine Tundra (Nagorsen and Brigham 1993, Eder and Pattie 2001, BC CDC 2015). Northern myotis has a more restricted range than the little brown myotis, and extends from the southern Columbia Mountains through central BC and the Peace Region up to the Yukon border (Nagorsen and Brigham 1993, Eder and Pattie 2001, BC CDC 2015). There have been recent captures of this species in the Hazelton-Skeena region, suggesting that their range extends into the Coast Mountains (BC CDC 2015). The northern myotis is found in the Boreal White and Black Spruce (BWBS), Interior Cedar - Hemlock (ICH), Mountain Hemlock (MH), and Sub-Boreal Spruce (SBS) BGC zones in BC (BC CDC 2015). The little brown myotis occurs in a wide range of habitats including arid grasslands, ponderosa pine (*Pinus ponderosa*) forests, humid coastal forests, and northern boreal forests (Nagorsen and Brigham 1993). In comparison, the northern myotis is generally associated with boreal forests (Nagorsen and Brigham 1993). The little brown myotis has the largest altitudinal range of any bat species in BC. It has been observed from sea level to 2,288 m with males being more abundant than females at higher elevations. Studies suggest that it is unlikely that breeding occurs at higher elevations (Nagorsen and Brigham 1993). Northern myotis have been observed up to 700 m elevation in Mount Revelstoke National Park (Nagorsen and Brigham 1993) but data is limited related to their elevation ranges throughout the province.

The list of biogeoclimatic (BGC) subzones and variants that occur within the W-RSA outlined in Table 1 were assessed for potential habitat use by forest bats in the development of the habitat suitability model.

Table 1: Summary of ecological classifications within the W-RSA.

Study Area:	Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecoregions:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)

Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun)
	Coastal Western Hemlock wet sub maritime Montane variant (CWHws2)
	Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc)
	Engelmann Spruce – Subalpine Fir moist-cold Parkland (ESSFmcp)
	Engelmann Spruce – Subalpine Fir moist-cold Woodland (ESSFmcw)
	Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk)
	Engelmann Spruce – Subalpine Fir moist-cool Parkland (ESSFmkp)
	Engelmann Spruce – Subalpine Fir moist-cool Woodland (ESSFmkw)
	Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv)
	Engelmann Spruce – Subalpine Fir wet-very cold Parkland (ESSFwvp)
	Engelmann Spruce – Subalpine Fir wet-very cold Woodland (ESSFwww)
	Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1)
	Sub-Boreal Spruce dry-cool (SBSdk)
	Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

2.2 Threats and Status

In 2014, three bat species (little brown myotis, northern myotis and tri-colored bat) were emergency listed on Schedule 1 under the *Species at Risk Act* (SARA) due to dramatic reductions in populations from White-Nose Syndrome (WNS) (Environment Canada 2015). WNS is a serious disease affecting hibernating bats; the name derives from the white fungus that appears on the muzzle and other body parts of infected bats and WNS is responsible for very high mortality levels (90-100%) in infected hibernating bats in eastern North America (US FWS 2015). Along with WNS, habitat fragmentation and reductions of old-growth forests that contain habitat attributes (i.e. snags, large diameter trees, cavities) used by little brown and northern myotis for maternal roosting (Eder and Pattie 2001, BC CDC 2015, ECCC 2018).

Little brown myotis is listed by the BC Conservation Data Centre (CDC) as yellow (Table 2), which indicates that the populations are apparently secure, while northern myotis are blue-listed (i.e. special concern and vulnerable to extirpation or extinction. Federally, COSEWIC has listed both species as endangered, and as outlined above were emergency listed as endangered on Schedule 1 of SARA.

Table 2: Conservation status of forest bat species modelled within the W-RSA.

Common Name	Little Brown Myotis	Northern Myotis
Species Name	<i>Myotis lucifugus</i>	<i>Myotis septentrionalis</i>
Species Code	M-MYLU	M-MYSE
Provincial Status¹	S4 (2015)	S3/S4 (2015)
B.C. List	Yellow	Blue
Identified Wildlife	No	No
COSEWIC Status	Endangered	Endangered
Species at Risk Act (SARA) Status	Endangered	Endangered

Note: 1) S3 = Special concern, vulnerable to extirpation or extinction; S4 = Apparently secure

3. HABITAT REQUIREMENTS

3.1 Life Requisites and Seasons

Within the RIC (1999) standards for habitat suitability models, life requisites such as Food, Security/Thermal, Reproductive and Hibernating habitats can be identified and modelled for various

seasons. For this forest bat model, we have identified foraging habitats, maternal roosting habitats (reproduction) and day/night roosting habitats within the spring, summer and fall as important growing season habitats. Hibernation habitats are important during the winter for both of these species, and although no hibernation sites for these species have been identified within the W-RSA; recent research as outlined in Section 3.1.3 suggests possible habitat types that the species may be using for overwintering within the W-RSA.

Growing season habitat selection is determined by roosting and foraging requirements (Crampton and Barclay 1998). Growing season habitat for bats can be characterized by forests with high potential for suitable roost trees (night roosts, day roosts and maternal roosts) with proximity to high value foraging habitat (Fenton 1997, Swystun 2007, van den Driessche et al. 2000). Night roosts are usually incidental roosts where bats may rest between foraging flights throughout the night (Grindal 1995). Day roosts are used for longer periods when bats are relatively inactive (often in torpor) and have more requirements to reduce effects from weather and provide protection from predators (Nagorsen and Brigham 1993, Grindal 1995, Crampton and Barclay 1998). Maternal roosting sites are used by reproductive females and their offspring and play a critical role to offset extra energy expenditure during reproduction and subsequent pup rearing months (Nagorsen and Brigham 1993, Grindal 1995, Eder and Pattie 2001, Parsons et al. 2003, Harvey et al. 2011).

3.1.1 Food Habitats in the Growing Season

Little brown and northern myotis are opportunistic hunters that feed on a large selection of insects including mayflies, midges, caddisflies, moths, beetles, leafhoppers, and other species of flies (Nagorsen and Brigham 1993). Both species forage at dusk and dawn and rely almost completely on echolocation to locate prey (Nagorsen and Brigham 1993, Eder and Pattie 2001, BC CDC 2015). Like other bat species, the diet of the little brown myotis and northern myotis changes seasonally in response to insect availability and diversity (Kunz 1980, Anthony et al. 1981, Nagorsen and Brigham 1993). A prominent study in the Okanagan Valley (Herd and Fenton 1983) found that midges were the primary forage insect for little brown myotis in the spring while caddisflies and mayflies were the primary forage insects in the summer. The foraging habits of both species also vary between BGC zones, ecoregions, and elevations (Anthony et al. 1981).

Foraging habitat for bats is often characterized by high insect prey abundance and uncluttered flight paths (Grindal 1995, Crampton and Barclay 1998, Davis et al. 2000). Little brown myotis feeds mainly over open areas with high insect abundance such as water features, riparian areas, and forest edges near water (Davis and Hitchcock 1965, Anthony et al. 1981, Eder and Pattie 2001, Swystun et al. 2007, Harvey et al. 2011). Little brown myotis prefer foraging over calm ponds and lake edges compared to turbulent waters such as streams and rivers. Mackey and Barclay (1987) found that little brown myotis may concentrate their foraging over calm waters over turbulent streams and riffles as water noise can interfere with detecting and location prey. The little brown myotis is considered a bat species with medium manoeuvrability and echolocation precision and often selects foraging habitats with less cluttered flight paths where hawking and gleaning of prey is easier (Grindal 1995).

In comparison, northern myotis often feed over small ponds and forest clearings under the tree canopy (Nagorsen and Brigham 1993) or on forested hillsides and ridges (Harvey et al. 2011) where insect abundance is high. The vast majority of research done on the foraging habits of northern myotis has occurred in eastern North America (Henderson and Broders 2008, Broders et al. 2010). Northern myotis are considered a bat species with high manoeuvrability and echolocation precision and can select foraging habitats in more cluttered environments below the tree canopy compared to other bats (Menzel et al. 2002).

For both bat species foraging heavily occurs along feature edges such as cutblock edges and the margins of bodies of water. A study conducted by Grindal (1995) in the southern interior of BC investigated habitat use by bats in fragmented forests. The results indicated that foraging activity was significantly higher in edge habitat compared to clear-cut or forested habitat even though insect abundance was greatest in

forested habitats. It is likely that increased clutter in forested habitat creates more complicated flight paths that increase flight and forage energy expenditure for bats. Although minimal foraging activity was detected in forested habitat, bats were observed commuting through forested habitat with activity peaking 30 minutes after sunset. This commuting activity may be associated with bat movement from day/night roosts to foraging areas, which highlights the importance of forest habitat for roosting (Thomas 1988).

3.1.2 Security / Thermal Habitats in the Growing Season (Day/Night Roosting)

Security and thermal habitats during the growing season for little brown and northern myotis are primarily related to day and night roosting habitats as these forest-dwelling bats utilize natural cavities (e.g. tree cavities, trees with exfoliating bark, rock crevices, caves), and man-made structures (e.g. old mines and buildings) to regulate temperature, humidity and avoid predators (Fenton and Barclay 1980, Brigham 1991, Menzel et al. 2002, Randall et al. 2014, Johnson et al 2019).

Little brown myotis and northern myotis utilize night roosts between foraging bouts and allow bats to save energy, thermoregulate and safely undergo torpor between feeding flights (Fenton and Barclay 1980, McGuire et al. 2009, Olson and Barclay 2013). Night roosts are important during periods of unfavourable weather (cool temperatures and/or rain) or low insect abundance to minimize energetic losses (Anthony et al. 1981). Night roosts are usually closely associated with foraging areas and are generally in different locations than maternal roosts (Anthony et al. 1981, Crampton and Barclay 1998, Eder and Pattie 2001). Typical locations for night roosts include buildings, trees with exfoliating bark, tree cavities and cracks, and rock crevices (Anthony et al. 1981, Crampton and Barclay 1998). Night roosts are primarily used by non-reproductive females, non-lactating females and males throughout the growing season (Anthony et al. 1981, Fenton and Barclay 1980, Randall et al. 2014).

Little brown and northern myotis leaving roosts for foraging flights generally require less cluttered forests (Grindal 1995, Davis et al. 2000). Clutter refers to obstacles that may interfere with flying or echolocation such as branches, leaves, and twigs (Luszczycki and Barclay 2016). Little brown myotis is considered to have medium manoeuvrability and echolocation precision and often selects roosting habitat that maintains ease of roost entering and exiting in addition to climatic conditions within roosts (Grindal 1995, Luszczycki and Barclay 2016). Northern myotis is considered to have high manoeuvrability and echolocation precision, and can use forests with higher clutter below the tree canopy (Menzel et al. 2002). Although both little brown and northern myotis are both considered “clutter-adapted” bats, both species are found more often in stands of below average clutter while foraging and travelling to foraging sites (Grindal 1995).

Old-growth forests provide critical growing season habitat for the little brown myotis and northern myotis (Thomas 1988, Menzel et al. 2002). Old-growth stands provide greater roost suitability potential as they have lower tree densities, less leaf/needle clutter, and a greater density of large, decaying trees (wildlife trees) and a high potential for tree cavities. (Gellman and Zielinski 1996, Crampton and Barclay 1998, Zielinski and Gellman 1999, Parsons et al. 2003, Edworthy et al. 2012, Luszczycki and Barclay 2016). A study conducted by Crampton and Barclay (1998) in northern Alberta found that forest-dwelling bats were always found in the oldest stands of mixed-aged forests. Bats in this study were observed to prefer tall, dying, or newly dead trees with low leaf cover. Trees with the deepest cavities (cracks, scars, knot holes, or woodpecker cavities) were strongly selected for and held the largest colonies (6-60 bats), and roost trees averaged 41 cm DBH. Small cracks and trees with exfoliating bark were used as night roosts in a minimal number of incidences.

Understanding the occurrence and longevity of tree cavities is important for understanding potential roosting suitability as tree cavities are an important habitat feature for forest-dwelling bats. A study conducted by Edworthy et al. (2012) in the central interior of BC investigated tree cavity occurrence and longevity in mixed forests within the Sub-Boreal Pine-Spruce (SBPS) BGC zone. Primary excavators such as red-naped sapsucker (*Sphyrapicus nuchalis*), American three-toed woodpecker (*Picoides dorsalis*), and northern flicker (*Colaptes auratus*) were responsible for over 95% of cavities within the continuous mixed forest study area. Only 3% of cavities found were formed naturally (limb fall with subsequent fungal rot). Edworthy et al.

(2012) also found that despite the widely accepted idea that old, decaying trees (and therefore old-growth forests) provide the best habitat for cavity nesters, cavities found in live, unhealthy trees lasted twice as long as those found in dead trees. As such, cavities found in live, unhealthy trees contribute the most to secondary cavity-nesters such as bats. Edworthy et al. (2012) also found that tree species containing cavities were selected by primary excavators, and tree cavities excavated by primary excavators in mostly living trees provided suitable roosting habitat for bats. As such, the use of cavities by secondary cavity-nesters such as bats is largely dependent on the presence and habitat selection of primary excavators (Martin and Eadie 1999).

As both little brown myotis and northern myotis can easily adapt feeding habits and behaviours, suitable roosting habitat may have a greater influence on growing season habitat selection than suitable foraging habitat (Fenton and Barclay 1980).

3.1.3 Reproduction Habitats in the Growing Season (Maternal Roosts)

Maternal roost are found in natural sites (tree cavities, rock crevices, trees with exfoliating bark, and caves) and man-made structures (buildings, houses, and mines) where internal conditions are warm, stable, and secure from weather and predators and therefore favorable for reproductive success (Nagorsen and Brigham 1993, Crampton and Barclay 1998, Eder and Pattie 2001, Parsons et al. 2003, Randall et al. 2014). In colder climates where summers are shorter and hibernation starts earlier, warm maternal roosts with increased solar exposure are especially beneficial as they lead to a shorter gestation period and postnatal development and allow for more feeding opportunities before hibernation (Menzel et al. 2002, Parsons et al. 2003). Availability of suitable maternal roosting sites may be a key driving factor in determining growing season habitat for bats and in some cases may even lead to a lower quality of forage habitat (Kunz 1982, Geggie and Fenton 1985). Suitable roosts for maternal roosting colonies are a major limiting factor for the distribution and persistence of little brown myotis and northern myotis (Kunz 1982, Rancourt et al. 2007, Olson and Barclay 2013).

Females require maximum energy input during pregnancy, parturition, and especially lactation (Fenton and Barclay 1980). To offset the extra energy expenditure, females form maternal roosting colonies during reproduction and subsequent pup rearing months (Nagorsen and Brigham 1993, Eder and Pattie 2001, Parsons et al. 2003, Harvey et al. 2011). Maternal roost colonies provide a vital function of offsetting energy loss in reproductive females; females who roost in a maternal roosting colony stay warmer than roosting alone and therefore spend less energy thermoregulating (Parsons et al. 2003). Female little brown myotis typically roost in large colonies containing hundreds or thousands of individuals (Nagorsen and Brigham 1993, Harvey et al. 2011) whereas female northern myotis typically roost in small colonies containing up to 30 individuals (Nagorsen and Brigham 1993, Eder and Pattie 2001).

Parturition for the little brown myotis and northern myotis occurs in late June or early July (Nagorsen and Brigham 1993, Eder and Pattie 2001) depending on latitude, elevation, location conditions, and timing of hibernacula emergence (Fenton and Barclay 1980, Nagorsen and Brigham 1993). Olson and Barclay (2013) found that in the group of little brown myotis they studied in northern Alberta, parturition was synchronized and happened on July 5th during both years of the study. Females and pups generally continued to use the maternal roost until pups reached independence as young pups are poor thermoregulators and take advantage of the stable temperatures in these roosts. Female bats rapidly burn energy during lactation and require increased insect consumption to maintain lactation (Frick et al. 2010) so high value feeding sites near maternal roosts are important. Unlike most small mammals, female little brown myotis and northern myotis only have a single pup each spring (Nagorsen and Brigham 1993, Eder and Pattie 2001, Frick et al. 2010, Harvey et al. 2011). Pups grow quickly and allometrically (Fenton and Barclay 1980, Nagorsen and Brigham 1993, Eder and Pattie 2001) and can thermoregulate 10 days after birth and fly and eat solid food within three to four weeks of birth (Fenton and Barclay 1980, Nagorsen and Brigham 1993).

Reproductive females use maternal roosts between foraging bouts throughout the growing season and do not typically use night roosts (Anthony et al. 1981). Roosting habits of reproductive females may differ throughout their reproductive cycle. Females tend to use deeper roosts during lactation and may use shallower cracks and cavities during gestation (Olson 2011). However, once young bats are capable of flight in late summer, the use of night roosts by females increases (Anthony et al. 1981).

A study conducted by Olson and Barclay (2013) in the boreal forest of northern Alberta investigated the movements and group sizes of reproductive female little brown myotis between roosts. This study found that during the growing season, most female little brown myotis roosted in trees with a diameter at breast height (DBH) greater than 30 cm. Tree diameter was found to be more important than tree height, and trees with suitable large cavities were more likely to have broken tops. This study found that almost all maternal roosts were located within trembling aspen (*Populus tremuloides*) or balsam poplar (*Populus balsamifera*), with balsam poplar slightly more selected for because of its larger DBH and larger cavities. Large diameter trees appear to be even more vital in colder regions where they are likely to provide warmer, more stable microclimates for maternal colonies (Fabianek et al. 2015).

Psyllakis and Brigham (2006) working in the SBSmc2 BGC subzone near Ft. St. James, found that myotis roosts were always found in stands with more open canopies and larger DBH when compared to the averages of random stands. At the site level, Psyllakis and Brigham (2006) found that in conifer stands, roosts were better predicted with distance to nearest tree directly in front of roost entrance, percent bark remaining, and number of limbs remaining, while in deciduous stands, roosts were best predicted using increasing DBH, entrance height and canopy closure.

Another study conducted within SBS forests by Parsons et al. (2003) found that tree cavities within trembling aspen were important as maternal roosts. This study highlighted the importance of decay in sub-boreal forests, particularly within trembling aspen. Maternal roost colonies were only found within large, well insulated cavities formed by longitudinal scars in live, mature trembling aspen in old forests. Parsons et al. (2003) concluded that natural decay processes such as heart rot are necessary to provide roosting habitat for forest-dwelling bats.

Additional evidence that larger diameter and taller trees were more often used as cavities for maternal and day roost sites was provided by a meta-analysis of 31 data sets from around North America completed by by Kalcounis-Ruppell et al. (2005). This analysis found that relative to average measurements of random trees in the same forest, confirmed cavity roosts of bats were in taller and larger DBH trees, more open canopies, and higher snag density. Kalcounis-Ruppell et al. (2005) also found roosts were more common with decreased distance to waterbodies. This suggests that at a landscape scale, higher value habitats can be identified by selecting stands above the average for attributes such as height, DBH, snag density and distance to waterbodies.

3.1.4 Hibernation in the Winter Season

The little brown myotis and northern myotis begin migrations to winter hibernacula in late summer and early fall (Nagorsen and Brigham 1993, Davis et al. 2000, Eder and Pattie 2001). Both species participate in swarming behaviour prior to hibernation, which begins with the breakdown of maternal colonies in late July and continues until hibernation (Davis and Hitchcock 1965, Nagorsen and Brigham 1993). Although the purpose of swarming activity is unclear, it is speculated that swarming may orient juvenile bats to the location of hibernacula (Fenton and Barclay 1980, Nagorsen and Brigham 1993). A study conducted by Schowalter (1980) in central Alberta investigated the swarming behavior of Little brown myotis at hibernacula. The results of this study indicated that the swarms were comprised mostly of males, similar to other studies (Davis and Hitchcock 1965). The results also indicated that juveniles hibernated later than adults likely because they needed more time to reach maximum weight before going into hibernation.

The little brown myotis and northern myotis return to hibernacula in September and October when night temperatures drop and insect availability decreases (Davis and Hitchcock 1965, Nagorsen and Brigham 1993, Eder and Pattie 2001, McGuire et al. 2009). The little brown myotis and northern myotis typically

hibernate alone or in small groups although some hibernacula on the east coast of Canada contain thousands of hibernating little brown myotis (Nagorsen and Brigham 1993). The little brown myotis and northern myotis may hibernate within the same hibernacula; however, they are rarely observed touching individuals of the opposite species (Nagorsen and Brigham 1993). Hibernation is a crucial life requisite for bats as colder temperatures and winter conditions introduce constraints on energy resources via limited prey availability and high energy demands (McGuire et al. 2009). Although hibernation is a crucial life requisite for bats, little is known about the locations and use of hibernacula across BC (Davis et al. 2000, Reimer et al. 2014).

The little brown and northern myotis hibernate in sites characterized by high humidity (70-100%), relatively consistent temperatures at or above freezing (1- 5°C), and security from adverse weather and predators (Fenton and Barclay 1980, Nagorsen and Brigham 1993, Crampton and Barclay 1998, Davis et al. 2000, Reimer et al. 2014). A study conducted by Davis et al. (2000) on Vancouver Island found that little brown myotis hibernated at higher elevations compared to growing season habitat. The largest concentrations of hibernating bats were found above 800 m with no occurrences found below 592 m. Hibernating bats were only found in deep caves (greater than 100 m long) with consistent temperatures (2.4 to 4.0°C) and high humidity (100%). A study conducted by Reimer et al. (2014) in northern Alberta found similar hibernacula conditions for little brown myotis with the bats found deep in caves with consistent temperatures (-1.1 to 0.8°C) and high humidity (90% or higher). Reimer et al (2014) also found that little brown myotis were using hibernacula as growing season day roosts as the hibernacula was located close to wetlands, watercourses, and large ponds.

Although caves and abandoned mines are considered optimal structures for hibernation for little brown and northern myotis, lack of karst features in much of western North America and British Columbia suggests that these species would need to migrate long distances or find hibernacula in other natural or anthropogenic features (Neubaum 2018). Little brown myotis has been observed to migrate relatively long distances (600 to 800 km) from mine and cave hibernation sites to summer foraging areas (Fenton 1969, Norquay et al 2013). Research in North America and Norway on winter activity levels (Lausen and Barclay 2006, Klug-Baerwald et al. 2016, Johnson et al. 2017, Blomberg et al. 2021) and non-cave hibernation sites (Michaelsen et al. 2013, Johnson et al. 2017, Neubaum 2018, Blomberg et al. 2021) indicate that myotis species such as little brown and northern myotis are overwintering in rocky crevices, scree slopes and other non-cave sites. This suggests that these features could be used as hibernation sites in portions of their range in BC.

4. MODEL DEVELOPMENT

The life requisites and seasons that were identified as important for the forest bat model included **Food**, **Security/Thermal (Day/Night Roosting)** and **Reproductive (Maternal Roosting)** habitats in the **Growing (Spring/Summer/Fall)** season and **Hibernation** in the **Winter** season.

The RIC (1999) standard for wildlife habitat suitability mapping was developed to provide ratings for wildlife habitats based on ecological mapping. Although the RIC (1999) standard is primarily based on ecosystem attributes found in Terrestrial Ecosystem Mapping (TEM), Vegetation Resource Inventory (VRI) mapping was identified as most useful to model the life requisite habitats of little brown and northern myotis. This was due to VRI data being explicit in the interpretation of habitat attributes such as tree species, canopy closure, and tree diameters rather than being inferred through ecosystem / structural stage combinations.

4.1 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the forest bat habitat suitability model are described in Table 3. Provincial Vegetation Resource Inventory (VRI) datasets were merged and updated

with fire, cutblock, and forest reserve layers to better represent current conditions as well as other anthropogenic and administrative datasets and the W-LSA and W-RSA.

Table 3: Datasets used in the development of the forest bat model.

Dataset Name	Description	Source
Vegetation Resource Inventory	Polygons representing vegetated and non-vegetated land classifications combined with VRI, wildfire, harvested area, and forest reserve layers	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-historical https://catalogue.data.gov.bc.ca/dataset/harvested-areas-of-bc-consolidated-cutblocks https://catalogue.data.gov.bc.ca/dataset/recreation-sites-reserves-and-interpretive-forests-details-and-closures-fully-attributed
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow
Oil and Gas Commission Pipeline Right-of-Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
BC Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line
Slope (derived from Digital Elevation Model)	Polygons representing slopes greater than 40 degrees	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop 9.3.1.

4.2 Model Rating Scheme

There is moderate level of knowledge of the habitat requirements of little and northern myotis in BC, with additional knowledge of their requirements from other jurisdictions in Canada and the United States. For food and reproduction (maternal roosting) habitats a 4-class rating scheme was applied as there was sufficient knowledge and detail in the mapping to effectively rate those habitats (Table 4). A 2-class ratings scheme was applied to security/thermal (day/night roosting) as these sites are chosen largely opportunistically and can be accommodated by a wide range of forest attributes near foraging habitats. For hibernation, a 2-class ratings scheme was also chosen due to the limited knowledge of what these forest bat species may be using within the W-RSA as well as the limitations of the current data to identify those features effectively.

Table 4: Habitat suitability rating scheme used for life requisites modelled for forest bats (from RIC 1999).

Food and Reproduction ¹ Ratings			Hibernation and Security/Thermal ² Ratings		
% of Provincial Benchmark	Rating	Code	% of Provincial Benchmark	Rating	Code
76 to 100%	High	1	6 to 100%	Habitat Useable	U
26 to 75%	Moderate	2			
1 to 25%	Low	3			
0%	Nil	4	0 to 5%	Likely No Value	X

Note: 1) Maternal Roosting habitats
2) Day / Night Roosting habitats

Provincial Benchmark

There are no known provincial benchmarks for little brown or northern myotis (or any other bat species) in BC as the benchmarking of habitats for this species has not been completed at this time. It is assumed that a full range of habitats for these species is available in the W-RSA.

4.3 Seasonal Use Summary

Both little brown and northern myotis are known to be present in the W-RSA during the growing season and are assumed to be present during the winter, although that has not been confirmed. Table 5 summarizes the seasonal life requisite requirements that will be modelled for forest bats based on the seasons outlined in RIC (1999) for the Central Interior ecoprovince.

Table 5. Seasonal chronology for the forest bat model habitat use in the W-LSA.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Season ¹	Winter				Spring		Summer		Fall		Winter	
Life Requisite	Hibernation (HI-W)				Food (FD-G), Security/Thermal (Day/Night Roosting) (ST-G), Reproduction (RB-G)						Hibernation (HI-W)	

Note: 1) Seasons defined for the W-RSA based on RIC (1999)

4.4 Habitat Variables

The following summary of the habitat attributes required to satisfy the seasonal life requisites of little brown and northern myotis (Table 6) are based on the assumption that these bat species use habitats within the W-RSA similarly to those used by these bat species in similar habitats in other areas of BC and by other populations in similar habitats in North America.

Table 6: Summary of habitat attribute requirements for forest bats in the W-RSA.

Life Requisite	Season	Specific Attributes Required	Preferred Stand Ages ¹
Food	Growing (Spring / Summer / Fall)	Open water, lakes, ponds, wetlands, watercourses	N/A
		Riparian areas	Any age
		Natural forest openings, cutblocks, agricultural fields, residential properties	< 30 years or N/A
		Low clutter forest <15% canopy closure	Any age
		Low-traffic roads	N/A
Security / Thermal (Day / Night Roosting)	Growing (Spring / Summer / Fall)	Mature or old forests (deciduous or coniferous)	80-200 years
		Decaying tree stands near foraging areas	121-200 years
		Loose bark or cracks, on decaying or dead trees	80-200 years
		Buildings with accessible openings, residential areas	N/A
		Canopy closure under 15% for low clutter flight access	80-200 years
		High snag frequency, >30 dead stems per hectare	80-200 years
Reproduction (Maternal Roosting)	Growing (Spring / Summer / Fall)	Preference for mature deciduous dominant forests with large diameter trees	80-200 years
		Mature coniferous dominant forests with large diameter trees	80-200 years
		Presence of large diameter decaying or dead trees with cavities	80-200 years
Reproduction (Maternal Roosting)	Growing (Spring / Summer / Fall)	Canopy closure under 40% for low clutter flight access in and out of roosts	80-200 years
		Snag frequency, > 20 dead stems per hectare	121-200 years
		Habitat diversity including edges and riparian areas	80-200 years
		Buildings with accessible openings	N/A
Hibernation	Winter	Abandoned mines or natural caves	Any age
		Steep, rocky areas and cliffs with fractured rock, talus slopes	Any age

4.5 Ratings Assumptions

This forest bat model was developed using available literature from research studies completed within BC for the species of interest and included several studies completed within the SBSmc2 and other SBS subzones within the BC interior. Most of the literature on habitat attributes and habitat use by little brown and northern myotis, however is from research completed in other provinces, with different ecological habitats and conditions. Where possible, boreal forest research was assessed and used, but in many cases

the information reviewed had to be evaluated and attribute interpreted in the context of how those forests were similar or different than those found within the W-RSA.

The VRI data, although providing a wide range of habitat attributes for ecological interpretation, is still only as useful as the original interpretation and quality control applied during the development of the mapping. Most of the data contained within VRI is modelled using assumptions based on the air-photo interpretation related to tree species, age, height and inferred stand characteristics. Other limitations to the VRI data that have been noted is that individual, large diameter trees that may be left behind in harvested, non-treed, or sparsely-treed polygons are not likely to be represented in the VRI database, which will under-represent these potentially important Reproduction (maternal roosting) habitats. Finally, small ephemeral wetlands and open water areas that could provide high insect activity are generally not mapped at the 1:20,000 VRI scale, reducing the ability to identify these potential high value Food habitats.

Where possible, the forest bat model attempted to use existing vegetation and other ground plot data collected during the baseline program, along with interpretation of existing satellite imagery to refine the assumptions and queries developed for the seasonal life requisites modelled.

General ratings assumptions for the seasonal life requisites modelled are provided below, while the actual queries and ratings based on the VRI attributes are provided in Appendix C1- B.

- Low elevation areas (i.e. SBS, ICH and CWH biogeoclimatic zones) have higher ratings than sub-alpine areas (i.e. ESSF biogeoclimatic zones); alpine, parkland and woodland areas (e.g. BAFA, ESSFmcp, ESSFmcw, etc.) are assumed to be not used and are rated Nil.
- Old growth forest (>121 years) is assumed to provide the best quality habitat for bat Security/Thermal (day/night roosting) and Reproduction (maternal roosting), but mature forests (41-120 years) that possess the structural attributes of old growth, including high snag frequency, dead or decaying trees, low canopy closure, and abundant large diameter trees, were considered of similar quality as old growth.
- Dense, young forests, with closed canopies are of low value for both Food, Security/Thermal (day/night roosting), Reproduction (maternal roosting) habitats,
- The more open the canopy in a mature to old forest stand, the higher the rating would be for Food and Security/Thermal (day/night roosting) habitats.
- Oldest, largest diameter trees within a landscape will be the best potential for Reproduction (maternal roosting) habitat and would receive the highest rating.
- Security/Thermal (day/night roosting) habitat rating will be higher with increased snag density, but there will be a trade-off as overall stand density increases will cause lower ratings due to difficulty for the bat to maneuver through the stand.
- Roosting (maternal and night) habitat within 500 m to foraging habitat (streams, water bodies, wetlands, edges), will result in a higher value.
- Anthropogenic buildings such as barns and houses are presumed to be useable maternal and night roosting habitat along with urban areas that contain these structures. As it is not possible to determine whether a structure is has high or low value, and it is likely that high value and moderate sites are limited on the landscape, all anthropogenic structures will be rated low (L) for maternal roosting and useable (U) for night roosting.
- Roads and trails are used as both flight corridors and foraging by bats and so secondary and tertiary roads are assumed to have lower traffic levels and so rated low to moderate, highways are rated nil.
- Mature trees with flaking bark are suitable for night roosting for single bats and so many stands can be considered usable for night roosting (e.g. quadratic mean diameter > 20 cm and > 80 years old).
- Based on available mapping, four abandoned underground coal mines associated with coal deposits in the Telkwa River and Goathorn Creek area were identified (Handy and Cameron 1983).

Three locations within the Goathorn Creek drainage were reviewed and their openings were found to be blocked and there was no visible access to the underground areas that would allow bat passage. The fourth site on the Telkwa River has not been investigated at this time. Several other abandoned underground mine sites are located on Hudson Bay Mountain of the outside of the W-RSA to the north.

- Talus slopes, rock outcrops, cliffs and steep, open areas greater than 40 degrees are potential Hibernation habitat.

4.6 Ratings Adjustments

Adjustments to the Reproduction (maternal roosting) habitat ratings were made after the initial ratings for the habitat attributes from the VIR to increase the Reproduction ratings by one value (e.g. moderate increased to high) for those polygons that were within 500 m of high value Food habitats.

4.7 Model Evaluation

A baseline project to review mature and old forest habitats for day/night and maternal roosting sites was completed within the W-LSA in 2018. The results of the assessments of potential day/night and maternal roosting trees were used to identify potential VRI attributes that could be effective in predicting these types of sites and assess model predictions.

Automatic recording units (ARUs) capable of ultrasonic recording were deployed within the W-LSA from 2017 to 2019 in a variety of habitats to identify bat species using those habitats and obtain relative abundance of calls by the species. The results of the ARU baseline program were used to refine queries of the VRI attributes to identify potential foraging habitats for the forest bat model.

5. LIMITATIONS/CONFIDENCE

The forest bat model was primarily developed as an expert-based model, with some use of local data and data that is comparable to habitats found within the W-RSA. The VRI data that is used as the model basis contains spatial interpretations and internal modelling assumptions that may affect the ability to accurately reflect specific habitat attributes at the stand/polygon level. The habitat ratings for the model are based upon information on species-habitat relationships obtained from several studies in BC of similar ecosystems to those found in the W-RSA (e.g. Parsons et al. 2003, Psyllakis and Brigham 2006). Habitat relationships and stand characteristics for boreal forests as well as mixed hardwood and conifer forests in other parts of North America provided the bulk of the interpretations that were used in the ratings development. Assessments for both Day/Night and Maternal roosts were conducted within mature forests within the W-LSA to calibrate the VRI data with potential roosting habitats, WHA habitat suitability data also provided roosting habitat information for use in modeling. Data obtained from ARUs deployed within a range of habitats provided species and some relative use information on foraging habitat use by those species.

Based on the above, the overall confidence level for the model is considered moderate based on the amount of information on the habitat requirements and habitat attributes that were modelled from the VRI data.

6. SUMMARY OF MODEL RESULTS

The results of the forest bat model for the Baseline condition within the W-LSA and W-RSA are shown in Table 7, and the habitat suitability maps are provided in Appendix C1- B.

Model results for food habitat in the growing season identified similar relative amounts of high value habitat within both the W-LSA and the W-RSA, while there are proportionally more moderate and low value habitats

modelled in the W-LSA than the W-RSA. This is due to the larger proportion of sub-alpine area within the W-RSA than the W-LSA, which has fewer open habitats such as agriculture and forest harvesting that are concentrated in lower elevations. There are also more suitable security/thermal (day/night roosting) habitats modelled within the W-LSA than the W-RSA, which may be due to the older ages, higher amounts of dead standing trees and more buildings and urban areas within the W-LSA compared to the W-RSA. Reproduction (maternal roosting) habitat proportions modelled in the W-LSA and W-RSA were very similar, with slightly more high value habitat identified within the W-LSA, likely due to relatively more low elevation riparian habitats that contain old, large diameter cottonwood and trembling aspen in the W-LSA than the W-RSA. Only a limited amount of hibernation habitat was modelled within either the W-LSA or W-RSA, although the potential for hibernation within the W-LSA could be higher if abandoned mines along the Telkwa River or other nearby areas (e.g. Hudson Bay Mountain) are accessible to bats.

Table 7: Summary of the forest bat model results for the seasonal life requisites within the W-LSA and the W-RSA under Baseline conditions.

Model	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
Food in the Growing Season	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 in the Growing Season (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 in the Growing Season (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 in the Winter Season	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%

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Appendix C1-A Forest Bat Model Habitat Processing and Queries - Baseline Conditions

GIS processing for the Forest Bat Habitat Suitability model involved pre-processing of the data layers, model queries and post-processing steps as outlined below:

Data Layer Preprocessing

- Create Bat Model Data layer from VRI_EDI_V4_Scenario2_V2_20200319 with selected fields required for analysis
- Rename [Anthro_Layer] = 'Road haul' within "Mine Boundary" as "Mine_Access" due to another 'Haul Road' in data
- Create Slope >= 40 degrees from Slope Raster
 - Reclass >= 40 deg to Code = 1; Create polygons; Create Field [GT40Deg] = "Yes"; Remove polygons < 1 ha
- Union Slope >= 40 degrees polygons with Bat Model Data layer for Hibernation model
- Union W-LSA & W-RSA layers with Bat Model Data layer
- Explode multi-part polygons to allow for selection of only polygons near high value forage areas
- Add field [Bats_Deciduous] = [AC_PCT] + [ACT_PCT] + [AT_PCT] + [DR_PCT] + [EP_PCT]
- Add field [Bats_Coniferous] = [B_PCT] + [BA_PCT] + [BL_PCT] + [CW_PCT] + [H_PCT] + [HM_PCT] + [HW_PCT] + [PA_PCT] + [PL_PCT] + [PLI_PCT] + [PLC_PCT] + [S_PCT] + [SB_PCT] + [SE_PCT] + [SW_PCT] + [SS_PCT] + [SX_PCT] + [SXS_PCT] + [YC_PCT] + [XX_PCT]
- Add field [Mine_Related] = "Yes" = [Anthro_Layer] = 'Mine Boundary' + 'Mine Core' + 'Mine Access'
- Initialize all Model Ratings Fields with 99 (to track that rated polygons easier)

Modelling Queries - Baseline Conditions

Habitat Attributes	Habitat Model Query	Habitat Rating
Food in Growing Season		
Select low elevation BGC zones (SBS, ICH, CWH) and select lake/pond (LA) or wetland types (W) and excluding rivers (RI)	"Low_Elev" = 'Yes' AND (("BCLCS_LEVEL_5" = 'LA') OR ("BCLCS_LEVEL_3" = 'W') AND "BCLCS_LEVEL_5" <> 'RI') AND	
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads h%' AND "Anthro_Layer" NOT LIKE 'Roads p%' AND "Anthro_Layer" NOT LIKE 'Roads q%' AND "Anthro_Layer" NOT LIKE 'Roads s%' AND "Anthro_Layer" NOT LIKE 'Roads t%') AND	H
Exclude previously rated habitats and highways or primary road	("Forage_Base" > 1 AND ("Anthro_Layer" NOT LIKE 'Roads hw%' OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%')) AND	M

Habitat Attributes	Habitat Model Query	Habitat Rating
Select sub-alpine BGC zones (ESSF) and lake/pond or wetland types	("Sub_Alpine" = 'Yes' AND ("BCLCS_LEVEL_5" = 'LA' OR "BCLCS_LEVEL_3" = 'W')) OR	
Select low elevation BGC zones and Wetland Land Classifications or young, or open forest habitats. Also select agriculture, buildings, powerlines, railways, secondary or tertiary roads or urban areas	("Low_Elev" = 'Yes' AND ("BCLCS_LEVEL_3" = 'W' OR "Final_Stand_Age" <= 30 OR "CROWN_CLOSURE" <= 15 OR "CROWN_CLOSURE" IS NULL OR "Anthro_Layer" = 'Agriculture' OR "Anthro_Layer" LIKE 'Buildings %' OR "Anthro_Layer" LIKE 'P%' OR "Anthro_Layer" LIKE 'Rail %' OR "Anthro_Layer" LIKE 'Roads s%' OR "Anthro_Layer" LIKE 'Roads t%' OR "Anthro_Layer" = 'Urban Areas'))	
Exclude previously rated habitats and highways or primary road	("Forage_Base" > 2 AND "Anthro_Layer" NOT LIKE 'Roads hw%') AND	
Select sub-alpine BGC zones (ESSF) and young or open areas, or agriculture, buildings, powerlines, railways, secondary or tertiary roads or urban areas	("Sub_Alpine" = 'Yes' AND (("Final_Stand_Age" <= 30) OR ("CROWN_CLOSURE" <= 15) OR ("CROWN_CLOSURE" IS NULL) OR ("Anthro_Layer" = 'Agriculture' OR "Anthro_Layer" LIKE 'Buildings %' OR "Anthro_Layer" LIKE 'P%' OR "Anthro_Layer" LIKE 'Rail %' OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%' OR "Anthro_Layer" LIKE 'Roads s%' OR "Anthro_Layer" LIKE 'Roads t%' OR "Anthro_Layer" = 'Urban Areas')))) OR	L
Select low elevation BGC zones and Land Class = Broadleaf or Open or Sparse or low crown closure or haul, or primary roads	("Low_Elev" = 'Yes' AND ("BCLCS_LEVEL_4" = 'TB' AND ("BCLCS_LEVEL_5" = 'OP' OR "BCLCS_LEVEL_5" = 'SP') OR ("CROWN_CLOSURE" <= 25 OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%'))))	
Select all un-rated habitats and rate as Nil	"Forage_Base" > 3	N
Security/Thermal in Growing Season (Day/Night Roosting)		
Select low elevation BGC zones (SBS, ICH, CWH)	("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND	U
Select quadratic diameter > 12.5 cm trees that are > 30 cm, older than 80 years	("QUAD_DIAM_125" >= 30) AND ("Final_Stand_Age" >= 80) AND	
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads h%' AND "Anthro_Layer" NOT LIKE 'Roads p%' AND "Anthro_Layer" NOT LIKE 'Roads s%' AND "Anthro_Layer" NOT LIKE 'Roads t%') OR	
Select low elevation BGC zones and sub-alpine BGC zones (ESSF) that have percent dead standing > 30 or identified as buildings or urban areas	("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("STAND_PERCENTAGE_DEAD" >= 30) OR ("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("Anthro_Layer" LIKE 'Buildings %') OR ("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("Anthro_Layer" = 'Urban Areas')	
Select all un-rated habitats and rate as Nil	"NightRoost_Base" > 1	X

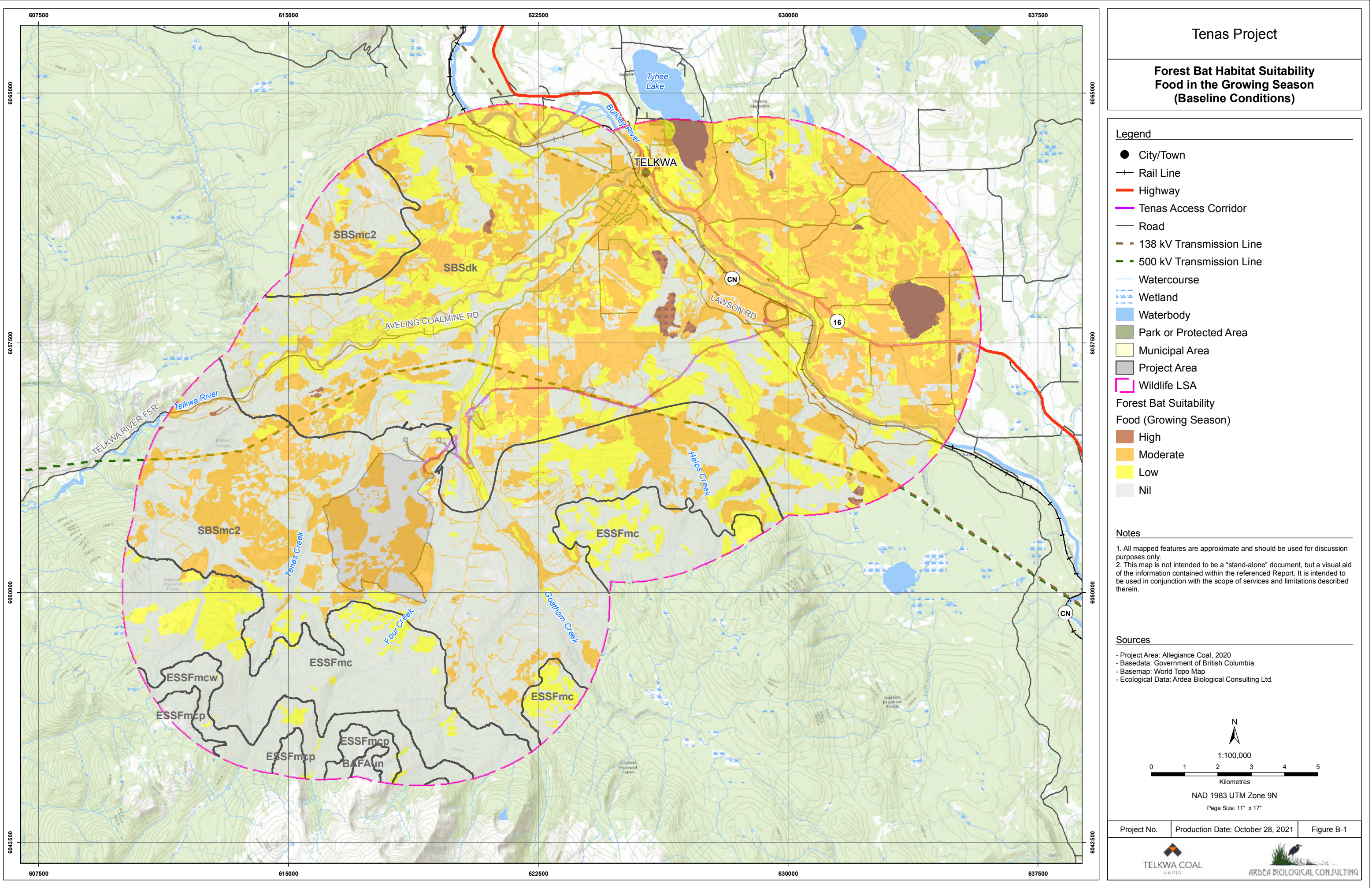
Habitat Attributes	Habitat Model Query	Habitat Rating
Reproduction in Growing Season (Maternal Roosting)		
Select low elevation BGC zones (SBS, ICH, CWH) with Land Classification as treed, and quadratic diameter > 12.5 cm trees that are > 30 cm, >= 25% deciduous tree cover and >= 20 dead trees/ha	"Low_Elev" = 'Yes' AND ("BCLCS_LEVEL_2" = 'T' AND "QUAD_DIAM_125" >= 30 AND "Bats_Deciduous" >= 25 AND "VRI_DEAD_STEMS_PER_HA" >= 20) AND	H
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %')	
Select low elevation BGC zones with Land Classification as treed or land, and quadratic diameter > 12.5 cm trees that are > 30 cm, < 25% deciduous tree cover and >= 50 dead trees/ha	"Low_Elev" = 'Yes' AND (("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'L') AND "QUAD_DIAM_125" >= 30 AND "Bats_Deciduous" < 25 AND "VRI_DEAD_STEMS_PER_HA" >= 50) AND	M
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %')	
Select low elevation BGC zones with buildings or urban areas	("Low_Elev" = 'Yes' AND ("Anthro_Layer" LIKE 'Buildings %' OR (MatRoost_Base > 2 AND "Anthro_Layer" = 'Urban Areas'))) OR	L
Select low elevation BGC zones classified as treed or land with quadratic diameter >12.5 cm trees > 25 cm and < 30 cm and >= 50 dead trees/ha	("Low_Elev" = 'Yes' AND (((("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'L') AND "QUAD_DIAM_125" > 25 AND "QUAD_DIAM_125" < 30 AND "VRI_DEAD_STEMS_PER_HA" >= 50) OR ("BCLCS_LEVEL_2" = 'N' AND "QUAD_DIAM_125" >= 25 AND "VRI_DEAD_STEMS_PER_HA" >= 50))) AND	
Exclude pipelines, powerlines, railways and roads	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %')) OR	
Select sub-alpine BGC zones (ESSF) that are classified as tree or non-vegetated and with quadratic diameter > 12.5 cm trees that are > 30 cm and >= 50 dead trees/ha	("Sub_Alpine" = 'Yes' AND (("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'N') AND "QUAD_DIAM_125" >= 30 AND "VRI_DEAD_STEMS_PER_HA" >= 50) AND	
Exclude pipelines, powerlines, railways and roads	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %'))	
Select all un-rated habitats and rate as Nil	"MatRoost_Base" > 3	N
Hibernation in Winter		
Select low elevation BGC zones (SBS, ICH, CWH) or sub-alpine BGC zones (ESSF) and crown closure in <= 30% and	("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("CROWN_CLOSURE" <= 30 AND ("GRIDCODE" = 1 OR "BCLCS_LEVEL_5" = 'TA' OR "BCLCS_LEVEL_4" = 'RO'))	

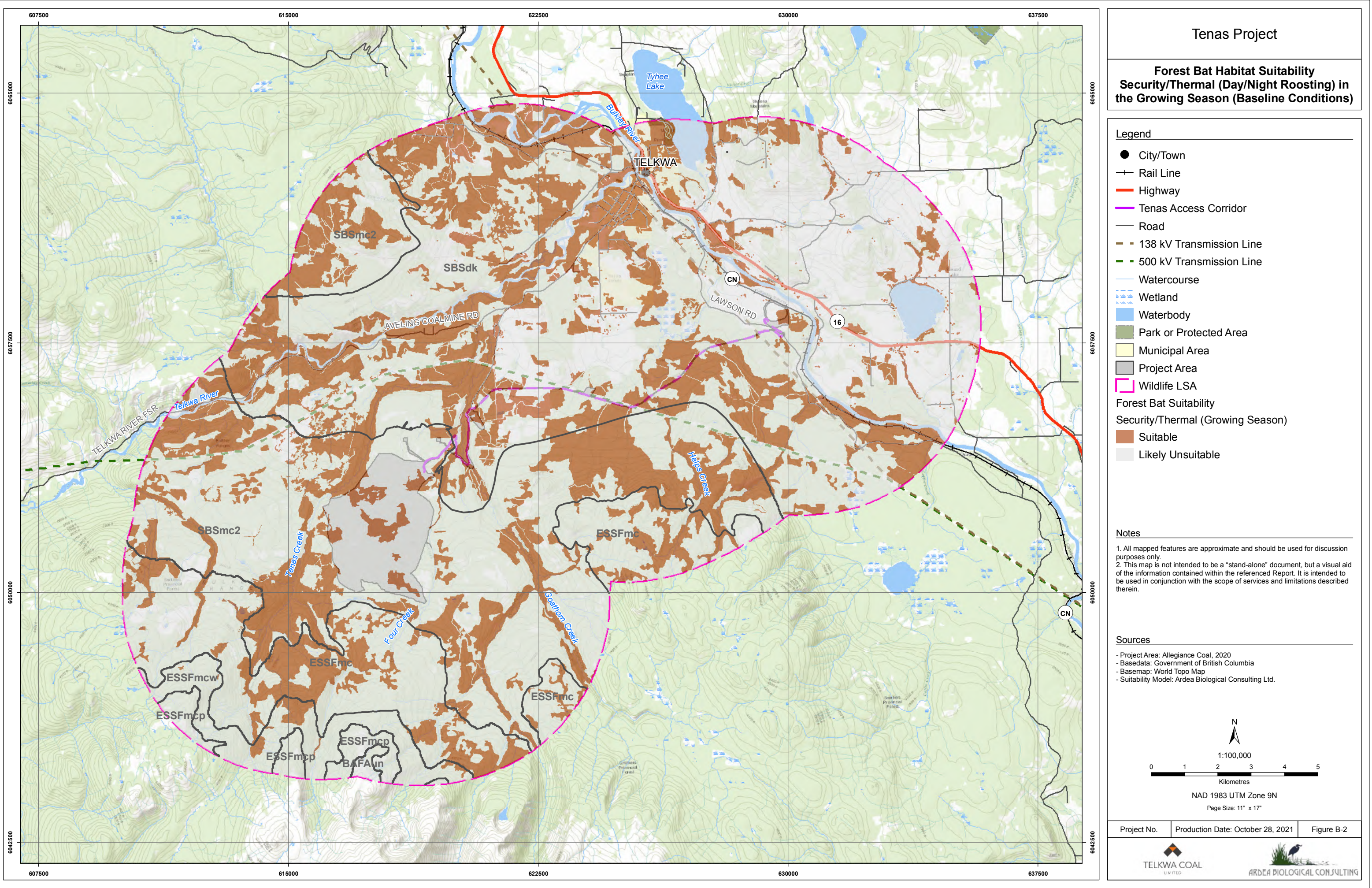
Habitat Attributes	Habitat Model Query	Habitat Rating
slopes >= 40 deg or Land Classification is talus (TA) or rock outcrop (RO)		
Select all un-rated habitats and rate as Nil	"Hibernat_Base" > 1	

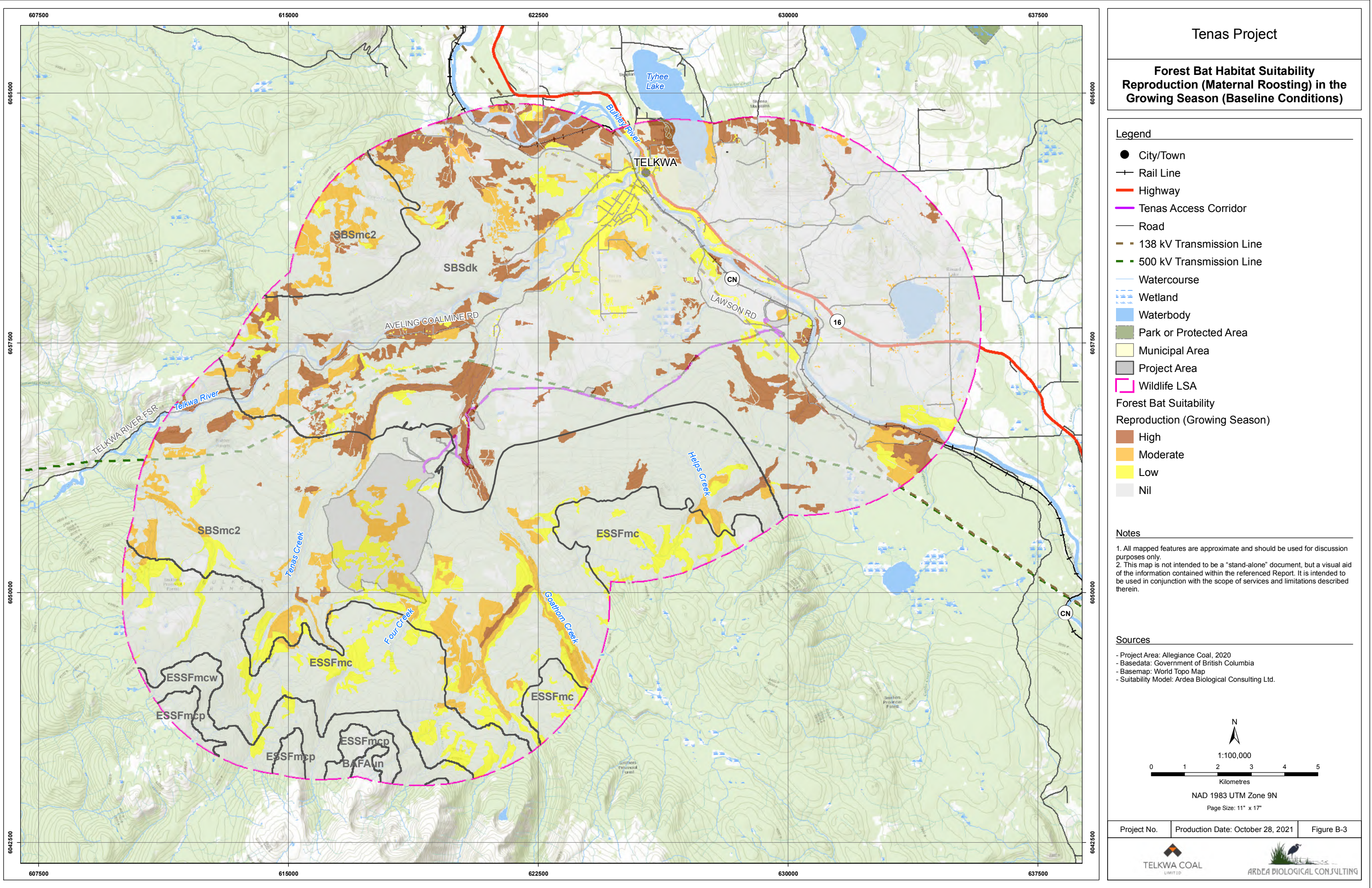
Post Processing

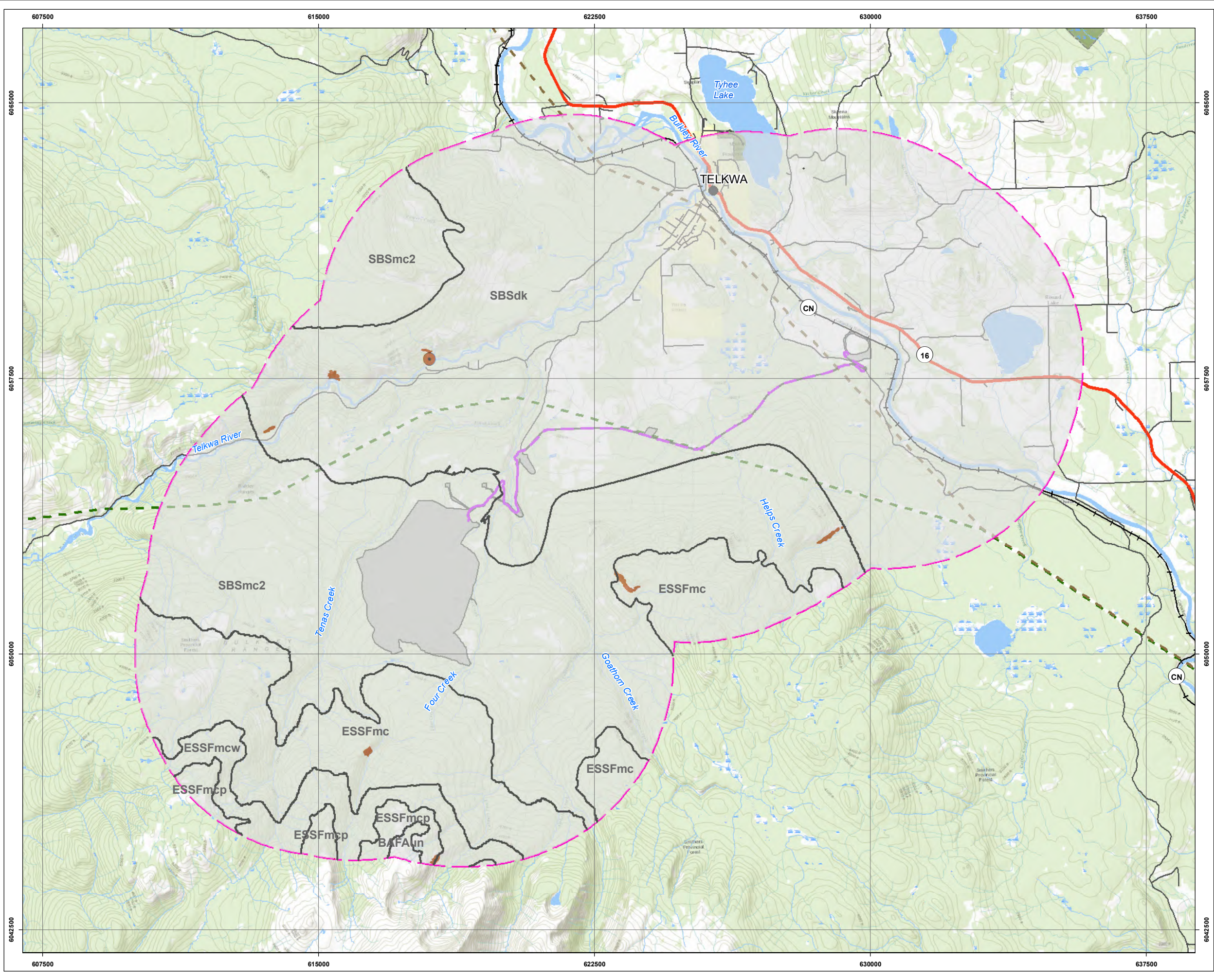
- Select High value Food polygons and buffer by 500 m
- Select by Location all polygons within buffered area; update field [MatRoost_Base] & [MatRoost_Mine] for polygons that are within 500 buffer and are rated Low to Moderate to next higher rating (e.g. Low to Moderate; Moderate to High)

Appendix C1-B Forest Bat Habitat Suitability Maps - Baseline Conditions









Tenas Project

Forest Bat Habitat Suitability
Hibernation in the Winter Season
(Baseline Conditions)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

Wetland

Waterbody

Park or Protected Area

Municipal Area

Project Area

Wildlife LSA

Forest Bat Suitability
Hibernation (Winter)

Suitable

Likely Unsuitable

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, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Model: Ardea Biological Consulting Ltd.

N

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Kilometres

NAD 1983 UTM Zone 9N

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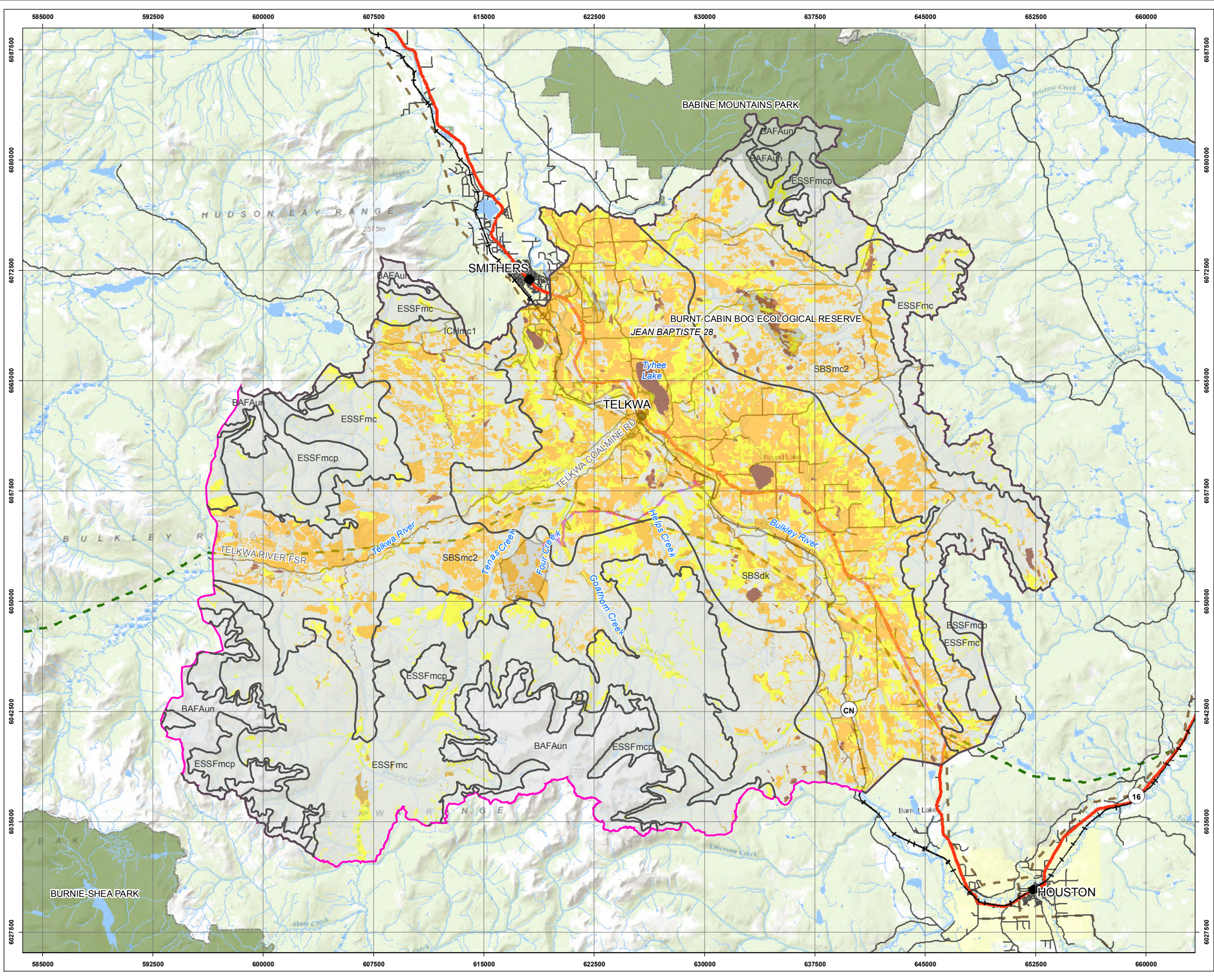
Project No.

Production Date: October 28, 2021

Figure B-4

TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING



Tenas Project

Forest Bat Habitat Suitability
Food in the Growing Season
(Baseline Conditions)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

Wetland

Waterbody

Park or Protected Area

Municipal Area

First Nation Reserve

Project Area

Wildlife RSA

Forest Bat Suitability
Food (Growing Season)

High

Moderate

Low

Nil

Notes

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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

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- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Mapping: Ardea Biological Consulting Ltd.

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NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

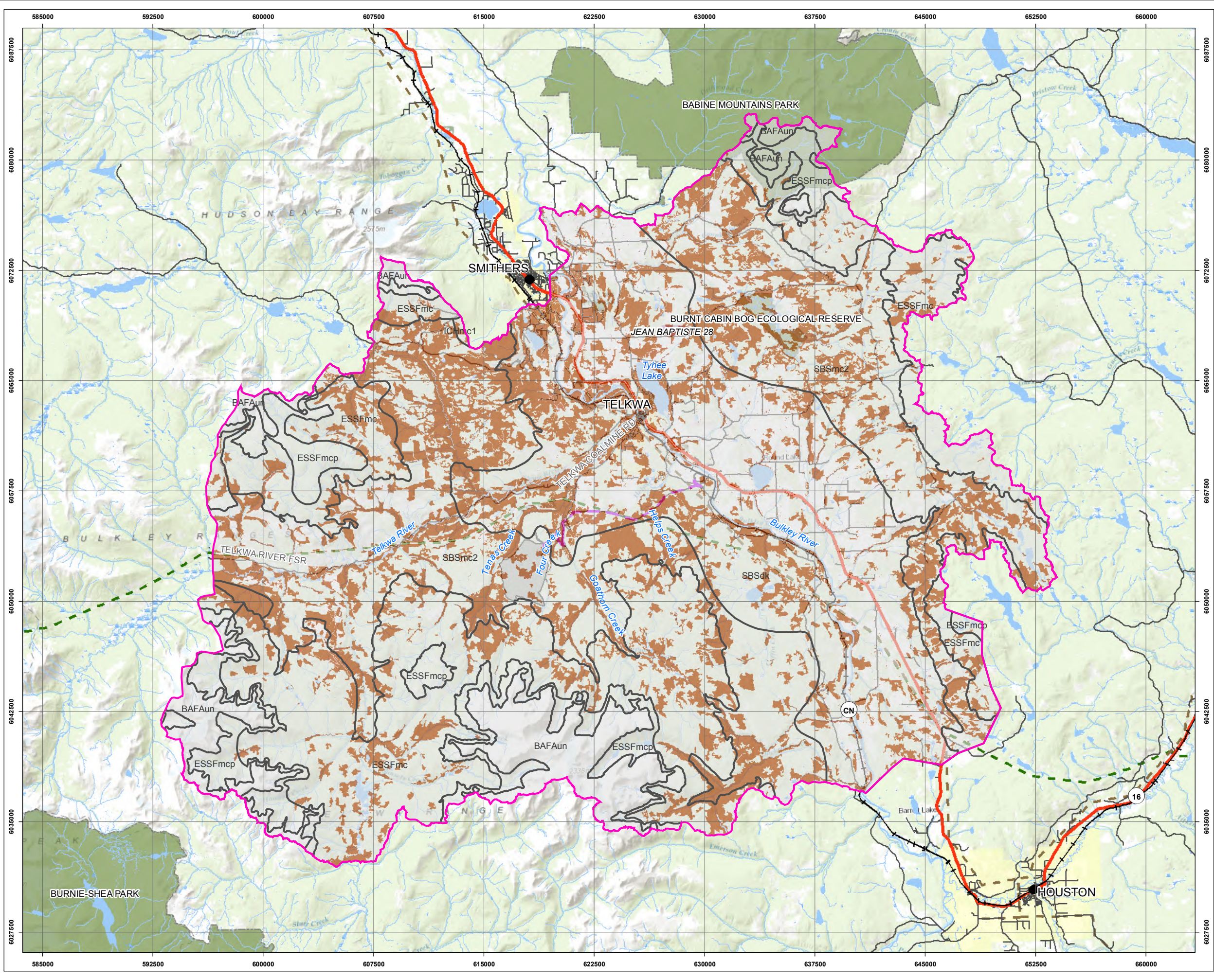
Project No.

Production Date: October 28, 2021

Figure B-5

TELKWA COAL
LIMITED


ARDEA BIOLOGICAL CONSULTING



Tenas Project

Forest Bat Habitat Suitability
Security/Thermal (Day/Night Roosting) in
the Growing Season (Baseline Conditions)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

— Wetland

— Waterbody

— Park or Protected Area

— First Nation Reserve

— Municipal Area

— Project Area

— Wildlife RSA

Forest Bat Suitability

Security/Thermal (Growing Season)

Suitable

Likely Unsuitable

Notes

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Sources

- Project Area: Allegiance Coal, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Mapping: Ardea Biological Consulting Ltd.

N

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Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

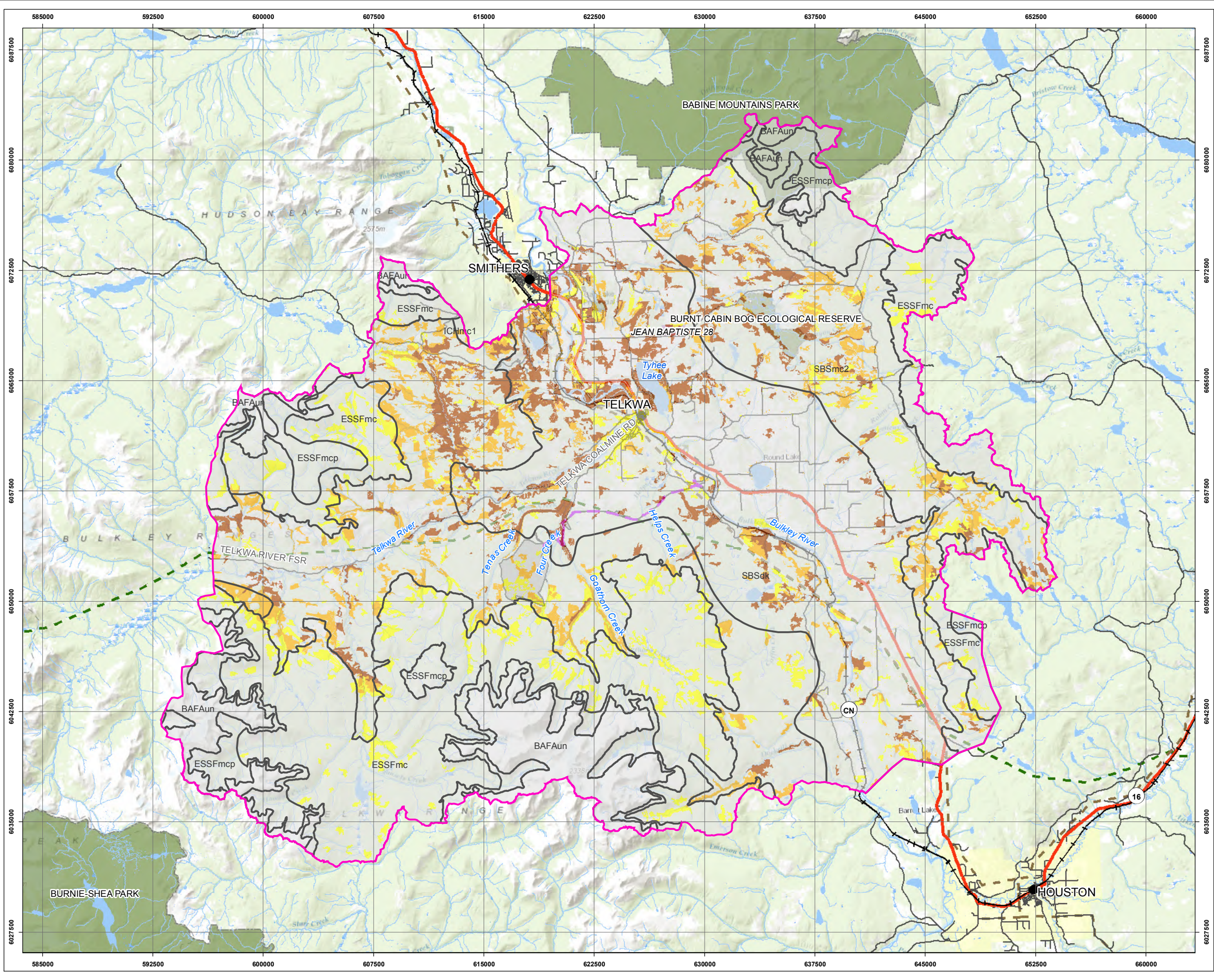
Project No.

Production Date: October 28, 2021

Figure B-6

TELKWA COAL
LIMITED


ARDEA BIOLOGICAL CONSULTING



Tenas Project

Forest Bat Habitat Suitability Reproduction (Maternal Roosting) in the Growing Season (Baseline Conditions)

Legend

- City/Town
- Rail Line
- Highway
- Tenas Access Corridor
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- First Nation Reserve
- Project Area
- Wildlife RSA

**Forest Bat Suitability
Reproduction (Growing Season)**

- 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, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map
- Suitability Mapping: Ardea Biological Consulting Ltd.

N

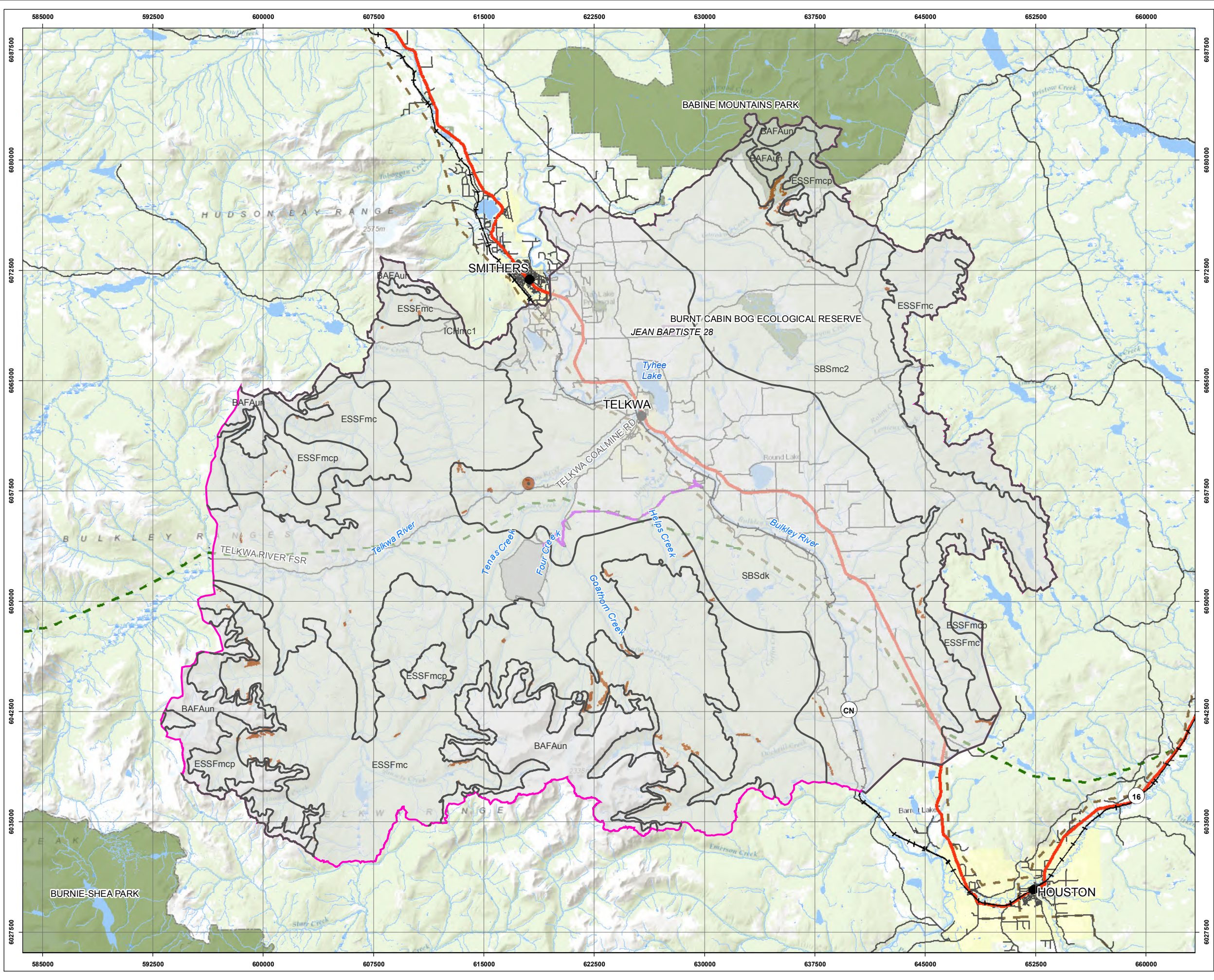
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Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.	Production Date: October 28, 2021	Figure B-7
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Tenas Project

Forest Bat Habitat Suitability
Hibernation in the Winter Season
(Baseline Conditions)

Legend

●

City/Town

—+—

Rail Line

—

Highway

—

Tenas Access Corridor

—

Road

—

138 kV Transmission Line

—

500 kV Transmission Line

—

Watercourse

—

Wetland

—

Waterbody

—

Park or Protected Area

—

Municipal Area

—

First Nation Reserve

—

Project Area

—

Wildlife RSA

Forest Bat Suitability

Hibernation (Winter)

—

Suitable

—

Likely Unsuitable

—

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

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- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Mapping: Ardea Biological Consulting Ltd.

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Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.

Production Date: October 28, 2021

Figure B-8

TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING

Appendix C1-C Forest Bat Model Habitat Queries - Proposed Mine Conditions

Modelling Queries - Proposed Mine Conditions

Habitat Attributes	Habitat Model Query	Habitat Rating
Food in Growing Season		
Select low elevation BGC zones (SBS, ICH, CWH) and exclude proposed mine and select lake/pond (LA) or wetland types (W) and excluding rivers (RI)	"Low_Elev" = 'Yes' AND "Mine_Related" = 'No' AND (("BCLCS_LEVEL_5" = 'LA') OR ("BCLCS_LEVEL_3" = 'W') AND "BCLCS_LEVEL_5" <> 'RI') AND	H
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads h%' AND "Anthro_Layer" NOT LIKE 'Roads p%' AND "Anthro_Layer" NOT LIKE 'Roads q%' AND "Anthro_Layer" NOT LIKE 'Roads s%' AND "Anthro_Layer" NOT LIKE 'Roads t%')	
Exclude previously rated habitats, proposed mine and highways or primary road	("Forage_Mine" > 1 AND "Mine_Related" = 'No' AND ("Anthro_Layer" NOT LIKE 'Roads hw%' OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%')) AND	M
Select sub-alpine BGC zones (ESSF) and lake/pond or wetland types	("Sub_Alpine" = 'Yes' AND ("BCLCS_LEVEL_5" = 'LA' OR "BCLCS_LEVEL_3" = 'W')) OR	
Select low elevation BGC zones and exclude proposed mine and Wetland Land Classifications or young, or open forest habitats. Also select agriculture, buildings, powerlines, railways, secondary or tertiary roads or urban areas	("Low_Elev" = 'Yes' AND "Mine_Related" = 'No' AND ("BCLCS_LEVEL_3" = 'W' OR "Final_Stand_Age" <= 30 OR "CROWN_CLOSURE" <= 15 OR "CROWN_CLOSURE" IS NULL OR "Anthro_Layer" = 'Agriculture' OR "Anthro_Layer" LIKE 'Buildings %' OR "Anthro_Layer" LIKE 'P%' OR "Anthro_Layer" LIKE 'Rail %' OR "Anthro_Layer" LIKE 'Roads s%' OR "Anthro_Layer" LIKE 'Roads t%' OR "Anthro_Layer" = 'Urban Areas'))	L
Select low elevation areas and proposed mine	("Low_Elev" = 'Yes' AND "Mine_Related" = 'Yes') OR	
Exclude previously rated habitats and highways or primary road	("Forage_Mine" > 2 AND "Anthro_Layer" NOT LIKE 'Roads hw%') AND	
Select sub-alpine BGC zones (ESSF) and young or open areas, or agriculture, buildings, powerlines, railways, secondary or tertiary roads or urban areas	("Sub_Alpine" = 'Yes' AND (("Final_Stand_Age" <= 30) OR ("CROWN_CLOSURE" <= 15) OR ("CROWN_CLOSURE" IS NULL) OR ("Anthro_Layer" = 'Agriculture' OR "Anthro_Layer" LIKE 'Buildings %' OR "Anthro_Layer" LIKE 'P%' OR "Anthro_Layer" LIKE 'Rail %' OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%' OR "Anthro_Layer" LIKE 'Roads s%' OR "Anthro_Layer" LIKE 'Roads t%' OR "Anthro_Layer" = 'Urban Areas')))) OR	
Select low elevation BGC zones and Land Class = Broadleaf or Open or Sparse or low crown closure or haul, or primary roads	("Low_Elev" = 'Yes' AND ("BCLCS_LEVEL_4" = 'TB' AND ("BCLCS_LEVEL_5" = 'OP' OR "BCLCS_LEVEL_5" = 'SP') OR ("CROWN_CLOSURE" <= 25 OR "Anthro_Layer" = 'Roads haul' OR "Anthro_Layer" LIKE 'Roads p%'))))	

Habitat Attributes	Habitat Model Query	Habitat Rating
Exclude previously rated habitats and rate remaining habitats as Nil	"Forage_Mine" > 3	N
Security/Thermal in Growing Season (Day/Night Roosting)		
Exclude proposed mine areas and select low elevation BGC zones (SBS, ICH, CWH) or sub-alpine BGC zones (ESSF) and select quadratic diameter > 12.5 cm trees that are > 30 cm and older than 80 years	("Mine_Related" = 'No' AND ("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("QUAD_DIAM_125" >= 30) AND ("Final_Stand_Age" >= 80) AND	U
Exclude proposed mine and anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads h%' AND "Anthro_Layer" NOT LIKE 'Roads p%' AND "Anthro_Layer" NOT LIKE 'Roads s%' AND "Anthro_Layer" NOT LIKE 'Roads t%') OR	
Select low elevation BGC zones or sub-alpine BGC zones (ESSF) that have percent dead standing > 30 or identified as buildings or urban areas	("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("STAND_PERCENTAGE_DEAD" >= 30) OR ("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("Anthro_Layer" LIKE 'Buildings %') OR ("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("Anthro_Layer" = 'Urban Areas'))	
Select all un-rated habitats and rate as Nil	NightRoost_Mine > 1	X
Reproduction in Growing Season (Maternal Roosting)		
Exclude proposed mine areas and select low elevation BGC zones (SBS, ICH, CWH) with Land Classification as treed, and quadratic diameter > 12.5 cm trees that are > 30 cm, >= 25% deciduous tree cover and >= 20 dead trees/ha	("Mine_Related" = 'No' AND "Low_Elev" = 'Yes' AND "BCLCS_LEVEL_2" = 'T' AND "QUAD_DIAM_125" >= 30 AND "Bats_Deciduous" >= 25 AND "VRI_DEAD_STEMS_PER_HA" >= 20) AND	H
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %')	
Exclude proposed mine areas and select low elevation BGC zones with Land Classification as treed or land, and quadratic diameter > 12.5 cm trees that are > 30 cm, < 25% deciduous tree cover and >= 50 dead trees/ha	("Mine_Related" = 'No' AND "Low_Elev" = 'Yes' AND ("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'L') AND "QUAD_DIAM_125" >= 30 AND "Bats_Deciduous" < 25 AND "VRI_DEAD_STEMS_PER_HA" >= 50) AND	M
Exclude anthropogenic layers (buildings, pipelines, powerlines, railways, roads)	("Anthro_Layer" NOT LIKE 'Buildings %' AND "Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %'))	

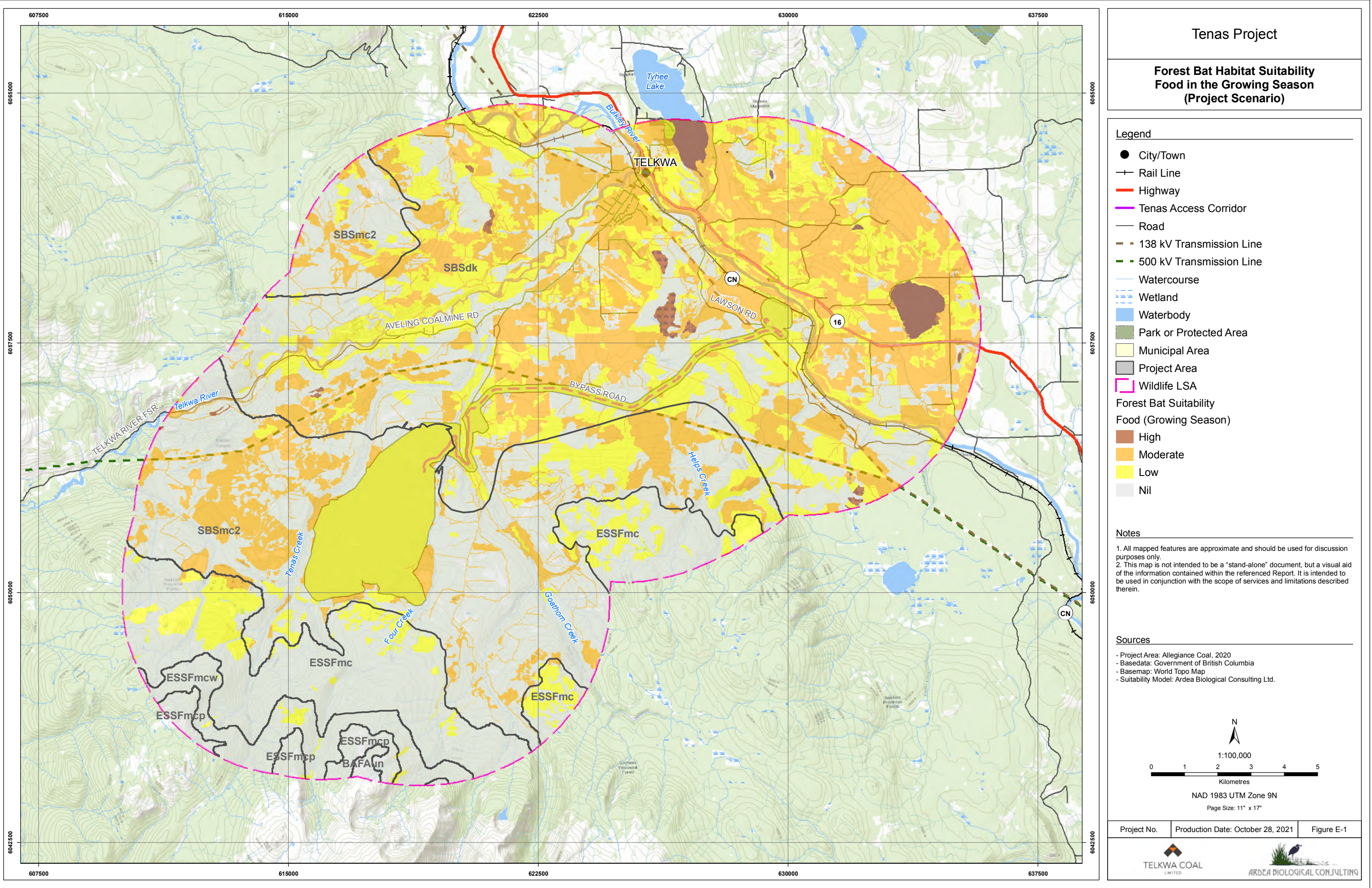
Habitat Attributes	Habitat Model Query	Habitat Rating
Exclude proposed mine areas and select low elevation BGC zones with buildings or urban areas that have not been rated	"Mine_Related" = 'No' AND (("Low_Elev" = 'Yes' AND ("Anthro_Layer" LIKE 'Buildings %' OR (MatRoost_Base > 2 AND "Anthro_Layer" = 'Urban Areas')) OR	
Select low elevation BGC zones classified as treed or land with quadratic diameter >12.5 cm trees > 25 cm and < 30 cm and >= 50 dead trees/ha	("Low_Elev" = 'Yes' AND (((("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'L') AND "QUAD_DIAM_125" > 25 AND "QUAD_DIAM_125" < 30 AND "VRI_DEAD_STEMS_PER_HA" >= 50) OR ("BCLCS_LEVEL_2" = 'N' AND "QUAD_DIAM_125" >= 25 AND "VRI_DEAD_STEMS_PER_HA" >= 50))) AND	
Exclude pipelines, powerlines, railways and roads	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %')) OR	L
Select sub-alpine BGC zones (ESSF) that are classified as tree or non-vegetated and with quadratic diameter > 12.5 cm trees that are > 30 cm and >= 50 dead trees/ha	("Sub_Alpine" = 'Yes' AND (("BCLCS_LEVEL_2" = 'T' OR "BCLCS_LEVEL_2" = 'N') AND "QUAD_DIAM_125" >= 30 AND "VRI_DEAD_STEMS_PER_HA" >= 50) AND	
Exclude pipelines, powerlines, railways and roads	("Anthro_Layer" NOT LIKE 'P%' AND "Anthro_Layer" NOT LIKE 'Rail %' AND "Anthro_Layer" NOT LIKE 'Roads %'))	
Select all un-rated habitats and rate as Nil	MatRoost_Mine > 3	N
Hibernation in Winter		
Select low elevation BGC zones (SBS, ICH, CWH) or sub-alpine BGC zones (ESSF) and crown closure in <= 30% and slopes >= 40 deg or Land Classification is talus (TA) or rock outcrop (RO)	("Low_Elev" = 'Yes' OR "Sub_Alpine" = 'Yes') AND ("CROWN_CLOSURE" <= 30 AND ("GRIDCODE" = 1 OR "BCLCS_LEVEL_5" = 'TA' OR "BCLCS_LEVEL_4" = 'RO'))	
Select all un-rated habitats and rate as Nil	Hibernat_Mine > 1	

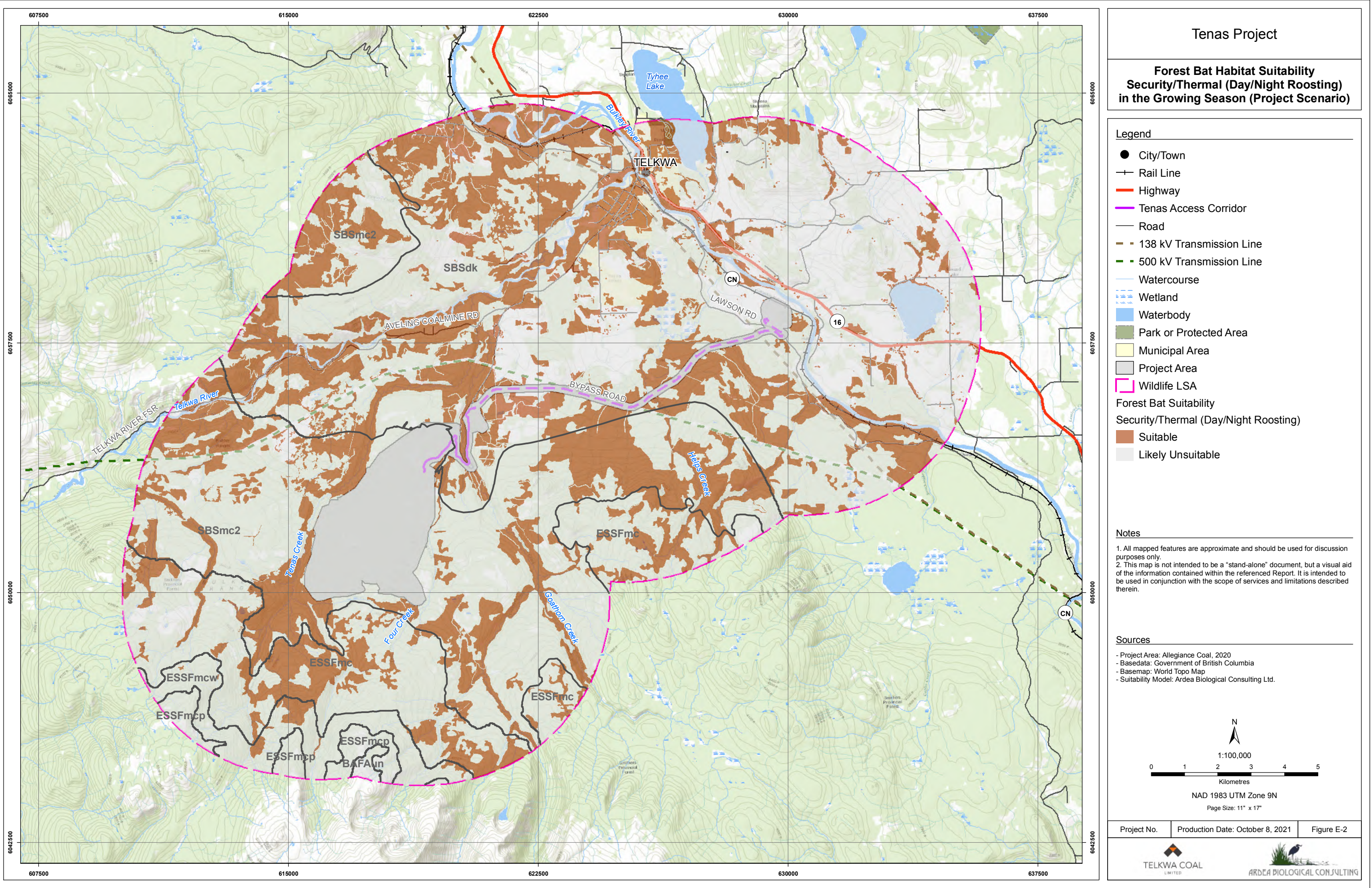
Appendix C1-D Forest Bat Habitat Model Results - Proposed Mine Conditions

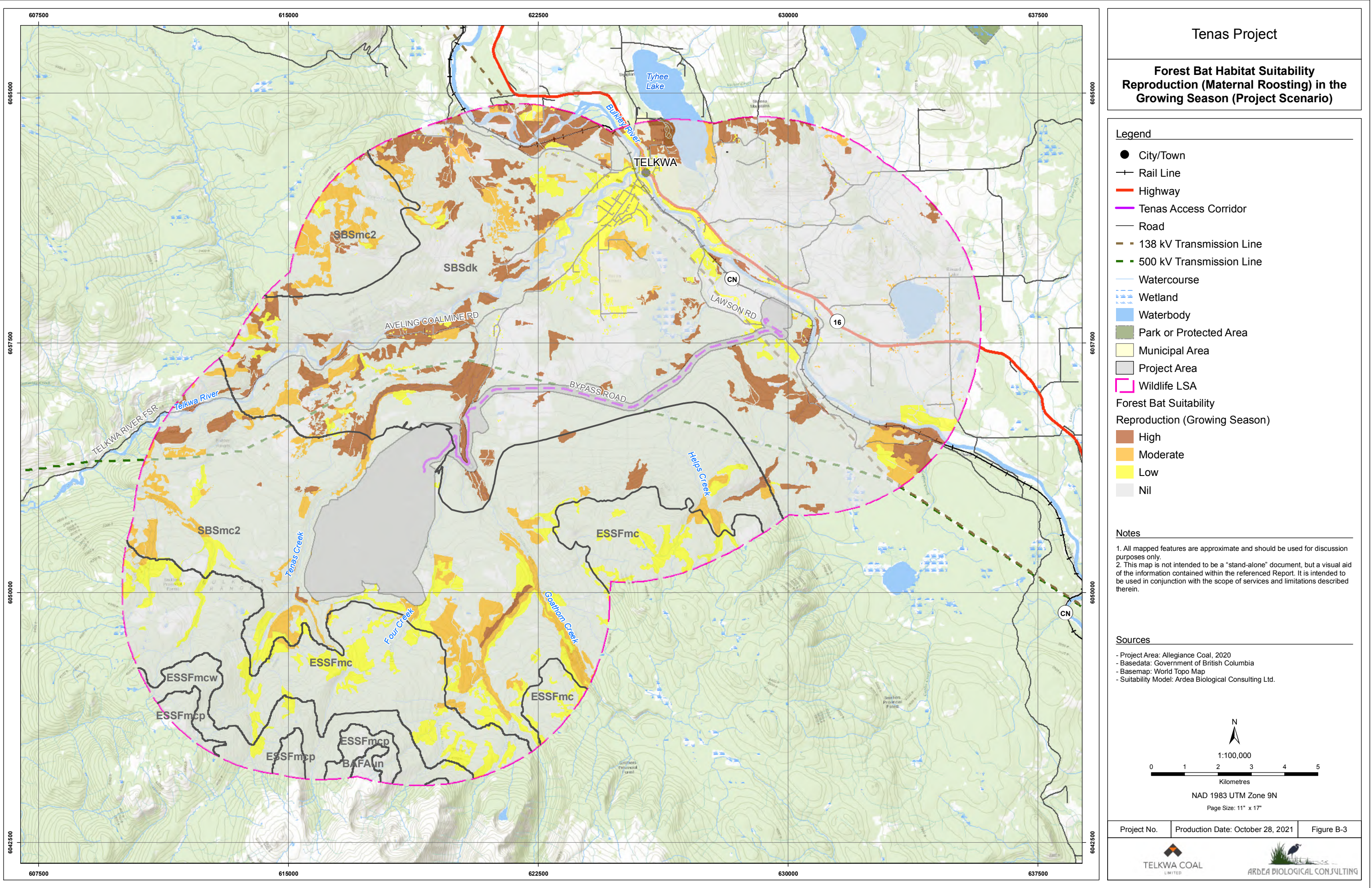
Table D-1: Summary of the forest bat model results for the seasonal life requisites within the W-LSA and the W-RSA under the proposed Project conditions.

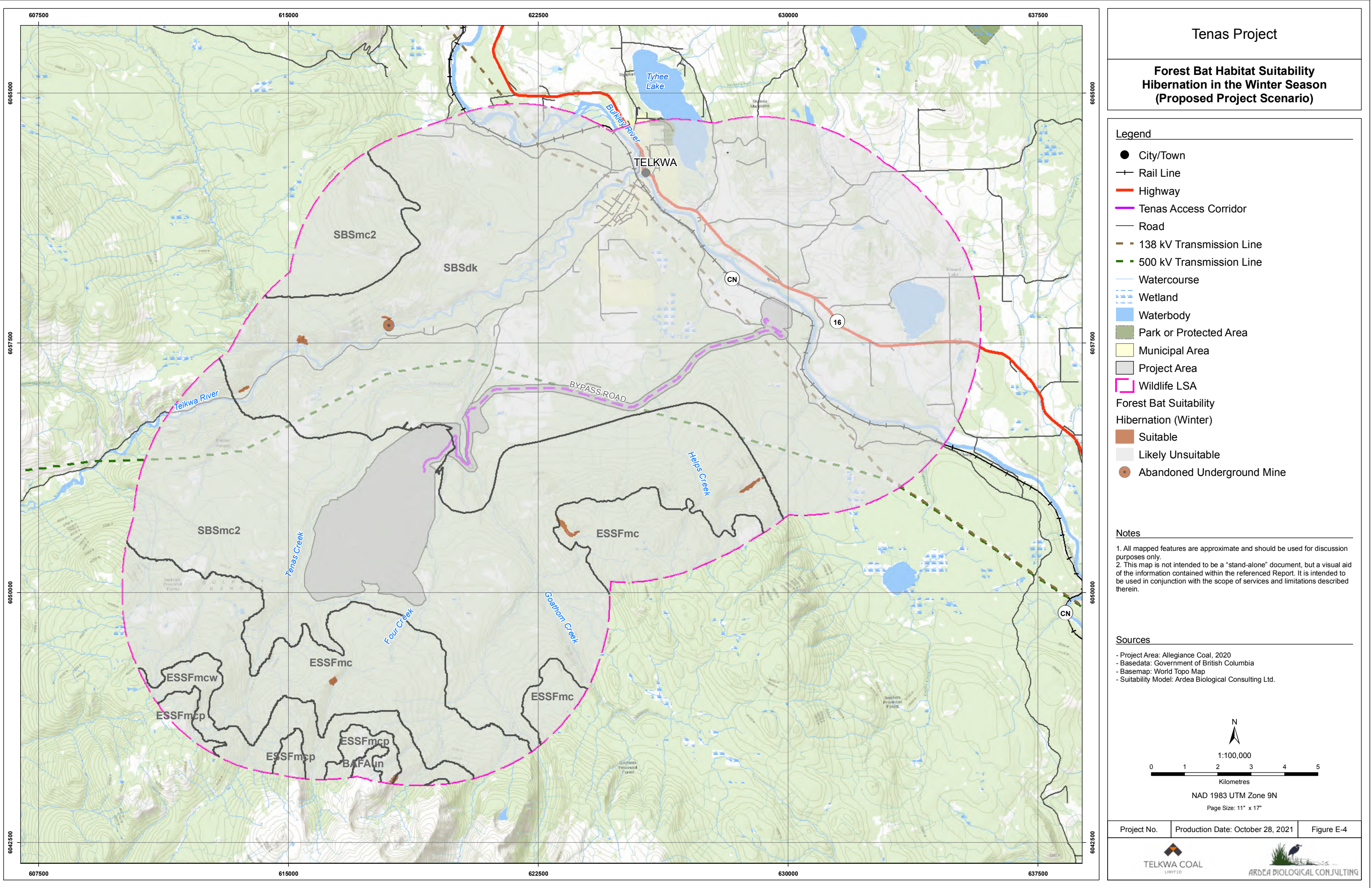
Model	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
Food in the Growing Season	High	440.3	1.2%	1,969.1	1.0%
	Moderate	9,847.0	27.6%	38,466.1	19.8%
	Low	8,678.0	24.3%	25,600.5	13.2%
	Nil	16,760.6	46.9%	128,614.8	66.1%
	Total	35,725.9	100.0%	194,650.5	100.0%
Security/Thermal in the Growing Season (Day/Night Roosting)	Suitable	10,867.9	30.4%	49,314.2	25.3%
	Unsuitable	24,858.0	69.6%	145,336.3	74.7%
	Total	35,725.9	100.0%	194,650.5	100.0%
Reproduction in the Growing Season (Maternal Roosting)	High	2,284.4	6.4%	9,971.7	5.1%
	Moderate	1,874.7	5.2%	10,959.4	5.6%
	Low	2,343.6	6.6%	10,190.7	5.2%
	Nil	29,223.2	81.8%	163,528.7	84.0%
	Total	35,725.9	100.0%	194,650.5	100.0%
Hibernation in the Winter Season	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%

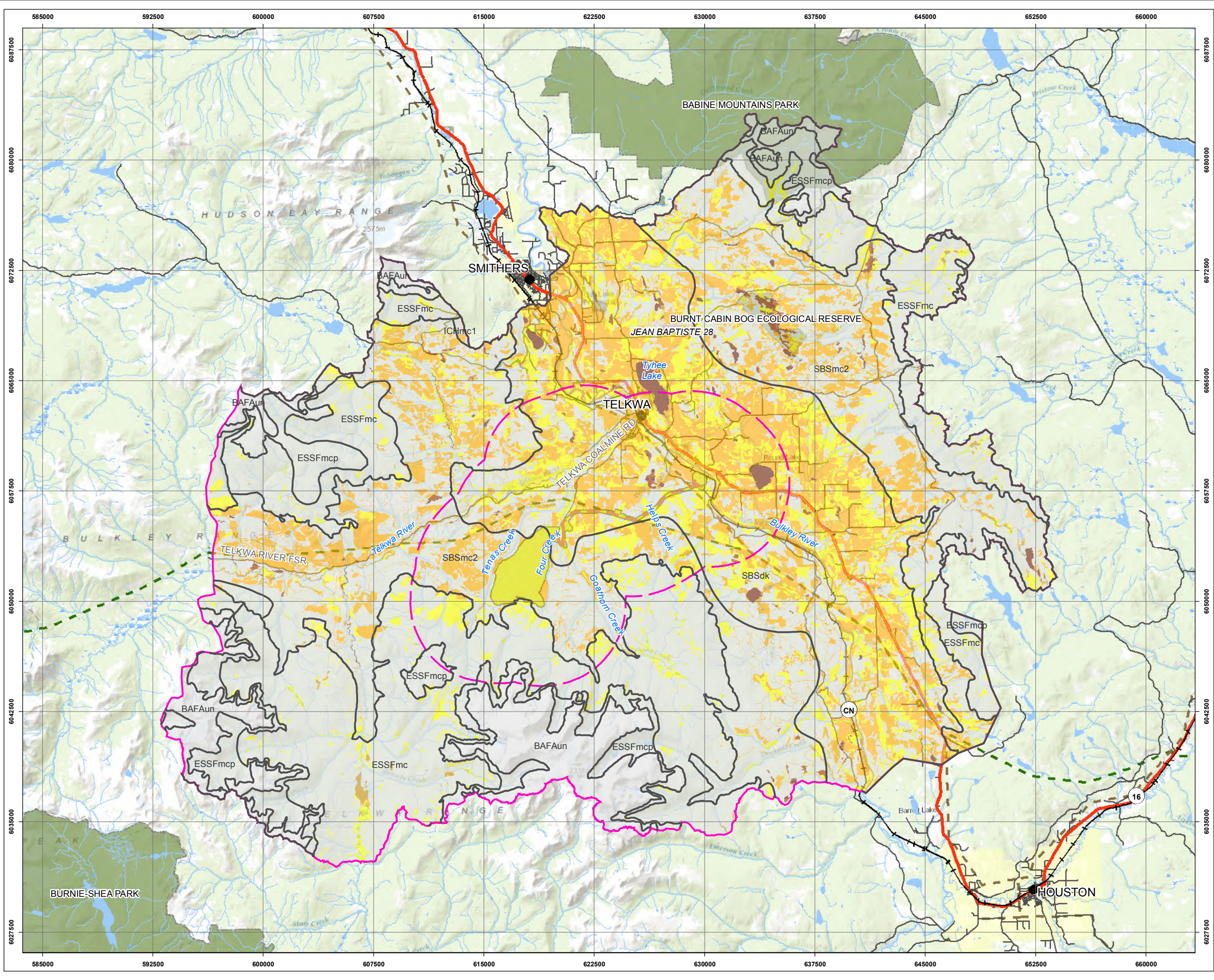
Appendix C1-E Forest Bat Habitat Suitability Maps - Proposed Project Conditions











Tenas Project

Forest Bat Habitat Suitability
Food in the Growing Season
(Project Scenario)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

Wetland

Waterbody

Park or Protected Area

Municipal Area

Project Area

Wildlife LSA

Wildlife RSA

Forest Bat Suitability
Food (Growing Season)

High

Moderate

Low

Nil

Notes

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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

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- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Mapping: Ardea Biological Consulting Ltd.

N

1:250,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

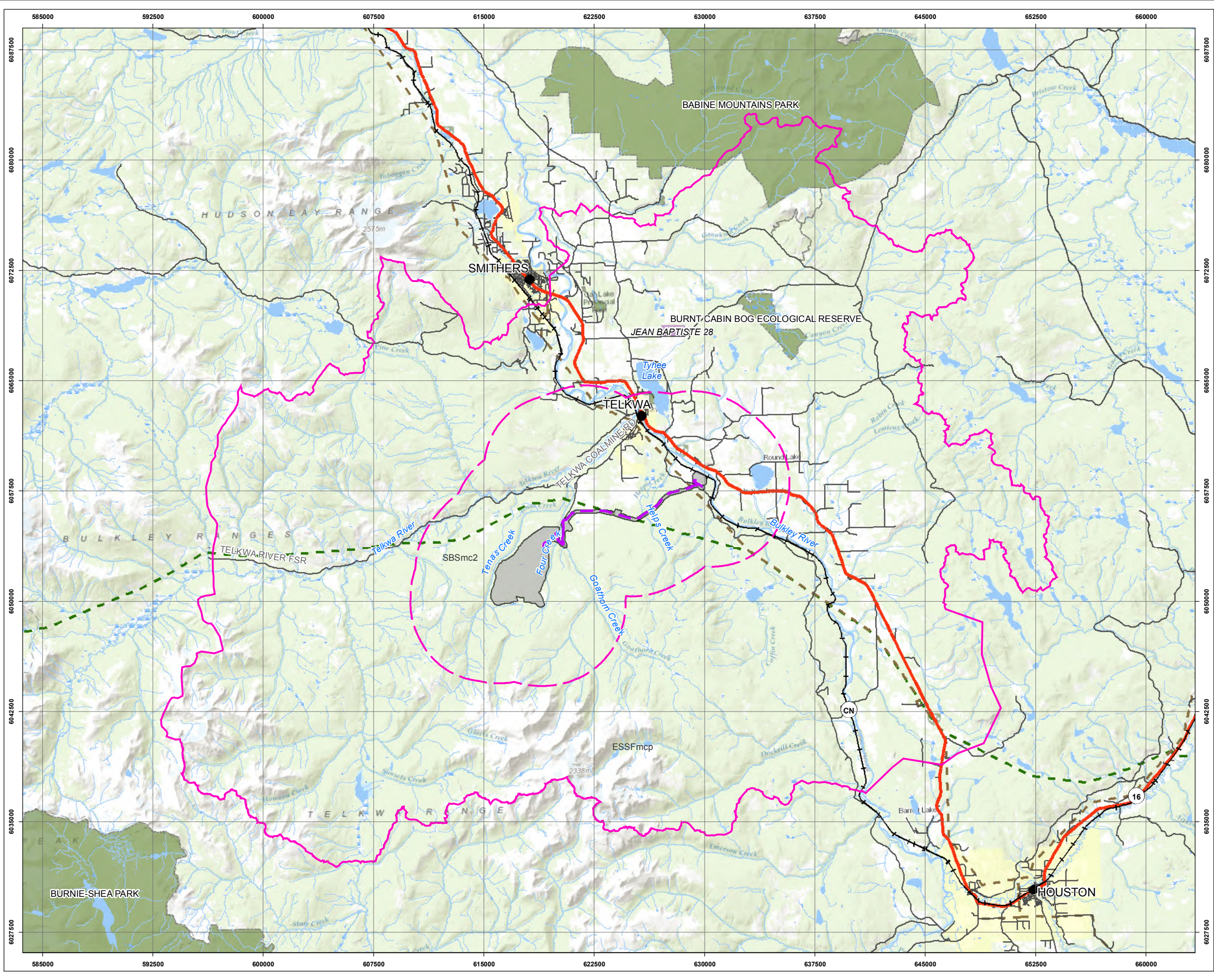
Project No.

Production Date: October 8, 2021

Figure E-5

TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING



Tenas Project

Forest Bat Habitat Suitability Security/Thermal (Day/Night Roosting) in the Growing Season (Project Scenario)

Legend

- City/Town
- Rail Line
- Highway
- Tenas Access Corridor
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- Project Area
- Wildlife LSA
- Wildlife RSA

**Forest Bat Suitability
Security/Thermal (Day/Night Roosting)**

- Suitable
- Likely Unsuitable

Notes

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

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map
- Suitability Mapping: Ardea Biological Consulting Ltd.

N

1:250,000

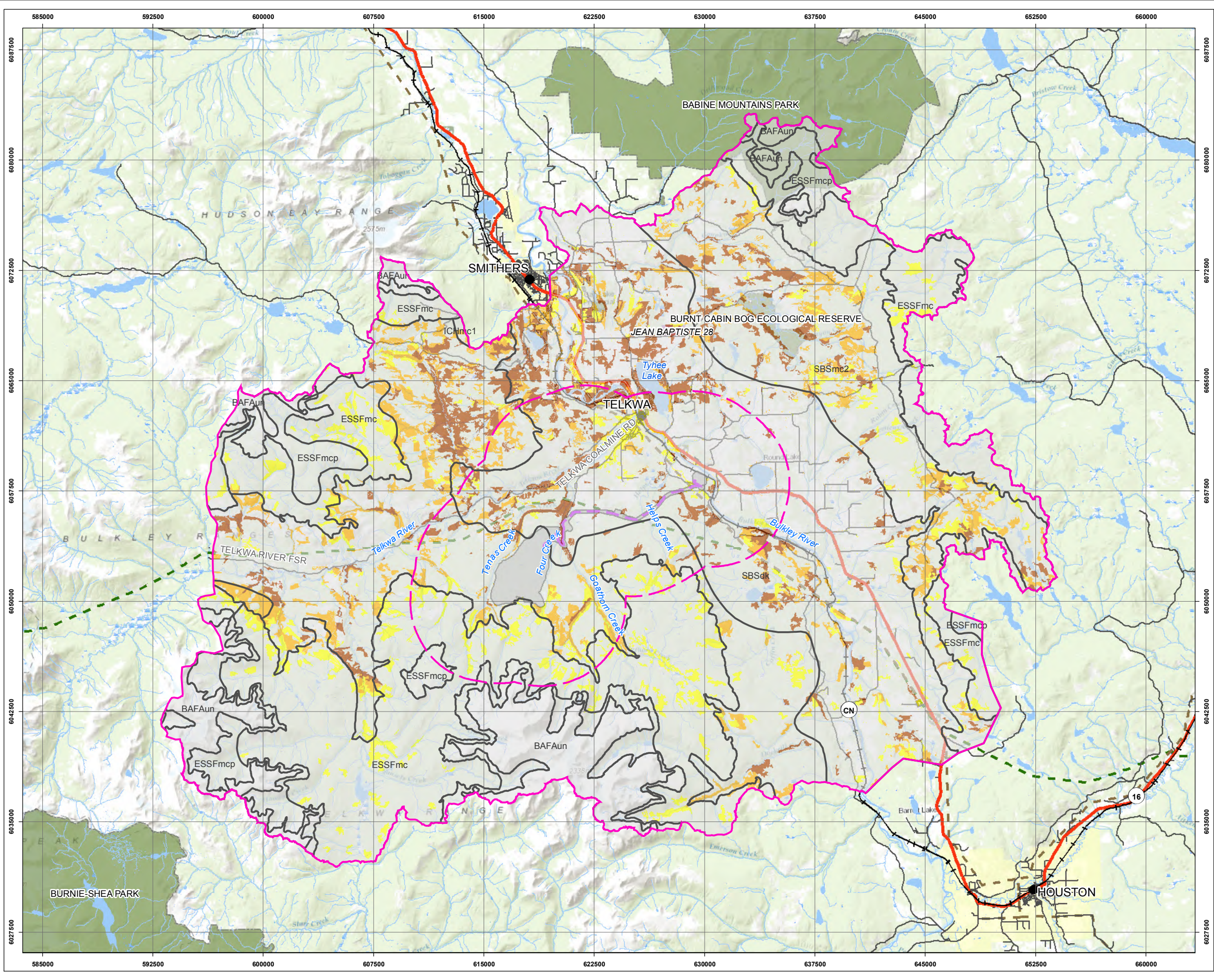
0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.	Production Date: October 8, 2021	Figure E-6
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Tensas Project

Forest Bat Habitat Suitability Reproduction (Maternal Roosting) in the Growing Season (Project Scenario)

Legend

- City/Town
- +— Rail Line
- Highway
- Tensas Access Corridor
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- Project Area
- Wildlife LSA
- Wildlife RSA

**Forest Bat Suitability
Reproduction (Growing Season)**

- 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, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map
- Suitability Mapping: Ardea Biological Consulting Ltd.

N

1:250,000

0 2 4 6 8 10

Kilometres

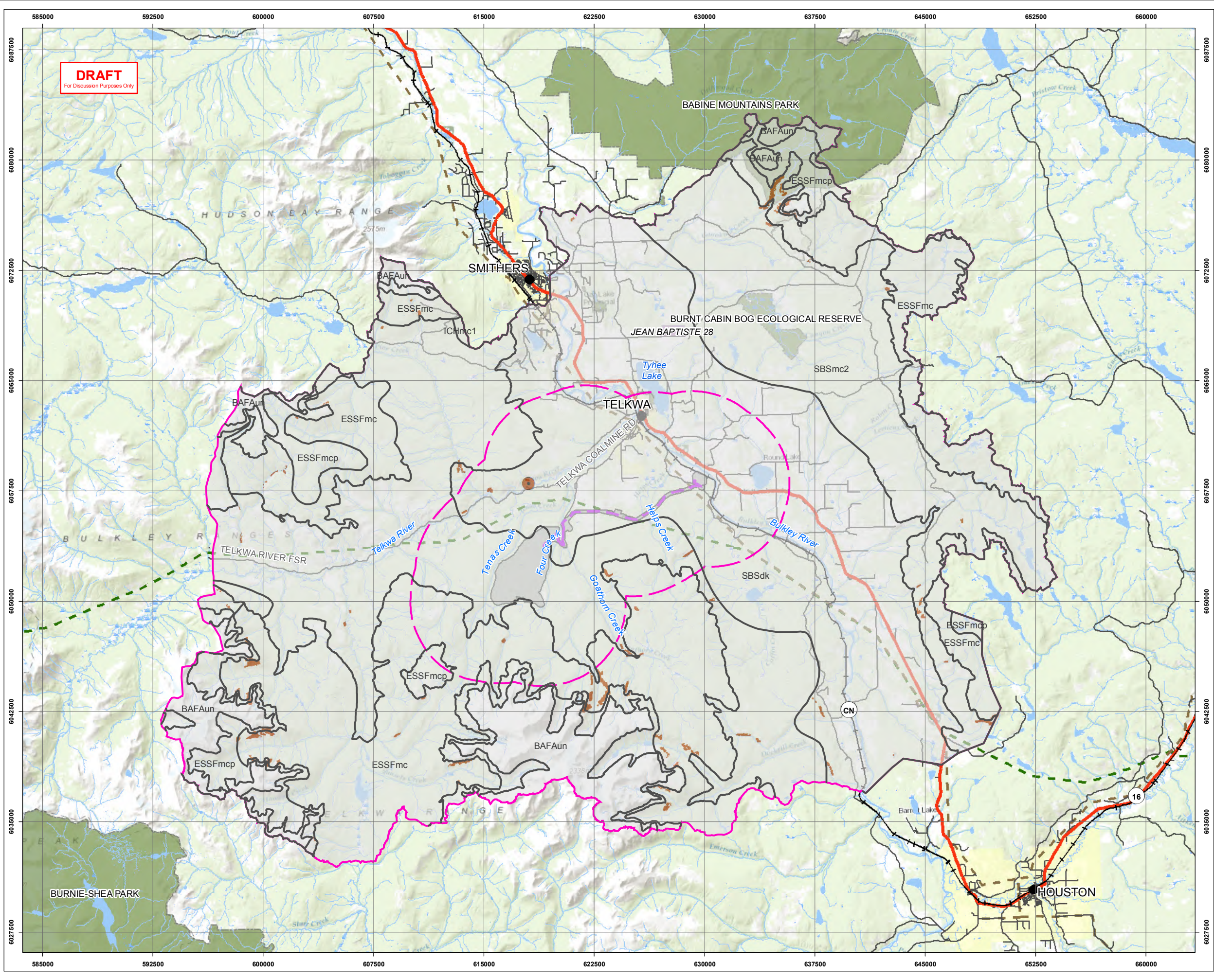
NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.	Production Date: October 8, 2021	Figure E-7
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TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING



Tenas Project

Forest Bat Habitat Suitability
Hibernation in the Winter Season
(Project Scenario)

Legend

● City/Town

—+— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Watercourse

— Wetland

— Waterbody

— Park or Protected Area

— Municipal Area

— Project Area

— Wildlife LSA

— Wildlife RSA

Forest Bat Suitability
Hibernation (Winter)

Suitable

Likely Unsuitable

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, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map

- Suitability Mapping: Ardea Biological Consulting Ltd.

N

1:250,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.

Production Date: October 8, 2021

Figure E-8

TELKWA COAL
LIMITED

ARDEA BIOLOGICAL CONSULTING

Appendix C2 Bat Species Additional Information

Table C2-1: Summary of migration / hibernation patterns and habitat preferences for bats identified from calls or literature as potentially found in the W-RSA.

Common Name	Migration/ Hibernate	Habitat Preferences	
		Roosting	Foraging
Big brown bat	Hibernates from November-April in caves or buildings	Buildings	Over water, forest canopies, clearings, around street lights in urban areas
California myotis	Largely unknown, migrates south for winter	Rock crevices, tree cavities, bark, bridges	Over water near surface, forest canopies
Eastern red bat ¹	Migrates south from area to overwinter	Tree foliage, solitary	Forested areas – forest canopy or treetop level
Hoary bat ¹	Migrates south for winter months	Tree branches, cavities, old growth forests	Hunts in well-lit areas outside of buildings where insects swarm
Little brown bat	Hibernates within 200km of summer habitat	Generalist, buildings, caves, rock crevices, tree cavities/bark	Generalist, preference for aquatic insects over water, lake/stream margins
Long-eared myotis	Largely unknown (Migrates south)	Loose bark, tree cavities Caves and mines	Flexible, open areas but can forage over foliage, tree trunks, rock surfaces
Long-legged myotis	Hibernates in caves, abandoned mine tunnels. May also migrate	Buildings, rock crevices, ground fissures, pockets under tree bark	Edges of trees groves, cliff faces, forest clearings, over water
Northern myotis	Hibernates from November-April in caves or buildings	Generalist, buildings, caves, rock crevices, tree cavities/bark	Over small ponds, forest clearings, under tree canopies, above the understory, gleaning and preying on substratum
Pallid bat ¹	Migrates south for winter months	Rock crevices of cliff faces	Grassland sparsely covered with shrubs and often bordered by ponderosa pines
Silver-haired bat	Migrates south for summer months	Dependent on trees (cavities and loose bark)	Small bodies of water in forested sites
Yuma myotis	Unknown provincially	Large colonies in man-made structures, snags, rock crevices, mines, bridges	Hunts over lakes, rivers and streams

Notes: 1) Not expected in Project area - included only for discussion of results obtained

Big Brown Bat (*Eptesicus fuscus*)

Big brown bats are a larger species of BC bats and are found in a variety of habitats throughout the province including grasslands and forests in both the interior and coastal regions. The highest altitude this species has been discovered is 1,070 m above sea level. The definitive range of the big brown bat in BC is unclear but as they have been found in parts of Alaska it is possible that their range extends to the extreme northern BC. There is at least one instance of big brown bats being observed within 100 km of the W-RSA (E-Fauna 2018) and it is commonly found throughout the interior north of BC (Handler and Psyllakis 1996).

The big brown bat is considered a generalist hunter that will hunt over water, over forest canopies, along roads, clearings, around street lights in urban settings, etc. Big Browns have been observed to prefer beetles (Whitaker 2004) but they are also known to prey on wasps, ants, flies and mosquitos. Diet of the big brown bat, as with most bats, most likely varies regionally.

This species shows a large affinity for roosting in buildings and is often called the house or barn bat. They are also known to use rocks crevices and Ponderosa Pine in the Okanagan. Big brown bats are less heat tolerant and often switch roosts if the roost temperature reaches temperatures above 35°C. Hibernation generally happens from November to April in interior populations but less known about the hibernation period and location of northern populations. These bats are considered to be very tolerant to low temperatures and will choose microclimates of -10°C to -5°C and temperatures of -4°C will prompt arousal. Migrations of up to 300km have been documents but most individuals travel more than 80 km between summer and winter roosts.

Eastern Red Bat (*Lasiurus borealis*)

Current information about the range and distribution of the eastern red bat in BC is limited; it is known from one museum specimen collected in 1905 from the Skagit Valley in southern BC and more recent confirmed records of collected specimens killed by wind turbines in northeastern BC (Nagorsen and Paterson 2012; L. Ramsay pers. comm. 2014; S. Sharpe pers. comm. 2014).

Prior to 2010, the western red bat (*Lasiurus blossevillii*) was the only red bat species assumed to be present in BC (Nagorsen and Brigham 1993); the assumption was based on a specimen identified as *L. blossevillii* that had been collected from the Skagit Valley in 1905. Several dead specimens of eastern red bat, *Lasiurus borealis*, were collected from a wind turbine facility in northeastern BC in 2010, and genetic testing carried out in 2010 on the 1905 specimen reported that the older specimen was an eastern red bat (Nagorsen and Paterson 2012). Based on the results of the DNA sample from the historical specimen and the collection of eastern red bat specimens from northeastern BC, the eastern red bat is the only red bat species thought to be present in BC.

The eastern red bat is an insectivore that hunts flying insects, particularly moths, within forested areas. The species is reported to forage near the forest canopy at or above treetop level (Schmidly 1991, in BC CDC 2014b), or along streams or lake margins (BC CDC 2014b). The species' foraging activity peaks at two to three and five to six hours after sunset. Bats may emerge from roosts prior to dusk in northern latitudes of their range (BC CDC 2014b).

The eastern red bat is a solitary species that prefers forested areas, roosts in tree foliage, and hunts within 500-900 m of its summer roost sites; the species apparently avoids caves and buildings during summer and winter months (BC CDC 2014b).

The occurrence of eastern red bat in BC is largely unknown, however, recent captures and acoustic surveys have indicated their range may be expanding into BC (Nagorsen and Paterson 2012) and into Northern BC (Ardea Consulting, unpublished data).

Hoary Bat (*Lasiurus cinereus*)

The hoary bat is the largest bat species in BC. They can be found throughout a variety of forested and grassland habitats from sea level to 1250 m in coastal and southeastern portions of BC. The hoary bat is largely known as the "Tree Bat" as has a preference to roost in coniferous and deciduous trees. There is little information on the tree roosting habits of the hoary bat within BC. In Oregon the hoary bat prefers old-growth Douglas-fir forests, presumably because of its tree-roosting habits. Although day roosts are usually in the branches of trees, hoary bats have been observed in the cavities of trees as well.

Hoary bats are insectivorous and hunt using a low frequency echolocation call. With low frequency calls these bats are able to detect large prey from long ranges. The hoary bat is large insect specialist preying on large moths, beetles and dragonflies. They have a tendency to hunt near well lit areas outside of buildings where concentrations of insects are larger. Once an individual bat has found an ideal feeding area, they will chase away other bats (including other Hoaries).

Little is known about the hibernation of hoary bats in BC. It has been suggested that this species of bat most likely migrate south during the hibernation months (Findley 1964, Cryan 2003), and therefore probably do not have a winter range within BC.

Information on the presence of hoary bat in Northern BC is limited, but several acoustic surveys have confirmed their presence in the area (Ardea Consulting, unpublished data, BC Bats, unpublished data).

Little brown myotis (*Myotis lucifugus*)

Little brown myotis is found throughout BC in a variety of habitats ranging from the northern boreal forest, coastal forests, and dry southern interior grassland and ponderosa pine forest areas; they exhibit the widest altitude range for BC bat species, with records from sea level in coastal habitats to 2,288 m elevation in the Rocky Mountains (Nagorsen and Brigham 1993). The species is found throughout mainland BC as well as a number of islands, including Haida Gwaii and Vancouver Island.

The little brown myotis is an insectivore that emerges at dusk to hunt and feed on a wide variety of invertebrate prey including insects. Herd and Fenton (1983) reported that bat flight and feeding activity was “conspicuous” at sites near waterbodies. Other investigators have made similar observations of hunting over water or near margins of lakes and streams (BC CDC 2014c). Aquatic insects accounted for a substantial portion of the species’ diet, though other insects such as moths and beetles were also eaten. The species’ diet shifts seasonally according to the availability of insect prey (Herd and Fenton 1983).

The little brown myotis uses buildings, caves, rock crevices, tree cavities and bark for summer roosting sites. The species hibernates in caves and abandoned mines (it does not appear to hibernate in buildings); some hibernacula observed in eastern Canada contained thousands of individuals (Nagorsen and Brigham 1993). Migration distances of 50 to 200 km have been recorded between summer roosts and winter hibernacula and the bats may use the same sites for many years if they are undisturbed (Nagorsen and Brigham 1993). Little brown myotis in western North America are thought to use hibernacula near their summer range (Schmidly 1991 in BC CDC 2014c). The sexes live separately during summer months. Females typically live in large nursery colonies in sites with stable hot temperatures of 30°C to 55°C. Colonies may contain hundreds or thousands of individuals. Males roost alone or in small summer colonies in much cooler sites than those of nursery colonies. The species can be long-lived in the wild, with some individuals reaching 30 years of age or more (Nagorsen and Brigham 1993).

Long-legged Myotis (*Myotis volans*)

Long-legged myotis is found throughout BC, from arid sites in the Interior to humid coastal and montane coniferous forests (BC CDC 2014d). Provincial records exist as far north as Atlin and the Kispiox Valley in northwestern BC, from Vancouver Island and the coastal mainland near Vancouver in the southwest, and Cranbrook and Mount Revelstoke National Park in southeastern BC (Nagorsen and Brigham 1993).

The long-legged myotis is one of the largest and most widespread bat species in BC (Nagorsen and Brigham 1993). The species is an insectivore that emerges at dusk and is active throughout much of the night; peak feeding activity occurs in the first few hours after sunset (Warner and Czaplewski 1984 in BC CDC 2014d). Moths are their primary prey (approximately 75%), but a range of other invertebrates are also eaten including spiders, flies, beetles, leafhoppers, lacewings, and termites (Nagorsen and Brigham 1993). The long-legged myotis is an opportunistic species that will follow prey for relatively long distances (BC CDC 2014d). Preferred hunting areas are located along edges of tree groves and cliff faces (Nagorsen and Brigham 1993), forest clearings, and over water (BC CDC 2014d).

The long-legged myotis uses buildings, rock crevices, ground fissures, and pockets under tree bark as summer day roost sites, while caves and abandoned mine tunnels are used for summer night roosts (Nagorsen and Brigham 1993). The species is reported to hibernate in small clusters and uses caves and mine sites as winter hibernacula, though the winter habits of the species are not well understood (BC CDC 2014d). A banding study reported individual bats can reach 21 years of age (Nagorsen and Brigham 1993).

Northern Myotis (*Myotis septentrionalis*)

Northern myotis (also called the northern long-eared myotis) has been identified in several locations in central, eastern and northeastern BC (BC CDC 2015e). The species is generally found in boreal forests and has been found in BC in Western Hemlock / Western Red-cedar forests near Revelstoke (Nagorsen and Brigham 1993) and Hazelton (Nagorsen *et al.* 2010). Approximately 30 records of the species have been documented for BC (BC CDC 2015q) with new records for the Site C area near Fort St. John (Simpson *et al.* 2009) and Hazelton (Nagorsen *et al.* 2010).

The northern myotis is a medium sized *Myotis* that can be distinguished from the western long-eared myotis (*Myotis evotis*) by its paler and smaller ears, lack of shoulder spots and a sparse fringe of hair along the outer edge of the tail (Nagorsen and Brigham 1993). The species hunts over small ponds and forest clearings under the tree canopy, just above the understory one to three meters above the ground (Nagorsen and Brigham 1993). Northern myotis is considered a gleaner forager and habitually preys on insects that are on substratum and not in flight. By comparison gleaning foraging is an uncommon style of foraging (Faure 1993). The diverse diet includes caddis flies, moths, beetles, flies and leafhoppers, with some prey being taken from twigs and foliage (Fenton 1982 *In* BC CDC 2015r).

Hibernacula such as caves, mines and tunnels are used, with swarming behaviour occurring in late summer and early autumn (Nagorsen and Brigham 1993). Northern myotis often hibernates with little brown myotis in the same caves (Nagorsen and Brigham 1993), but in smaller groups and in more confined spots (crevices, drill holes) rather than in the open (Caire *et al.* 1979 *In* BC CDC 2015r). Summer roosts are under the bark of trees or in buildings and it appears to be closely associated with mature forests with a high closed canopy with forest harvesting identified as a threat to the species. (BC CDC 2015q)

Pallid Bat (*Antrozous pallidus*)

Pallid bats are found in arid habitats and are restricted to grassland areas and ponderosa pine forests of low elevations in BC. Very little is known about their ecology in the province but seem to be strictly found in the Okanagan Valley. Demographic estimates from limited captures suggest the population found north of the United States are mostly male (Nagorsen and Brigham 1993).

Pallid bats are a gleaner species with large strong teeth adapted for eating large invertebrates such as June beetles, cicadas, and crickets. Within the populations of the United States, the species has been recorded preying on small lizards and other small animals. This species forages close to the ground and over foliage of shrubs and trees (Nagorsen and Brigham 1993).

In BC, pallid bats appear to show preference for ponderosa pines for roost sites where they return to torpor when nights are cool. In the USA, pallid bats are known to also use man-made roost sites like buildings and mines. No pallid bats have been recorded in winter in the province. Hibernating pallid bats of the United States show affinity for hibernation sites near its summer range in buildings, mine adits, and caves (Nagorsen and Brigham 1993).

Silver-haired Bat (*Lasionycteris noctivagans*)

The silver-haired bat is found primarily in coniferous forest sites near waterbodies such as lakes, ponds, and streams, as well as areas disturbed or modified by humans (BC CDC 2014f); they are also found in grassland habitats in BC (Nagorsen and Brigham 1993). The species is wide-ranging in North America and, in BC, the range extends to the Spatsizi Plateau and Peace River in the northern interior; the species' southern range extends through the continental US to northern Mexico. The Silver-haired Bat is also found on coastal islands in BC, including Haida Gwaii and Vancouver Island (Nagorsen and Brigham 1993). This species uses habitats from sea level to elevations up to 1,220 m in its range in BC (Nagorsen and Brigham 1993).

The silver-haired bat is an insectivore that preys on a wide range of insects. It is capable of taking advantage of the insect prey available at a given time and location; the bat's agile flying pattern and high-frequency

echolocation calls make the species particularly adept at catching small insects, especially those in a swarm situation, at close range. Prey items include moths, flies, caddis flies, spiders, beetles, ants, termites, and leafhoppers (Nagorsen and Brigham 1993). The species tends to focus foraging activity over small waterbodies in forested sites (BC CDC 2014f) or near tree-top level over waterbodies (Nagorsen and Brigham 1993). This species exhibits two periods of peak night-time foraging activity: the first peak occurs between 10 pm and midnight and a second approximately one hour before dawn (Nagorsen and Brigham 1993).

The silver-haired bat is a tree-roosting species, with summer roost sites and nursery sites located in abandoned cavities made by woodpeckers or under loose bark (Vonhof and Barclay, 1996). Summer roosts have also been found in buildings (BC CDC 2014f). The silver-haired bat also uses trees for hibernacula. The species reliance on tree habitat for all stages of its life history makes it vulnerable to deforestation and snag/wildlife tree removal activities (Nagorsen and Brigham 1993). Silver-haired bats tend to roost singly or in small groups of two to six individuals, though even in these small roosting groups, the bats are not typically found in close contact with each other (Nagorsen and Brigham 1993).

Western Long-eared Myotis (*Myotis evotis*)

The western long-eared myotis uses a wide range of habitats throughout northern and southern BC from montane coniferous forests and humid coastal forests to dry grasslands and ponderosa pine forests (Nagorsen and Brigham 1993), though forested areas appear to be the preferred habitat type (Vonhof and Barclay 1996, BC CDC 2014e). In BC, the western long-eared myotis is found in habitats from sea level to 1,220 m in Kootenay National Park. The species is consistently found at high elevation sites throughout its range in western Canada, with reports of summer populations at elevations up to 2,050m in the Rocky Mountains in Alberta (Nagorsen and Brigham 1993).

The western long-eared myotis is an insectivore that exhibits flexibility in its hunting habits; they may take insects on the wing, or pick invertebrate prey from surfaces as the bats fly over foliage, tree trunks, rock surfaces, or the ground (BC CDC 2014e). Diet studies from areas other than BC, show moths to be the primary prey item, along with spiders, beetles, and flies. The western long-eared myotis has a short-duration, high-pitched echolocation call that is likely a beneficial adaptation for feeding in densely-vegetated areas such as forests (Nagorsen and Brigham 1993). The species' flexible feeding behaviour has been suggested to aid female Western Long-eared bats in successfully rearing their young in cool, high elevation sites where aerial insect prey are limited (Nagorsen and Brigham 1993). Adult bats typically emerge from their day roost sites soon after dark to begin feeding activities (Nagorsen and Brigham 1993), although other investigators have reported the species emerges later in the evening to begin its feeding forays (BC CDC 2014e).

Caves and mine adits provide temporary summer night roosts for this species, and small maternity colonies of five to 30 individuals are often located in buildings (Nagorsen and Brigham 1993). Loose bark and tree cavities provide important summer roost sites (Vonhof and Barclay 1996); other roost sites include buildings, mines, caves, sink holes, and rock fissures (Nagorsen and Brigham 1993). The winter range and habits of the species in BC are not currently known (BC CDC 2014e). In the western US, small numbers of Western Long-eared myotis have been reported hibernating in caves and mine adits (Nagorsen and Brigham 1993).

Table C2-2: Summary of bat roost assessment data within the W-LSA.

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR01	BR01_1	1	SBSdk	Act	34.7	M	100	20	Dom	6	1	1	1	1	0			0	plot ~100m from Telkwa River
BR01	BR01_2	2	SBSdk	Act	36.1	M	100	16	Dom	6	1	1	1	1	0			1	
BR01	BR01_3	3	SBSdk	Act	<15													0	
BR01	BR01_4	4	SBSdk	Sx	<15													0	
BR01	BR01_5	5	SBSdk	Act	<15													0	
BR01	BR01_6	6	SBSdk	Act	<15													0	
BR01	BR01_7	7	SBSdk	Act	<15													0	
BR01	BR01_8	8	SBSdk	Sx	34.4	M	100	21	Dom	10	1	1	1	1	0			0	
BR02	BR02_1	1	SBSdk	Ep	30.2	M	90	17	Sub	10	2	2	1	1	0			2	Big mature aspen
BR02	BR02_2	2	SBSdk	At	25.6	M	70	2	-		7	-	4	8	0			0	
BR02	BR02_3	3	SBSdk	At	27.9	M	90	4	-		7	-	3	8	0			2	
BR02	BR02_4	4	SBSdk	At	<15													0	
BR02	BR02_5	5	SBSdk	At	25.4	M	60	6	-		7	-	4	8	0		Yes	2	
BR02	BR02_6	6	SBSdk	Ws	34.6	M	85	13	Sub		4	3	4	3	0			2	
BR02	BR02_7	7	SBSdk	At	<15													0	
BR02	BR02_8	8	SBSdk	At	16.2	M	50	6			7	-	5	7	0		Yes	5	
BR02	BR02_9	9	SBSdk	Sx	32.5	M	100	20	Dom	10	1	1	1	1	1			1	
BR02	BR02_10	10	SBSdk	Sx	<15													0	
BR02	BR02_11	11	SBSdk	At	31	M	80	22	Dom		2	2	3	4	0			2	
BR02	BR02_12	12	SBSdk	At	<15													0	
BR02	BR02_13	13	SBSdk	At	<15													0	
BR02	BR02_14	14	SBSdk	At	<15													0	
BR02	BR02_15	15	SBSdk	At	<15													0	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR02	BR02_16	16	SBSdk	At	<15													0	
BR02	BR02_17	17	SBSdk	At	<15													0	
BR02	BR02_18	18	SBSdk	Sx	<15													0	
BR03	BR03_1	1	SBSdk	Ep	30.2	M	90	17	Sub	8	1	1	1	1	0			3	
BR03	BR03_2	2	SBSdk	Sx	45.7	M	100	30	Dom	15	1	1	1	1	1			1	Lots of small loose bark
BR03	BR03_3	3	SBSdk	Sx	<15													0	
BR03	BR03_4	4	SBSdk	Sx	<15													0	
BR03	BR03_5	5	SBSdk	Sx	<15													0	
BR03	BR03_6	6	SBSdk	Sx	<15													0	
BR03	BR03_7	7	SBSdk	Sx	<15													0	
BR03	BR03_8	8	SBSdk	Ws	17.2	M	90	8	Sub		4	3	2	3	0			2	Scouler's Willow
BR03	BR03_9	9	SBSdk	Sx	<15													0	
BR03	BR03_10	10	SBSdk	Sx	35	M	80	28	Dom		3	2	2	1	1			3	Hung-up Snag -
BR04	BR04_1	1	SBSdk	Ep	46	M	100	20	Dom	10	1	1	1	1	0			2	
BR04	BR04_2	2	SBSdk	Ep	43.4	M	100	20	Dom	12	1	1	1	1	0			2	
BR04	BR04_3	3	SBSdk	Ep	36	M	100	23	Dom	16	1	1	1	1	0			1	
BR04	BR04_4	4	SBSdk	Ep	31.8	M	100	11	-		3	2	1	2	0			2	Broken Top
BR04	BR04_5	5	SBSdk	Ep	45.5	M	100	12	-		7	-	1	3	0			2	Snag
BR05	BR05_1	1	SBSdk	Sx	31.1	M	100	24	Dom	8	1	1	1	1	0			0	
BR05	BR05_2	2	SBSdk	Sx	21	M	100	21	Dom	8	1	1	1	1	0			0	
BR05	BR05_3	3	SBSdk	Sx	32	M	100	21	Dom	6	1	1	1	1	0			1	Shaggy old branches
BR05	BR05_4	4	SBSdk	Act	32.1	M	100	21	Dom		1	1	1	1	0			1	
BR05	BR05_5	5	SBSdk	Act	30.6	M	80	18			4	2	3	2	0			2	Snag
BR05	BR05_6	6	SBSdk	Act	50.2	M	100	26	Dom		1	1	1	1	0			1	Some loose and falling branches

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR06	BR06_1	1	SBSdk	Ep	52.8	M	85	24	Dom	16	1	1	1	1	0			2	Minimal loose bark
BR06	BR06_2	2	SBSdk	Sx	<15													0	
BR06	BR06_3	3	SBSdk	Sx	<15													0	Plot immediately adjacent to Goathorn Creek, Large rock outcrop with great roost potential (cracks)
BR06	BR06_4	4	SBSdk	Sx	<15													0	
BR06	BR06_5	5	SBSdk	At	24.1	M	10	20	Sub		4	3	6	4	0			2	Snag
BR06	BR06_6	6	SBSdk	Sx	33.1	M	100	21	Dom	5	1	1	1	1	0			0	
BR07	BR07_1	1	SBSdk	Sx	34	E	80	26	Dom	5	3	1	3	1	0			1	
BR07	BR07_2	2	SBSdk	At	<15													0	
BR07	BR07_3	3	SBSdk	At	<15													0	
BR07	BR07_4	4	SBSdk	At	33.1	E	100	19	Sub	15	1	1	1	1	0			1	
BR08	BR08_1	1	SBSmc2	Sx	52.4	M	80	33	Dom		3	2	3	1	0			1	
BR08	BR08_2	2	SBSmc2	Act	55.5	M	100		Dom	18	1	1	1	1	0			1	
BR08	BR08_3	3	SBSmc2	Bl	<15													0	
BR08	BR08_4	4	SBSmc2	Bl	<15													0	
BR08	BR08_5	5	SBSmc2	Sx	<15													0	
BR08	BR08_6	6	SBSmc2	Sx	61.2	M	100		Dom	16	1	1	1	1	0			1	
BR08	BR08_7	7	SBSmc2	Pl	<15													0	
BR08	BR08_8	8	SBSmc2	Bl	<15													0	
BR08	BR08_9	9	SBSmc2	Bl	<15													0	
BR08	BR08_10	10	SBSmc2	Bl	23.7	M	90		-		6	3	2	2	0			2	Snag
BR09	BR09_1	1	SBSmc2	Act	71.1	M	100	32	Dom		1	1	1	1	0			2	
BR09	BR09_2	2	SBSmc2	Sx	40.8	M	100	26	Dom		1	1	1	1	0			1	
BR09	BR09_3	3	SBSmc2	Bl	<15													0	25% of large trees are blowdown
BR09	BR09_4	4	SBSmc2	Sx	45.1	M	100	30	Dom		1	1	1	1	0			1	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR10	BR10_1	1	SBSmc2	Sx	36.6	M	100	21	Dom	8	1	1	1	1	0			1	
BR10	BR10_2	2	SBSmc2	Bl	<15													0	
BR10	BR10_3	3	SBSmc2	Bl	<15													0	
BR10	BR10_4	4	SBSmc2	At	38.8	M	100	22	Dom		1	2	1	1	0			1	
BR10	BR10_5	5	SBSmc2	Bl	<15													0	
BR10	BR10_6	6	SBSmc2	Bl	<15													0	
BR10	BR10_7	7	SBSmc2	Pl	32.2	M	0	12	-		6	6	7	5	0			2	Snag, burnt
BR10	BR10_8	8	SBSmc2	Bl	<15													0	
BR10	BR10_9	9	SBSmc2	Bl	<15													0	
BR10	BR10_10	10	SBSmc2	At	19.2	M	90				3	2	2	1	0			1	
BR10	BR10_11	11	SBSmc2	Bl	<15													0	
BR10	BR10_12	12	SBSmc2	Bl	<15													0	
BR10	BR10_13	13	SBSmc2	At	24.9	M	90	14	Sub	11	2	2	2	1	0			1	
BR10	BR10_14	14	SBSmc2	Sx	<15													0	
BR10	BR10_15	15	SBSmc2	Bl	<15													0	
BR10	BR10_16	16	SBSmc2	At	<15													0	Snag, no potential
BR11	BR11_1	1	SBSmc2	Sx	52.4	M	100	26	Dom	12	1	1	1	1	0			1	
BR11	BR11_2	2	SBSmc2	Bl	<15													0	
BR11	BR11_3	3	SBSmc2	Bl	<15													0	
BR11	BR11_4	4	SBSmc2	Bl	39.2	M	70	26	-		4	4	4	2	0			2	
BR11	BR11_5	5	SBSmc2	Bl	<15													0	
BR11	BR11_6	6	SBSmc2	Sx	66	M	80	31	Dom		3	2	3	2	0			2	
BR11	BR11_7	7	SBSmc2	Bl	<15													0	
BR12	BR12_1	1	SBSmc2	Sx	53.1	M	85	32	Dom		2	2	2	1	1		Yes	3	Big crack

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR12	BR12_2	2	SBSmc2	Act	<15													0	
BR13	BR13_1	1	SBSmc2	Bl	39	M	85	24	Dom		4	4	4	1	1	BC	Yes	3	Woodpecker cavities
BR13	BR13_2	2	SBSmc2	Bl	25	M	5	26	Dom		4	5	6	1	0			1	
BR13	BR13_3	3	SBSmc2	Sx	46.8	M	85	26	Dom		3	3	2	1	1			2	
BR13	BR13_4	4	SBSmc2	Bl	<15													0	
BR13	BR13_5	5	SBSmc2	Sx	<15													0	
BR13	BR13_6	6	SBSmc2	Pl	<15													0	
BR13	BR13_7	7	SBSmc2	Bl	<15													0	
BR13	BR13_8	8	SBSmc2	Sx	52	M	30	27	Dom		3	4	5	1	1			3	
BR13	BR13_9	9	SBSmc2	Sx	49.8	M	40	25	Dom		3	4	5	1	2			3	
BR14	BR14_1	1	SBSmc2	Bl	33.8	M	15	21	Dom		4	3	5	1	0		Yes	3	Snag
BR14	BR14_2	2	SBSmc2	Bl	28.6	M	8	15	-		5	6	6	1	0			2	Snag
BR14	BR14_3	3	SBSmc2	Sx	<15													0	
BR14	BR14_4	4	SBSmc2	Bl	32.3	M	80	22	Dom		4	4	3	1	0			2	Snag
BR14	BR14_5	5	SBSmc2	Bl	<15													0	
BR14	BR14_6	6	SBSmc2	Act	<15													0	
BR14	BR14_7	7	SBSmc2	Bl	<15													0	
BR14	BR14_8	8	SBSmc2	Bl	<15													0	
BR14	BR14_9	9	SBSmc2	Bl	<15													0	
BR15	BR15_1	1	SBSmc2	Pl	31.2	M	12	8	Sub		6	5	5	3	0	BC	Yes	2	Woodpecker cavities
BR15	BR15_2	2	SBSmc2	Bl	<15													0	
BR15	BR15_3	3	SBSmc2	Sx	<15													0	
BR16	BR16_1	1	SBSmc2	Pl	39.6	M	100	20	Co-dom		3	3	2	1	0			2	Snag
BR16	BR16_2	2	SBSmc2	Bl	48.8	M	95	22	Dom	11	1	1	1	1	0			1	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR16	BR16_3	3	SBSmc2	Sx	<15													0	
BR16	BR16_4	4	SBSmc2	Bl	<15													0	
BR16	BR16_5	5	SBSmc2	Pl	<15													0	
BR17	BR17_1	1	SBSmc2	Sx	58.4	M	75	24			3	2	4	1	0			1	
BR17	BR17_2	2	SBSmc2	Sx	66	E	98	26		15	1	1	1	1	0			1	
BR17	BR17_3	3	SBSmc2	Sx	<15													0	
BR17	BR17_4	4	SBSmc2	Bl	<15													0	
BR17	BR17_5	5	SBSmc2	Bl	<15													0	
BR17	BR17_6	6	SBSmc2	Bl	<15													0	
BR17	BR17_7	7	SBSmc2	Bl	<15													0	
BR17	BR17_8	8	SBSmc2	Bl	<15													0	
BR17	BR17_9	9	SBSmc2	Bl	<15													0	
BR17	BR17_10	10	SBSmc2	Bl	<15													0	
BR18	BR18_1	1	SBSdk	Ep	37.1	M	80	12	Sub	6	1	1	2	1	0			2	
BR18	BR18_2	2	SBSdk	Ep	29.7	M	90	11	Sub	6	1	1	2	1	0			2	
BR18	BR18_3	3	SBSdk	Sx	<15													0	Mature Stand, wetland areas nearby, open space
BR18	BR18_4	4	SBSdk	Sx	45.3	M	85	18	Dom		4	3	2	1	0		Yes	3	snag
BR18	BR18_5	5	SBSdk	Ep	47.4	M	80	14	Co-dom	8	1	1	2	1	0			2	
BR18	BR18_6	6	SBSdk	Ep	35.6	M	90	13	Sub	10	1	1	1	1	0			2	
BR18	BR18_7	7	SBSdk	Sx	<15													0	
BR18	BR18_8	8	SBSdk	Sx	<15													0	
BR19	BR19_1	1	SBSdk	Ep	27	M	100	18	Dom	8	1	1	1	1	0			2	
BR19	BR19_2	2	SBSdk	Sx	29.8	M	100	20	Dom	10	1	1	2	1	0			2	
BR19	BR19_3	3	SBSdk	Ep	<15													0	Wetland Adjacent - ideal forage

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BR19	BR19_4	4	SBSdk	At	<15													0	
BR19	BR19_5	5	SBSdk	At	<15													0	
BR19	BR19_6	6	SBSdk	Sx	<15													0	
BR20	BR20_1	1	SBSdk	Ep	33.4	M	90	22	Sub	15	1	1	2	2	0			2	
BR20	BR20_2	2	SBSdk	Sx	49.9	M	90	26	Dom		3	2	2	1	2			2	Snag
BR20	BR20_3	3	SBSdk	Sx	<15													0	
BR20	BR20_4	4	SBSdk	Ep	26.8	M	75	18	Sub	10	1	1	3	4	0			3	
BR20	BR20_5	5	SBSdk	Ep	19.6	M	90	15	Sub	8	1	1	2	1	0			1	
BR20	BR20_6	6	SBSdk	Ep	32.1	M	90	22	Sub	11	1	1	2	2	0			2	
BR20	BR20_7	7	SBSdk	Sx	<15													0	
BR20	BR20_8	8	SBSdk	Sx	<15													0	
BR21	BR21_1	1	SBSdk	At	<15													0	
BR21	BR21_2	2	SBSdk	At	<15													0	
BR21	BR21_3	3	SBSdk	At	<15													0	
BR21	BR21_4	4	SBSdk	At	<15													0	
BR21	BR21_5	5	SBSdk	Sx	<15											BO		0	Small Stick Nest
BR21	BR21_6	6	SBSdk	Sx	<15													0	no potential bat roosts
BR22	BR22_1	1	SBSdk	At	39.1	M	70	20	Sub		4	4	4	3	0	MM		2	Snag - Bear Claw marks in bark
BR22	BR22_2	2	SBSdk	Sx	<15													0	Snag
BR22	BR22_3	3	SBSdk	Sx	<15													0	
BR22	BR22_4	4	SBSdk	Sx	<15													0	
BR22	BR22_5	5	SBSdk	Sx	<15													0	
BR22	BR22_6	6	SBSdk	Sx	<15													0	
BR23	BR23_1	1	SBSdk	Ep	32.9		90	22	Sub	10	1	1	3	2	0			2	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR23	BR23_2	2	SBSdk	Ep	23.9		90	18	Sub	8	1	3	3	3	0			2	
BR23	BR23_3	3	SBSdk	Sx	<15													0	Lots of At <15cm
BR23	BR23_4	4	SBSdk	Ep	41			20	Sub	12	1	1	2	2	0			2	
BR24	BR24_1	1	SBSdk	At	34.9	M	90	21		18	2	1	2	2	0			2	
BR24	BR24_2	2	SBSdk	At	38.9	M	90	21		18	2	1	2	2	0			1	
BR24	BR24_3	3	SBSdk	At	27.8	M	85	18		15	3	3	2	3	0			1	
BR24	BR24_4	4	SBSdk	At	36.5	M	90	21		18	1	1		2	0			1	
BR24	BR24_5	5	SBSdk	Sx	<15													0	Aspen stand
BR24	BR24_6	6	SBSdk	Ws	<15													0	
BR25	BR25_1	1	SBSdk	At	45.4	M	95	26	Dom	20	1	1	2	1	0	BC	Yes	3	Cavities (4"X4") cavity nest
BR25	BR25_2	2	SBSdk	At	<15													0	Aspen Stand
BR25	BR25_3	3	SBSdk	At	<15													0	
BR25	BR25_4	4	SBSdk	At	<15													0	
BR25	BR25_5	5	SBSdk	At	<15													0	
BR26	BR26_1	1	SBSdk	Ep	33	M	85	18	Sub	9	1	1	2	2	0			2	
BR26	BR26_2	2	SBSdk	Sx	<15													0	
BR26	BR26_3	3	SBSdk	Sx	<15													0	
BR26	BR26_4	4	SBSdk	PI	<15													0	
BR26	BR26_5	5	SBSdk	Sx	<15													0	
BR26	BR26_6	6	SBSdk	Sx	<15													0	
BR26	BR26_7	7	SBSdk	PI	<15													0	
BR26	BR26_8	8	SBSdk	PI	37.5	M	-	25	Dom	18	3	2	1	1	0			2	
BR26	BR26_9	9	SBSdk	Sx	<15													0	
BR27	BR27_1	1	SBSmc2	BI	42.2	M	70	18			4	4	5	2	0			2	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR27	BR27_2	2	SBSmc2	Bl	29.6	M	90	18	Sub		2	2	1	2	0			1	
BR27	BR27_3	3	SBSmc2	Sx	<15													0	
BR27	BR27_4	4	SBSmc2	Sx	<15													0	
BR27	BR27_5	5	SBSmc2	Bl	26.8	M	95	19	Sub		2	2	1	2	0			1	
BR27	BR27_6	6	SBSmc2	Sx	<15													0	
BR27	BR27_7	7	SBSmc2	Sx	64.7	M	100	31	Dom		1	1	1	1	0			0	
BR27	BR27_8	8	SBSmc2	Bl	<15													0	
BR28	BR28_1	1	SBSmc2	Bl	39.8	M	85	10	-		6	5	3	4	0	BC		2	snag- bird cavities
BR28	BR28_2	2	SBSmc2	Bl	<15													0	
BR28	BR28_3	3	SBSmc2	Bl	<15													0	
BR28	BR28_4	4	SBSmc2	Sx	<15													0	
BR28	BR28_5	5	SBSmc2	Bl	<15													0	
BR28	BR28_6	6	SBSmc2	Sx	<15													0	
BR28	BR28_7	7	SBSmc2	Sx	<15													0	
BR28	BR28_8	8	SBSmc2	Sx	<15													0	Lichens on green tree = 0.1
BR29	BR29_1	1	SBSmc2	Bl	23	M	40	16			4	3	5	3	0			2	snag
BR29	BR29_2	2	SBSmc2	Bl	<15													0	
BR29	BR29_3	3	SBSmc2	Sx	<15													0	
BR29	BR29_4	4	SBSmc2	Bl	<15													0	
BR29	BR29_5	5	SBSmc2	Bl	<15													0	
BR29	BR29_6	6	SBSmc2	Bl	<15													0	
BR29	BR29_7	7	SBSmc2	Bl	<15													0	
BR29	BR29_8	8	SBSmc2	Bl	<15													0	
BR29	BR29_9	9	SBSmc2	Bl	<15													0	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR30	BR30_1	1	SBSmc2	At	24.4	M	20	15			4	5	6	4	0			2	snag
BR30	BR30_2	2	SBSmc2	Bl	<15													0	
BR30	BR30_3	3	SBSmc2	Bl	<15													0	
BR30	BR30_4	4	SBSmc2	Sx	<15													0	
BR30	BR30_5	5	SBSmc2	Bl	<15													0	
BR30	BR30_6	6	SBSmc2	Sx	<15													0	
BR30	BR30_7	7	SBSmc2	Sx	<15													0	
BR30	BR30_8	8	SBSmc2	At	<15													0	
BR30	BR30_9	9	SBSmc2	Bl	<15													0	
BR30	BR30_10	10	SBSmc2	Bl	<15													0	
BR31	BR31_1	1	SBSmc2	Ws	27.6	M	85	16	Sub		3	2	3	1	0			2	
BR31	BR31_2	2	SBSmc2	Ws	28	M	65	12	Sub		4	5	4	4	0			2	snag
BR31	BR31_3	3	SBSmc2	Bl	19.3	M	80	11			4	3	3	1	0			1	snag
BR31	BR31_4	4	SBSmc2	Sx	<15													0	
BR31	BR31_5	5	SBSmc2	Act	67.7	M	100	26	Dom		1	1	1	1	0			2	
BR31	BR31_6	6	SBSmc2	Bl	<15													0	
BR31	BR31_7	7	SBSmc2	Bl	<15													0	
BR31	BR31_8	8	SBSmc2	Bl	<15													0	
BR31	BR31_9	9	SBSmc2	Bl	<15													0	
BR31	BR31_10	10	SBSmc2	Bl	<15													0	
BR31	BR31_11	11	SBSmc2	Bl	<15													0	
BR31	BR31_12	12	SBSmc2	Bl	<15													0	
BR32	BR32_1	1	SBSmc2	Bl	48.9	M	90	26	Dom	8	2	2	2	1	0			1	
BR32	BR32_2	2	SBSmc2	Sx	<15													0	

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	Comments
BR32	BR32_3	3	SBSmc2	Bl	18.2	M	85	9	-		5	4	2	3	0			1	snag
BR32	BR32_4	4	SBSmc2	Bl	17.1	M	85	11	-		5	4	2	3	0			1	snag
BR32	BR32_5	5	SBSmc2	Bl	<15													0	
BR32	BR32_6	6	SBSmc2	Bl	<15													0	
BR33	BR33_1	1	SBSmc2	Bl	30.9	M	0	9	-		6	6	7	8	0			2	burnt snag
BR33	BR33_2	2	SBSmc2	Sx	<15													0	
BR33	BR33_3	3	SBSmc2	Sx	<15													0	
BR33	BR33_4	4	SBSmc2	Ws	27	M	100	16	Sub	10	4	1	1	1	0			2	
BR33	BR33_5	5	SBSmc2	Sx	<15													0	
BR33	BR33_6	6	SBSmc2	Sx	<15													0	
BR33	BR33_7	7	SBSmc2	Sx	<15													0	
BR33	BR33_8	8	SBSmc2	Bl	<15													0	
BR33	BR33_9	9	SBSmc2	Bl	<15													0	
BR33	BR33_10	10	SBSmc2	Bl	<15													0	
BR33	BR33_11	11	SBSmc2	Sx	<15													0	
BR33	BR33_12	12	SBSmc2	Sx	<15													0	
BR33	BR33_13	13	SBSmc2	Sx	<15													0	
BR33	BR33_14	14	SBSmc2	Sx	<15													0	
BR33	BR33_15	15	SBSmc2	Bl	<15													0	
BR34	BR34_1	1	SBSmc2	Bl	32	M	90	26			4	3	3	3	0			2	snag
BR34	BR34_2	2	SBSmc2	Sx	35.8	M	90	26			4	3	3	3	0			1	snag
BR34	BR34_3	3	SBSmc2	Sx	<15													0	
BR34	BR34_4	4	SBSmc2	Bl	<15													0	
BR34	BR34_5	5	SBSmc2	Bl	18.9	M	40	18			5	5	4	3	0			2	snag

Plot ID	Tree ID	Tree Number	BGC Zone	Tree Species	DBH cm	Measured or Estimated	Remaining Bark (%)	Estimated Length (m)	Crown Class	Height Live Crown	Appear	Crown	Bark	Wood	Arboreal Lichen	Wildlife Use	Maternity Potential	Roost Rank	snag	Comments
BR34	BR34_6	6	SBSmc2	Bl	28.3	M	60	25			4	5	4	3	0		Yes	3	snag	
BR34	BR34_7	7	SBSmc2	Bl	<15													0		
BR34	BR34_8	8	SBSmc2	Bl	24.3	M	70	16			6	5	4	3	0			2	snag	
BR34	BR34_9	9	SBSmc2	Bl	24.6	M	70	18			6	5	4	3	0			1	snag	
BR34	BR34_10	10	SBSmc2	Sx	<15													0		
BR34	BR34_11	11	SBSmc2	Bl	<15													0		
BR34	BR34_12	12	SBSmc2	Sx	<15													0		
BR34	BR34_13	13	SBSmc2	Sx	<15													0		
BR34	BR34_14	14	SBSmc2	Sx	<15													0		
BR34	BR34_15	15	SBSmc2	Bl	27.4	M	80	21	-		5	5	3	3	0			2	snag	
BR34	BR34_16	16	SBSmc2	Bl	19.8	M	90	19	-		5	5	3	3	0			1	snag	
BR34	BR34_17	17	SBSmc2	Bl	26	M	40	19	-		5	5	3	3	0		Yes	3	snag	
BR34	BR34_18	18	SBSmc2	Bl	23.8	M	90	19	-		5	5	3	3	0			2	snag	
BR35	BR35_1	1	SBSmc2	Bl	23.5	M	70	11	-	-	6	5	4	5	0			2		
BR35	BR35_2	2	SBSmc2	Pl	<15													0		
BR35	BR35_3	3	SBSmc2	Bl	<15													0		
BR35	BR35_4	4	SBSmc2	Sx	<15													0		
BR35	BR35_5	5	SBSmc2	Bl	<15													0		
BR35	BR35_6	6	SBSmc2	Bl	<15													0		
BR35	BR35_7	7	SBSmc2	Sx	<15													0		
BR35	BR35_8	8	SBSmc2	Sx	<15													0		
BR35	BR35_9	9	SBSmc2	Bl	<15													0		
BR35	BR35_10	10	SBSmc2	Sx	<15													0		
BR35	BR35_11	11	SBSmc2	Sx	<15													0		

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BR35	BR35_12	12	SBSmc2	Sx	<15													0	
BR35	BR35_13	13	SBSmc2	Sx	<15													0	
BR35	BR35_14	14	SBSmc2	Bl	<15													0	
BR35	BR35_15	15	SBSmc2	Sx	21.1	M	90	13		-	5	4	3	4	0			1	
BR35	BR35_16	16	SBSmc2	Bl	<15													0	
BR35	BR35_17	17	SBSmc2	Bl	<15													0	
BR35	BR35_18	18	SBSmc2	Sx	<15													0	
BR35	BR35_19	19	SBSmc2	Sx	<15													0	
BR36	BR36_1	1	SBSmc2	Bl	34.6	M	90	12			3	3	2	2	0			1	snag
BR36	BR36_2	2	SBSmc2	Sx	<15													0	
BR36	BR36_3	3	SBSmc2	Bl	<15													0	
BR36	BR36_4	4	SBSmc2	Bl	<15													0	
BR36	BR36_5	5	SBSmc2	Bl	26.4	M	70	16			3	3	3	2	0			2	snag
BR36	BR36_6	6	SBSmc2	Bl	<15													0	
BR36	BR36_7	7	SBSmc2	Bl	<15													0	
BR36	BR36_8	8	SBSmc2	Sx	<15													0	
BR36	BR36_9	9	SBSmc2	Sx	<15													0	
BR36	BR36_10	10	SBSmc2	Sx	<15													0	
BR36	BR36_11	11	SBSmc2	Sx	<15													0	
BR36	BR36_12	12	SBSmc2	Bl	19.5	M	90	9			4	4	2	1	0			1	snag
BR36	BR36_13	13	SBSmc2	Bl	<15													0	
BR37	BR37_1	1	SBSdk	Ep	65.1	M	85	16	Dom	10	3	2	3	2	0			3	Loose bark
BR37	BR37_2	2	SBSdk	Ep	34.1	M	90	6	-		7	6	3	8	0			1	snag
BR37	BR37_3	3	SBSdk	Ep	39	M	85	12	Dom	8	3	2	3	2	0			2	

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BR37	BR37_4	4	SBSdk	Ep	35	M	90	8	-		7	6	3	5	0			1	snag
BR37	BR37_5	5	SBSdk	Ep	48.5	M	70	16	Dom	8	2	2	4	2	0			3	Loose bark
BR38	BR38_1	1	SBSdk	Act	103.2	M	90	26	Dom	8	2	2	3	5	0		Yes	3	
BR39	BR39_1	1	SBSdk	Ep	31.5	M	90	19	Sub	6	2	2	3	1	0			2	
BR39	BR39_2	2	SBSdk	Ep	28.2	M	90	16	Sub	6	2	2	3	1	0			2	
BR39	BR39_3	3	SBSdk	At	<15													0	
BR39	BR39_4	4	SBSdk	At	<15													0	
BR39	BR39_5	5	SBSdk	At	<15													0	
BR39	BR39_6	6	SBSdk	At	<15													0	
BR39	BR39_7	7	SBSdk	At	<15													0	
BR39	BR39_8	8	SBSdk	At	<15													0	
BR39	BR39_9	9	SBSdk	At	41.6	M	100	22	Dom	18	1	1	1	1	0			1	
BR39	BR39_10	10	SBSdk	At	<15													0	
BR39	BR39_11	11	SBSdk	Ep	<15													0	
BR39	BR39_12	12	SBSdk	Sx	<15													0	
BR39	BR39_13	13	SBSdk	Sx	<15													0	
BR39	BR39_14	14	SBSdk	At	<15													0	
BR39	BR39_15	15	SBSdk	At	<15													0	
BR40	BR40_1	1	SBSdk	Ep	29.6	M	90	16	Sub	8	2	2	3	1	0			2	
BR40	BR40_2	2	SBSdk	Sx	<15													0	
BR40	BR40_3	3	SBSdk	Sx	<15													0	
BR40	BR40_4	4	SBSdk	Pl	<15													0	
BR40	BR40_5	5	SBSdk	Ws	<15													0	
BR40	BR40_6	6	SBSdk	Sx	85	M	100	28	Dom	10	1	1	1	1	0			0	big witches broom

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BR41	BR41_1	1	SBSdk	Sx	38.4	M	55	25	Dom	-	3	3	5	1	0			2	
BR41	BR41_2	2	SBSdk	Sx	33.1	M	75	22	Dom	-	3	3	4	1	0			2	
BR41	BR41_3	3	SBSdk	Sx	<15													0	
BR41	BR41_4	4	SBSdk	Act	81	M	-	27	Dom	16	1	1	1	1	0			1	
BR42	BR42_1	1	SBSdk	Ep	48	M	90	18	Sub	9	2	1	3	1	0			2	
BR42	BR42_2	2	SBSdk	Ep	43.7	M	90	18	Sub	9	2	1	3	1	0			2	
BR42	BR42_3	3	SBSdk	Sx	<15													0	
BR42	BR42_4	4	SBSdk	Sx	<15													0	
BR42	BR42_5	5	SBSdk	Act	<15													0	
BR42	BR42_6	6	SBSdk	Sx	<15													0	
BR43	BR43_1	1	SBSdk	Ep	30.5	M	95	14	Sub	4	1	1	2	1	0			2	
BR43	BR43_2	2	SBSdk	Ep	21.1	M	95	12	Sub	4	1	1	2	1	0			1	
BR43	BR43_3	3	SBSdk	Act	<15													0	
BR44	BR44_1	1	SBSdk	Act	66.6	M	100	22	Dom	10	1	2	1	1	0			1	
BR44	BR44_2	2	SBSdk	Ws	30.5	M	60	6	-	-	2	2	4	1	0			2	snag
BR44	BR44_3	3	SBSdk	At	<15													0	
BR44	BR44_4	4	SBSdk	At	<15													0	
BR44	BR44_5	5	SBSdk	Sx	<15													0	
BR44	BR44_6	6	SBSdk	At	<15													0	
BR44	BR44_7	7	SBSdk	At	<15													0	
BR44	BR44_8	8	SBSdk	At	<15													0	
BR44	BR44_9	9	SBSdk	At	<15													0	
BR45	BR45_1	1	SBSdk	Bl	40.3	M	90	18	Dom	-	3	2	3	1	0			2	snag, witches broom
BR45	BR45_2	2	SBSdk	Bl	<15													0	

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BR45	BR45_3	3	SBSdk	Bl	<15													0	
BR45	BR45_4	4	SBSdk	Bl	<15													0	
BR45	BR45_5	5	SBSdk	Sx	<15													0	
BR45	BR45_6	6	SBSdk	Sx	<15													0	
BR45	BR45_7	7	SBSdk	Bl	<15													0	
BR45	BR45_8	8	SBSdk	Sx	27.1	M	70	18			6	4	4	4	0			1	snag
BR45	BR45_9	9	SBSdk	Sx	<15													0	
BR45	BR45_10	10	SBSdk	Sx	<15													0	
BR45	BR45_11	11	SBSdk	Sx	<15													0	
BR45	BR45_12	12	SBSdk	Sx	<15													0	
BR46	BR46_1	1	SBSdk	Act	78.9	M	95	22		12	3	2	2	4	0		Yes	4	large cavity, decaying wood
BR46	BR46_2	2	SBSdk	Sx	<15													0	
BR46	BR46_3	3	SBSdk	Act	88	M	100	22			2	2	1	4	0			1	
BR46	BR46_4	4	SBSdk	Act	91.4	M	100	22			3	2	1	4	0		Yes	3	
BR46	BR46_5	5	SBSdk	Act	70.6	M	100	22			2	2	1	4	0			2	
BR46	BR46_6	6	SBSdk	Act	78.4	M	100	20			1	1	1	2	0			2	
BR47	BR47_1	1	SBSdk	Act	92.3	M	95	26	Dom	12	2	2	1	1	0		Yes	3	large cavity
BR47	BR47_2	2	SBSdk	Sx	<15													0	
BR48	BR48_1	1	SBSmc2	Bl	25.5	M	70	18	Dom	-	3	2	4	1	0	BC		1	woodpecker cavities
BR48	BR48_2	2	SBSmc2	Bl	<15													0	
BR48	BR48_3	3	SBSmc2	Bl	<15													0	
BR48	BR48_4	4	SBSmc2	Bl	<15													0	
BR48	BR48_5	5	SBSmc2	Bl	<15													0	
BR48	BR48_6	6	SBSmc2	Bl	<15													0	

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BR48	BR48_7	7	SBSmc2	Bl	<15													0	
BR48	BR48_8	8	SBSmc2	Sx	<15													0	
BR48	BR48_9	9	SBSmc2	Bl	<15													0	
BR48	BR48_10	10	SBSmc2	Sx	<15													0	
BR48	BR48_11	11	SBSmc2	Bl	<15													0	
BR48	BR48_12	12	SBSmc2	Sx	<15													0	
BR48	BR48_13	13	SBSmc2	Bl	26.7	M	65	20	Dom		4	3	3	1	0	BC	Yes	2	woodpecker cavities
BR48	BR48_14	14	SBSmc2	Bl	<15													0	
BR48	BR48_15	15	SBSmc2	Bl	<15													0	
BR48	BR48_16	16	SBSmc2	Bl	24.8	M	70	19	Dom		4	3	3	1	0	BC	Yes	2	woodpecker cavities
BR48	BR48_17	17	SBSmc2	Bl	<15													0	
BR48	BR48_18	18	SBSmc2	Bl	<15													0	
BR48	BR48_19	19	SBSmc2	Bl	<15													0	
BR49	BR49_1	1	SBSmc2	Bl	38	M	55	22	Dom	-	4	3	5	1	0	BC	Yes	3	snag
BR49	BR49_2	2	SBSmc2	Bl	<15													0	
BR49	BR49_3	3	SBSmc2	Sx	<15													0	
BR49	BR49_4	4	SBSmc2	Bl	<15													0	
BR49	BR49_5	5	SBSmc2	Bl	<15													0	
BR49	BR49_6	6	SBSmc2	Sx	<15													0	
BR49	BR49_7	7	SBSmc2	Sx	<15													0	
BR49	BR49_8	8	SBSmc2	Bl	<15													0	
BR49	BR49_9	9	SBSmc2	Bl	37.8	M	80	21	Dom	-	3	3	3	1	0	BC		1	snag
BR50	BR50_1	1	SBSmc2	Sx	41.8	M	90	27	Dom	-	3	2	3	1	0	BC		1	snag, small cavities and crack
BR50	BR50_2	2	SBSmc2	Pl	<15													0	

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BR50	BR50_3	3	SBSmc2	Sx	<15													0	
BR50	BR50_4	4	SBSmc2	Sx	<15													0	
BR50	BR50_5	5	SBSmc2	PI	<15													0	
BR50	BR50_6	6	SBSmc2	PI	<15													0	
BR50	BR50_7	7	SBSmc2	Sx	<15													0	
BR50	BR50_8	8	SBSmc2	PI	33.5	M	90	20	Sub	-	4	5	3	1	0			1	snag
BR50	BR50_9	9	SBSmc2	Sx	<15													0	
BR50	BR50_10	10	SBSmc2	Sx	<15													0	
BR50	BR50_11	11	SBSmc2	Sx	<15													0	
BR50	BR50_12	12	SBSmc2	Sx	<15													0	
BR51	BR51_1	1	SBSmc2	Sx	25.6	M	100	4			6	6	1	1	0			2	broken top @ 4m
BR51	BR51_2	2	SBSmc2	Sx	<15													0	
BR51	BR51_3	3	SBSmc2	Sx	32.3	M	100	?	Dom		2	1	1	1	0			1	forked tree @ 3m
BR51	BR51_4	4	SBSmc2	Sx	<15													0	
BR51	BR51_5	5	SBSmc2	Sx	<15													0	
BR51	BR51_6	6	SBSmc2	Sx	<15													0	
BR51	BR51_7	7	SBSmc2	Sx	<15													0	
BR51	BR51_8	8	SBSmc2	Sx	<15													0	
BR51	BR51_9	9	SBSmc2	Sx	<15													0	
BR51	BR51_10	10	SBSmc2	Sx	<15													0	
BR51	BR51_11	11	SBSmc2	Sx	<15													0	
BR51	BR51_12	12	SBSmc2	Sx	<15													0	
BR51	BR51_13	13	SBSmc2	Sx	<15													0	
BR51	BR51_14	14	SBSmc2	Sx	<15													0	

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BR52	BR52_1	1	SBSmc2	Bl	32.8	M	20	16	Sub		4	5	5	1	0	BC	Yes	4	woodpecker cavities
BR52	BR52_2	2	SBSmc2	Sx	56.2	M	60	24	Dom		3	4	3	1	0			1	
BR52	BR52_3	3	SBSmc2	Bl	<15													0	
BR52	BR52_4	4	SBSmc2	Bl	<15													0	
BR52	BR52_5	5	SBSmc2	Sx	<15													0	
BR52	BR52_6	6	SBSmc2	Sx	<15													0	
BR52	BR52_7	7	SBSmc2	Sx	<15													0	
BR52	BR52_8	8	SBSmc2	Bl	<15													0	
BR52	BR52_9	9	SBSmc2	Sx	<15													0	
BR52	BR52_10	10	SBSmc2	Pl	<15													0	
BR52	BR52_11	11	SBSmc2	Bl	<15													0	
BR53	BR53_1	1	SBSmc2	Pl	39.4	M	70	24	Dom	-	3	4	3	1	0		yes	4	snag, large cracks
BR53	BR53_2	2	SBSmc2	Bl	32.5	M	90	25	Dom	-	3	4	2	1	0			1	snag, loose bark
BR53	BR53_3	3	SBSmc2	Pl	<15													0	
BR53	BR53_4	4	SBSmc2	Pl	<15													0	
BR53	BR53_5	5	SBSmc2	Bl	<15													0	
BR53	BR53_6	6	SBSmc2	Pl	40.9	M	80	21	Dom	-	4	5	3	1	0			2	snag, crack
BR53	BR53_7	7	SBSmc2	Pl	37.9	M	75	23	-	-	3	4	3	1	0			2	snag, crack
BR53	BR53_8	8	SBSmc2	Pl	28.1	M	40	24	Dom	-	4	5	4	1	0			2	snag, loose bark
BR53	BR53_9	9	SBSmc2	Pl	26.4	M	95	24	Dom	-	4	5	3	1	0			1	snag
BR53	BR53_10	10	SBSmc2	Pl	30.3	M	70	23	Dom	-	4	4	4	1	0			2	snag, loose bark
BR53	BR53_11	11	SBSmc2	Pl	<15													0	
BR53	BR53_12	12	SBSmc2	Bl	<15													0	
BR53	BR53_13	13	SBSmc2	Sx	<15													0	

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BR53	BR53_14	14	SBSmc2	PI	31.3	M	75	23	Dom	-	5	5	3	1	0		Yes	3	snag, cracks and loose bark
BR53	BR53_15	15	SBSmc2	PI	24.5	M	90	9	-	-	6	6	3	1	0			2	snag
BR54	BR54_1	1	SBSmc2	Sx	68.9	M	100	25	Dom	10	1	1	1	1	0			1	
BR54	BR54_2	2	SBSmc2	BI	<15													0	
BR54	BR54_3	3	SBSmc2	Ws	<15													0	
BR54	BR54_4	4	SBSmc2	Sx	<15													0	
BR54	BR54_5	5	SBSmc2	Sx	<15													0	