Red Mountain Underground Gold Project: Baseline Wildlife Resources

IDM Mining Ltd.

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Executive Summary

IDM Mining Ltd is proposing the development of an underground gold mine, The Red Mountain Underground Gold Project, located in northwestern British Columbia, 17 km east-northeast of Stewart, BC. As a component of the Environmental Assessment, wildlife and wildlife habitat baseline studies were undertaken during the summers of 2015 and 2016 which entailed wildlife and wildlife habitat inventories and assessments and wildlife habitat modelling.

Wildlife baseline studies were conducted to support the assessment of potential effects of the Project on terrestrial wildlife. The key objectives of the wildlife baseline study included:

- Conducting wildlife and wildlife habitat inventories and assessments on select species within the Local Study Area (LSA).
- Determining the presence and/or relative abundance of selected wildlife species within the LSA;
- Identifying, rating, and quantifying suitable habitat for all selected wildlife species within the LSA; and
- Quantifying habitat suitability within the RSA for a selected sub-set of species.

Nineteen species of wildlife were listed as valued components (VCs) and were the focus of this baseline study. The wildlife VCs included:

- Mammals:
    - Mountain Goat (*Oreamnos americanus*), Grizzly Bear (*Ursus arctos*), Moose (*Alces americanus*), Marten (*Martes Americana*), Wolverine (*Gulo gulo*), Hoary Marmot (*Marmota caligata*), Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), Keen's Myotis (*Myotis keenii*);
- Migratory Breeding Birds:
    - Olive-sided Flycatcher (*Contopus cooperii*), McGillivray's Warbler (*Geothlypis tolmiei*), Common Nighthawk (*Chordeilles minor*);
- Marbled Murrelet (*Brachyrampus marmoratus*);
- Raptors:
    - Northern Goshawk (*Accipiter gentilis laingii*), Western Screech-Owl (*Megascops kennicottii kennicottii*);
- Upland Game Birds:
    - White-tailed Ptarmigan (*Lagopus leucura*), Sooty Grouse (*Dendragapus fulginosus*); and
- Amphibians:
    - Western Toad (*Anaxyrus boreas*),

- Coastal Tailed Frog (*Ascaphus truei*) is not listed a VC however it was a focal species during the 2015 field surveys and results are presented in this report.

Field studies included aerial and ground surveys for selected species and focused on: Mountain Goat, Grizzly Bear, Moose, and Hoary Marmot for mammals, and songbirds and upland game birds for the avian community. Aerial and ground surveys also focused on identifying Marbled Murrelet nesting habitat within the LSA. All incidental wildlife and evidence of wildlife use was also recorded during all surveys.

Wildlife habitat was quantified, rated, and mapped using Terrestrial Ecosystem Mapping (TEM) and Wildlife Habitat Ratings (WHR) for all wildlife VCs within the LSA (14,595 ha). Wildlife habitat mapping and suitability ratings were field verified during the 2015 and 2016 field visits. To provide a regional context, wildlife habitat suitability was quantified, rated, and mapped for a subset of wildlife VCs using Predictive Ecosystem Mapping (PEM) for the entire RSA (205,350 ha). Species included in the subset were: Mountain Goat, Grizzly Bear, Moose, Marten, and Wolverine. Field verification for the RSA was conducted primarily with helicopter overview flights combined with sporadic ground checks.

Summary of habitat suitability for select species within the RSA

Habitat Suitability Area[1] (ha) by Habitat Class within the RSA													
Species	***Season***	***High***	***%***	***Mod. High***	***%***	***Moderate***	***%***	***Low***	***%***	***V. Low***	***%***	***Nil***	***%***
Mountain Goat	Summer	10,126	4.9	33,290	16.2	992	0.5	233	0.1	1,154	0.6	159,556	77.7
	Winter	5817	2.8	6,850	3.3	7,878	3.8	1,530	0.7	8,482	4.1	174,792	85.1
Grizzly Bear	Early Spring	9,633	4.7	4,451	2.2	464	0.2	457	0.2	9,455	4.6	180,889	88.1
	Late Spring	6,536	3.2	2,098	1.0	10,412	5.1	1306	0.6	1,797	0.9	183,201	89.2
	Summer	3,761	1.8	39,742	19.4	29,160	14.2	359	0.2	608	0.3	131,720	64.1
	Fall	2,072	1.0	28,568	13.9	42,346	20.6	0	0.0	510	0.2	131,854	64.2
	Winter	6,679	3.3	490	0.2	3,177	1.5	404	0.2	3,472	1.7	191,128	93.1
Moose	Winter	583	0.3	1,305	0.6	3,422	1.7	1,773	0.9	92	0.0	198,176	96.5
	Summer	3,511	1.7	7,211	3.5	13,960	6.8	30,996	15.1	5,055	2.5	144,618	70.4
Marten	Winter	10,530	5.1	NC[2]	NC	11,176	5.4	8,592	4.2	NC	NC	175,051	85.2
Wolverine	Summer	13,160	6.4	NC	NC	44,272	21.6	10,3439	50.4	NC	NC	44,479	21.7
	Winter	4,306	2.1	NC	NC	6,472	3.2	8,822	4.3	NC	NC	185,751	90.5

[1] Area includes the Local Study Area (LSA)

[2] NC = Not Calculated because Marten and Wolverine only use a 4 class rating scheme.

Habitat suitability modelling was conducted for 18 species within the LSA. A total of 26 models generated wildlife habitat suitability ratings for specific seasons of use depending on the individual species requirements.

Summary of habitat suitability for select species within the LSA

Habitat Suitability Area (ha) by habitat class within the LSA												
Species and Season	High	%	Mod. High	%	Moderate	%	Low	%	V. Low	%	Nil	%
Mountain Goat												
Summer	802	5.5	1107	7.6	319	2.2	0	0	27	0.2	12340	84.6
Winter	605	4.1	879	6.0	787	5.4	437	3.0	646	4.4	11243	77.0
Grizzly Bear												
Early Spring	202	1.4	1036	7.1	220	1.5	309	2.1	19	0.1	12810	87.8
Late Spring	740	5.1	1332	9.1	623	4.3	943	6.5	740	5.1	10217	70.0
Summer	2621	18.0	2494	17.1	1093	7.5	253	1.7	25	0.2	8109	55.6
Fall	1336	9.2	394	2.7	1969	13.5	22	0.1	1350	9.2	9525	65.3
Winter/Denning	437	3.0	497	3.4	335	2.3	280	1.9	622	4.3	12425	85.1
Moose												
Winter	122	0.8	50	0.3	103	1.5	224	1.5	93	0.6	10903	74.7
Summer	42	0.3	424	2.9	1055	7.2	1356	9.3	815	5.6	14004	95.6
Marten												
Winter	573	3.9	NC	NC	584	4.0	2567	17.5	NC	NC	10872	74.5
Wolverine												
Summer	3846	26.4	NC	NC	4610	31.6	4318	29.6	NC	NC	1820	12.5
Winter	573	3.9	NC	NC	584	4.0	3459	23.7	NC	NC	10806	74.0
Hoary Marmot												
Summer	59	0.7	NC	NC	684	8.3	245	2.9	NC	NC	7235	87.9
Bats												
Summer	Useable habitat = 2893 (20%)								Likely no Value = 11702 (80%)			
Common Nighthawk												
Breeding	80	0.6	NC	NC	21	0.1	1868	12.8	NC	NC	12626	86.5
Olive-sided Flycatcher												
Breeding	368	2.5	NC	NC	441	3.0	623	4.3	NC	NC	13163	90.2
MacGillivray's Warbler												
Breeding	924	6.3	NC	NC	1333	9.1	116	0.8	NC	NC	12222	83.7
Northern Goshawk												
Breeding	80	0.6	NC	NC	273	1.9	721	4.9	NC	NC	13521	93.6
Western Screech Owl												
Breeding	71	0.5	NC	NC	0	0	70	0.5	NC	NC	14454	99.0
White-tailed Ptarmigan												
Breeding	1170	8.0	NC	NC	1698	11.6	524	3.6	NC	NC	11203	76.8
Sooty Grouse												
Winter	805	5.5	NC	NC	1154	7.9	984	6.7	NC	NC	11652	79.8
Breeding	1868	12.8	NC	NC	1866	12.8	2087	14.3	NC	NC	8774	60.1
Marbled Murrelet												
Nesting	20	0.1	142	1.0	410	2.8	0	0	340	2.3	13683	93.8
Western Toad												
Breeding	21	0.1	NC	NC	72	0.5	164	1.1	NC	NC	14338	98.2

NC = Not Calculated

TABLE OF CONTENTS

Executive Summary ..... **ii**
Glossary and Abbreviations ..... **xvi**
1.0 Introduction **1**
1.1 Project Description 1
1.2 Study Objectives 1
1.3 Study Area 2
1.3.1 Local Study Area (LSA) 2
1.3.2 Regional Study Area (RSA) 9
1.3.3 Protected Areas 9
2.0 Background Review **1**
2.1 Species of Management Concern 1
2.2 Valued Components (VC) 2
3.0 Methodology **4**
3.1 Habitat Modelling for Valued Components 4
3.1.1 Model Development 4
3.1.2 Model Verification 6
3.2 Field Surveys 8
3.2.1 Mountain Goat 8
3.2.2 Grizzly Bear 13
3.2.3 Moose 13
3.2.4 Marten and Wolverine 13
3.2.5 Hoary Marmot 14
3.2.6 Bats 17
3.2.7 Breeding Birds 19
3.2.8 Common Nighthawk 22
3.2.9 Olive-sided Flycatcher and McGillivray's Warbler 24
3.2.10 Northern Goshawk 24
3.2.11 Western Screech-Owl 27
3.2.12 White-tailed Ptarmigan 27
3.2.13 Sooty Grouse 27
3.2.14 Marbled Murrelet 27
3.2.15 Pond Breeding Amphibians 28
3.2.16 Coastal Tailed Frog 30
3.2.17 Wildlife Cameras 32
4.0 Results and Discussion **35**
4.1 Mountain Goat 35
4.1.1 Identification and General Ecology 35
4.1.2 Habitat 35
4.1.3 Study Area Distribution 36
4.1.4 Habitat Suitability Modelling 37
4.1.5 Field Surveys 47
4.1.6 Conclusions 55
4.2 Grizzly Bear 55
4.2.1 Identification and General Ecology 55

4.2.2 Habitat 56
4.2.3 Study Area Distribution 57
4.2.4 Habitat Suitability Modelling 57
4.2.5 Field Surveys 75
4.2.6 Conclusions 81
4.3 Moose 82
4.3.1 Identification and General Ecology 82
4.3.2 Habitat 83
4.3.3 Study Area Distribution 83
4.3.4 Habitat Suitability 84
4.3.5 Field Surveys 92
4.3.6 Conclusions 92
4.4 Marten 92
4.4.1 Identification and General Ecology 92
4.4.2 Habitat 93
4.4.3 Study Area Distribution 93
4.4.4 Habitat Suitability 93
4.4.5 Field Surveys 97
4.4.6 Conclusions 97
4.5 Wolverine 99
4.5.1 Identification and General Ecology 99
4.5.2 Habitat 99
4.5.3 Study Area Distribution 100
4.5.4 Habitat Suitability Modelling 101
4.5.5 Field Surveys 104
4.5.6 Conclusions 104
4.6 Hoary Marmot 107
4.6.1 Identification and General Ecology 107
4.6.2 Habitat 107
4.6.3 Study Area Distribution 108
4.6.4 Habitat Suitability 108
4.6.5 Field Surveys 113
4.6.6 Wildlife Cameras 113
4.6.7 Conclusions 117
4.7 Bats 118
4.7.1 Little Brown Bat 118
4.7.2 Keen's Myotis 122
4.7.3 Field Surveys 129
4.7.4 Conclusions 132
4.8 Breeding Birds 133
4.8.1 Field Surveys 133
4.8.2 Conclusions 144
4.9 Common Nighthawk 145
4.9.1 Identification and General Ecology 145
4.9.2 Habitat 145
4.9.3 Study Area Distribution 146

4.9.4 Habitat Suitability Modelling 147
4.9.5 Field Surveys 151
4.9.6 Conclusions 153
4.10 Olive-sided Flycatcher 153
4.10.1 Identification and General Ecology 153
4.10.2 Habitat 153
4.10.3 Study Area Distribution 154
4.10.4 Habitat Suitability Mapping 155
4.10.5 Field Surveys 160
4.10.6 Conclusions 160
4.11 MacGillivray's Warbler 160
4.11.1 Identification and General Ecology 160
4.11.2 Habitat 161
4.11.3 Study Area Distribution 161
4.11.4 Habitat Suitability Mapping 162
4.11.5 Field Surveys 167
4.11.6 Conclusions 170
4.12 Northern Goshawk 170
4.12.1 Identification and General Ecology 170
4.12.2 Habitat 171
4.12.3 Study Area Distribution 172
4.12.4 Habitat Suitability 172
4.12.5 Field Surveys 179
4.12.6 Conclusions 183
4.13 Western Screech-Owl 183
4.13.1 Identification and General Ecology 183
4.13.2 Habitat 184
4.13.3 Study Area Distribution 184
4.13.4 Habitat Suitability Modelling 185
4.13.5 Field Surveys 190
4.13.6 Conclusions 190
4.14 White-tailed Ptarmigan 190
4.14.1 Identification and General Ecology 190
4.14.2 Habitat 191
4.14.3 Study Area Distribution 192
4.14.4 Habitat Suitability 193
4.14.5 Field Surveys 196
4.14.6 Conclusions 197
4.15 Sooty Grouse 198
4.15.1 Identification and General Ecology 198
4.15.2 Habitat 199
4.15.3 Study Area Distribution 200
4.15.4 Habitat Suitability Mapping 200
4.15.5 Field Surveys 207
4.15.6 Conclusions 209
4.16 Marbled Murrelet 209

4.16.1 Identification and General Ecology 209
4.16.2 Habitat 209
4.16.3 Study Area Distribution 211
4.16.4 Habitat Suitability Mapping 212
4.16.5 Field Surveys 219
4.16.6 Conclusions 225
4.17 Western Toad 225
4.17.1 Identification and General Ecology 225
4.17.2 Habitat 225
4.17.3 Study Area Distribution 226
4.17.4 Western Toad Habitat Suitability Modelling 227
4.17.5 Field Surveys 233
4.17.6 Conclusions 235
4.18 Coastal Tailed Frog 235
4.18.1 Conclusions 240
4.19 Wildlife Cameras 240
5.0 Disclaimer 242
6.0 References 243

LIST OF FIGURES

Figure 1-1. Local Study Area and Regional Study Area boundaries 5
Figure 1-2. Biogeoclimatic Zones within the Project LSA and RSA 1
Figure 3-1. Mountain Goat survey blocks 11
Figure 3-2. Mountain Goat observation stations within the LSA 12
Figure 3-3. 2015 Grizzly Bear aerial surveys 15
Figure 3-4. Moose survey locations 16
Figure 3-5. Bat detector locations 18
Figure 3-6. Songbird point count locations 21
Figure 3-7. Common Nighthawk survey route locations and ARU stations 23
Figure 3-8. Northern Goshawk call-playback station locations 26
Figure 3-9. Time constrained search locations for pond breeding amphibians 29
Figure 3-10. Coastal Tailed Frog survey locations 31
Figure 3-11. Wildlife camera locations 34
Figure 4-1. Mountain Goat Summer-Living habitat suitability map 45
Figure 4-2. Mountain Goat Winter-Living habitat suitability map 46
Figure 4-3. Habitat plot with Mountain Goat hair 53
Figure 4-4. Two nannies with kids (born this year) taken with wildlife camera TC4, feeding on Mountain Heather/Sedge/Lichen complex. Equipment from previous mining efforts in background. 54
Figure 4-5. Grizzly Bear Early Spring Feeding habitat suitability map 70
Figure 4-6. Grizzly Bear Late Spring Feeding habitat suitability map 71
Figure 4-7. Grizzly Bear Summer Feeding habitat suitability map 72
Figure 4-8. Grizzly Bear Fall habitat suitability map 73
Figure 4-9. Grizzly Bear Winter Denning habitat suitability map 74

Figure 4-10. Photos showing Grizzly Bear dens with dense mat of White Mountain Heather and Partridgefoot above entrance 76
Figure 4-11. Grizzly Bear den found on August 30, 2016..... 77
Figure 4-12. Overview of slope with vegetation and den sites (arrows pointing to den sites) 78
Figure 4-13. Grizzly Bear caught on wildlife camera TC 3..... 80
Figure 4-14. Grizzly Bear caught on Wildlife Camera TC 4 in the alpine travelling along well-worn Mountain Goat trail 81
Figure 4-15. Moose Winter Habitat suitability map for the LSA..... 90
Figure 4-16 Moose Summer-Living habitat suitability map for the LSA..... 91
Figure 4-17 Marten Living Winter habitat suitability map 98
Figure 4-18. Wolverine Living-Growing habitat suitability map 105
Figure 4-19. Wolverine Living-Winter habitat suitability map 106
Figure 4-20. Habitat suitability map for Hoary Marmot 112
Figure 4-21. Hoary Marmot taken by Wildlife Camera TC9 114
Figure 4-22. Hoary Marmot den entrance and scat near mine camp (UTM 9 U 455829 6201746) 115
Figure 4-23. Hoary Marmot den site in Mountain Heather near mining camp (UTM 9 U 455829 6201746)..... 115
Figure 4-24. Large blocky talus surrounded by Mountain Heather and herbaceous alpine meadow represents class 1 (high) suitability habitat for Hoary Marmots (UTM 9 U 454563 6203930)..... 116
Figure 4-25. Hoary Marmot remains likely preyed upon by a large raptor. These remains were also investigated by Black Bear (based on fresh scat pile close by UTM9 U 454536 6203991). 117
Figure 4-26. Bat Living-Growing season habitat suitability map 128
Figure 4-27. MYLU Sonograph 131
Figure 4-28. MYEV Sonograph..... 131
Figure 4-29. MYVO Sonograph 131
Figure 4-30. LANO Sonograph 132
Figure 4-31. MYCA Sonograph..... 132
Figure 4-32. Point count distribution by BEC Zone..... 134
Figure 4-33. Point count distribution by structural stage 135
Figure 4-34. Cumulative percent of total bird detections per survey interval..... 137
Figure 4-35. Total bird detections within the LSA..... 138
Figure 4-36. Relative abundance of individuals and species within each BEC zone..... 138
Figure 4-37. Comparison of Simpson's Index of Diversity between BEC zones..... 139
Figure 4-38. Common Nighthawk habitat suitability map 150
Figure 4-39. Map of Common Nighthawk survey results..... 152
Figure 4-40. Olive-Sided Flycatcher habitat suitability map 159
Figure 4-41. MacGillivray's Warbler nesting habitat suitability map..... 166
Figure 4-42. Typical habitat for MacGillivray's Warbler, at point count station RM PC 05 close to the proposed Tailings Management Facility 167
Figure 4-43. Photo taken at the edge of small wetland at point count station RMPC 31 168
Figure 4-44. Map with MacGillivray's Warbler locations 169

Figure 4-45 Northern Goshawk habitat suitability map 178
Figure 4-46. Map with Northern Goshawk stations and detections 181
Figure 4-47. Photo of Class 1 Northern Goshawk habitat within the upper limits of the CWHwm and the lower portions of the MHmm1 zones, showing mature closed canopy with open flyways in the understory 182
Figure 4-48. Photo of mature/old-growth stand at NOGO-6 where Northern Goshawk was detected. This area was rated as Class 1 habitat. 182
Figure 4-49. Western Screech-Owl habitat suitability map 189
Figure 4-50. White-tailed Ptarmigan habitat suitability map 195
Figure 4-51. Photo from Wildlife Camera #4 capturing a male and female White-tailed Ptarmigan feeding in a Mountain heather/Lichen complex just above the current Mine Camp 197
Figure 4-52. Sooty Grouse Winter habitat suitability map 205
Figure 4-53. Sooty Grouse Nesting habitat suitability 206
Figure 4-54. Sooty Grouse female on nest in low shrub habitat within the MHmm1 zone 207
Figure 4-55. Sooty Grouse in Heather Lichen complex at the edge of a Mountain Hemlock krummholz patch 208
Figure 4-56. Critical habitat mapped as suitable nesting habitat (adapted from the BC Model 2003) 214
Figure 4-57. Nesting habitat suitability for Marbled Murrelet within the LSA 218
Figure 4-58. Typical young even aged stand characteristics of the polygon originally identified as critical habitat for Marbled Murrelet 219
Figure 4-59. Clear lack of nesting platforms suitable for nesting Murrelets 220
Figure 4-60. Photo of polygon 145 with large Sitka spruce and good vertical canopy diversity 221
Figure 4-61. Photo of Sitka spruce in Polygon 145 with good large mossy platforms providing potential nesting habitat for Marbled Murrelet 222
Figure 4-62. Large Western Hemlock in Polygon 31 with large mossy covered platforms providing suitable nesting habitat. Ground search for egg shells conducted under trees like this one. 223
Figure 4-63. Map with Marbled Murrelet aerial survey results 224
Figure 4-64. Western Toad breeding habitat suitability map 232
Figure 4-65. High quality breeding habitat for Western Toad near the outlet of Clements Lake 233
Figure 4-66. Columbia Spotted Frogs were found in small pocket wetland in a wet fen perched on a bench along the western boundary of the LSA 234
Figure 4-67. Columbia Spotted Frog in small pocket wetland (photo 4-66 above) 234
Figure 4-68. Coastal Tailed Frog survey station TF-02 236
Figure 4-69. Coastal Tailed Frog survey station TF-06 238
Figure 4-70. Sample data form used during Red Mountain field assessments 239

LIST OF TABLES

Table 1-1. Administrative boundary summary for the study area 2
Table 1-2. Ecosystem classification for the study area 2
Table 1-3. Biogeoclimatic Ecosystem Classification of both the Local Study Area and Regional Study Area 6
Table 2-1. CDC Database search results 1
Table 2-2. Valued components (wildlife) 2
Table 3-1. Relative Habitat Suitability Rating (HSR) schemes 5
Table 3-2. Target wildlife species life requisites and rating scheme for the Project 5
Table 3-3. Minimum data collected at habitat plots 7
Table 3-4 Wildlife Camera locations and habitat descriptions 32
Table 4-1. Life Requisites of the Mountain Goat within the Project area (near Stewart, BC) rated by month and season 37
Table 4-2. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Mountain Goat 38
Table 4-3. Provincial Benchmark habitat for Mountain Goat 38
Table 4-4. Relative suitability classes to be assigned to Mountain Goat habitat polygons (compared to the Provincial best) 39
Table 4-5. Summary of habitat requirements for Mountain Goat by season and structural stage 39
Table 4-6. Detailed rating assumptions for Mountain Goat Living-Growing 40
Table 4-7. Detailed Rating Assumptions for Mountain Goat Living-Winter 41
Table 4-8. Habitat Suitability summary for each habitat class within both the LSA and RSA 42
Table 4-9. Mountain Goat LSA effective survey area summaries 47
Table 4-10. Summary of aerial Mountain Goat observations within the LSA 48
Table 4-11 Mountain Goat RSA effective survey area summaries 48
Table 4-12. Summary of aerial Mountain Goat observations within the RSA 49
Table 4-13. Observability estimates and effective survey areas of each survey block 50
Table 4-14. Summary of Mountain Goat observations within the LSA from the fixed observation stations 50
Table 4-15. Summary of field ratings of habitat plots 51
Table 4-16. Summary of Mountain Goat detections by wildlife cameras 54
Table 4-17 Important habitat features for coastal Grizzly Bears used for each season 56
Table 4-18. Monthly life requisites for Grizzly Bear near Stewart, BC 58
Table 4-19. Relative suitability classes to be assigned to Grizzly Bear habitat polygons 59
Table 4-20. Summary of general habitat attributes for Grizzly Bears 60
Table 4-21. Detailed Early Spring habitat assumptions within the LSA 62
Table 4-22. Late Spring habitat ratings assumptions 64
Table 4-23. Summer Habitat Ratings Assumptions 65
Table 4-24. Fall Habitat Ratings Assumptions 65
Table 4-25. Detailed Rating Assumptions for Winter Denning (Wi-DE) 66
Table 4-26. Summary of habitat suitability within both the LSA and RSA for Grizzly Bear Feeding and Denning requirements 67
Table 4-27. Habitat attributes of the Grizzly Bear den sites located within the LSA 75

Table 4-28. Summary of incidental sightings of Grizzly Bears and/or sign within the LSA . 79
Table 4-29 Wildlife Cameras with Grizzly Bear detections 79
Table 4-30. Provincial Benchmark habitat for Moose..... 85
Table 4-31. Life Requisites of the Moose within the Project area rated by month and season 85
Table 4-32. Summary of general habitat requirements for Moose..... 85
Table 4-33. Terrestrial Ecosystem Mapping (TEM) attributes for Moose life requisites 86
Table 4-34. Relative suitability classes to be assigned to Moose habitat polygons..... 86
Table 4-35. Habitat ratings assumptions for Moose Living during growing (LI-G)..... 87
Table 4-36. Habitat ratings assumptions for Moose Living during winter (LI-w)..... 87
Table 4-37. Habitat suitability ratings summary for Moose..... 88
Table 4-38. Monthly life requisites for Marten near Stewart, BC..... 94
Table 4-39. TEM attribute relationships for each winter life requisite for Marten 95
Table 4-40. Relative suitability classes to be assigned to Marten habitat polygons..... 95
Table 4-41. Habitat suitability ratings assumptions for Marten Living-Winter..... 96
Table 4-42. Habitat suitability ratings summary for Marten winter habitat..... 97
Table 4-43. Monthly life requisites for Wolverine near Stewart, BC 101
Table 4-44. Summary of habitat attributes for Wolverine reproduction 101
Table 4-45. Cross reference for HSI values with respect to habitat ratings classes 102
Table 4-46. Habitat variable ratings assumptions table for Wolverine..... 102
Table 4-47. Habitat Suitability Ratings summary for Wolverine Living for both growing (summer) and winter seasons..... 104
Table 4-48. Life Requisites of the Hoary Marmot within the Project area (near Stewart, BC) rated by month and season..... 109
Table 4-49. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Hoary Marmot..... 109
Table 4-50. Summary of habitat requirements for Hoary Marmots by season and structural stage 110
Table 4-51. Habitat ratings assumptions for Hoary Marmot Living-Summer..... 110
Table 4-52. Habitat suitability ratings summary for Hoary Marmot..... 111
Table 4-53. Incidental observations of Hoary Marmots within the LSA 113
Table 4-54. Summary of Hoary Marmot detections on wildlife cameras 114
Table 4-55. Life Requisites of the Little Brown Myotis within the Project area rated by month and season 120
Table 4-56. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Little Brown Myotis..... 121
Table 4-57. Summary of habitat requirements for Little Brown Myotis by season and structural stage 121
Table 4-58. Habitat ratings assumptions for Little Brown Myotis – Living 122
Table 4-59. Habitat Suitability for Little Brown Myotis within the LSA only 122
Table 4-60. Life Requisites of Keen's Myotis rated by month and season..... 124
Table 4-61. Terrestrial Ecosystem Mapping (TEM) relationships for Living Life Requisite of the Keen's Myotis..... 125
Table 4-62. Summary of habitat requirements for Keen's Myotis by season and structural stage 125
Table 4-63. Habitat ratings assumptions for Keen's Myotis 126

Table 4-64. Habitat Suitability summary for Keen's Myotis within the LSA only 126
Table 4-65. Summary of deployment effort and detections 129
Table 4-66. Summary of detections from July 5 – July 28, 2016 129
Table 4-67. Summary of Kaleidoscope's Auto ID results for bat detections between July 5 and July 28, 2016 130
Table 4-68. Comparison of structural stages sampled within each BEC zone relative to the total available 136
Table 4-69. Comparison of bird detections and diversity by BEC zone 140
Table 4-70. Summary of point count detections by habitat association 140
Table 4-71. Summary of point count detections by nesting strata 142
Table 4-72 Bird densities (birds/ha) by BEC zone 142
Table 4-73. Number of territorial males of each species detected during point count surveys 144
Table 4-74. Life Requisites of the Common Nighthawk within the Project area rated by month and season 147
Table 4-75. Summary of habitat attributes for Common Nighthawk 147
Table 4-76. Relative suitability classes to be assigned to Common Nighthawk habitat polygons 148
Table 4-77. Habitat ratings assumptions for Common Nighthawk Reproducing-Eggs-Growing 148
Table 4-78. Habitat Suitability ratings summary for Common Nighthawk within the LSA only 149
Table 4-79. Summary of Common Nighthawk observations within the LSA and portions of the RSA immediately adjacent to the LSA 151
Table 4-80. Monthly life requisites being rated for Olive-sided Flycatcher in the Project area 155
Table 4-81. Summary of habitat attributes for Olive-sided Flycatcher reproduction 155
Table 4-82. Relative suitability classes to be assigned to Olive-sided Flycatcher habitat polygons 156
Table 4-83. Habitat ratings assumptions for Olive-sided Flycatcher Reproducing-Eggs-Growing 157
Table 4-84. Habitat suitability ratings summary for Olive-sided Flycatcher 158
Table 4-85. Seasons and the life requisites for MacGillivray's Warbler being rated in the Project Area 162
Table 4-86. Summary of habitat attributes for McGillivray's Warbler reproduction 163
Table 4-87. Relative suitability classes to be assigned to MacGillivray's Warbler habitat polygons 163
Table 4-88. Habitat ratings assumptions for MacGillivray's Warbler - Reproducing-Eggs-Growing 164
Table 4-89. Summary of habitat suitability for MacGillivray's Warbler within the LSA only 165
Table 4-90. Monthly life requisites being rated for Queen Charlotte Goshawk in the Project area 172
Table 4-91. Cross reference for HSI values with respect to wildlife habitat ratings classes 173
Table 4-92. Nesting habitat variables ratings table for *A. g. laingi* 174

Table 4-93. Northern Goshawk habitat ratings assumptions 175
Table 4-94. Habitat Suitability ratings summary for Northern Goshawk in the LSA only.. 176
Table 4-95. Summary of Northern Goshawk call-playback locations and responses 179
Table 4-96. Monthly life requisites being rated for Western Screech-Owl in the Project area 185
Table 4-97. Summary of habitat attributes for Western Screech-Owl 186
Table 4-98. Relative suitability classes to be assigned to Western Screech-Owl habitat polygons 186
Table 4-99. Western Screech-Owl habitat assumptions table 186
Table 4-100. Habitat suitability ratings summary for Western Screech-Owl nesting habitat within the LSA 187
Table 4-101. Life requisites of the White-tailed Ptarmigan within the Project area rated by month and season 193
Table 4-102. Summary of habitat attributes for White-tailed Ptarmigan reproduction.. 193
Table 4-103. Relative suitability classes to be assigned to White-tailed Ptarmigan habitat polygons 194
Table 4-104. Habitat suitability ratings summary for White-tailed Ptarmigan 194
Table 4-105. White-tailed Ptarmigan observations during the 2015 and 2016 field seasons 196
Table 4-106. Life Requisites of the Sooty Grouse within the Project area rated by month and season 201
Table 4-107. Terrestrial Ecosystem Mapping relationships for each Life Requisite of the Sooty Grouse 201
Table 4-108. Summary of habitat requirements for Sooty Grouse by season and structural stage 202
Table 4-109. Sooty Grouse Winter living habitat assumptions table 203
Table 4-110. Sooty Grouse Nesting habitat assumptions table 203
Table 4-111. Habitat suitability ratings summary for Sooty Grouse within the LSA for both Winter and Growing seasons 204
Table 4-112. Summary of Sooty Grouse observations within the LSA (Map Appendix 5-2) 208
Table 4-113. Key microhabitat characteristics of breeding habitat for Marbled Murrelet in BC 210
Table 4-114. Summary of habitat attributes for Marbled Murrelet reproduction 212
Table 4-115. Relative suitability classes to be assigned to Marbled Murrelet habitat polygons 212
Table 4-116 Detailed habitat suitability ratings assumptions for Marbled Murrelet nesting habitat 215
Table 4-117. Summary of nesting habitat suitability for Marbled Murrelet within the LSA 219
Table 4-118. Aerial and ground field ratings summary for Marbled Murrelet nesting habitat assessment 220
Table 4-119. Life Requisites of the Western Toad within the Project area (near Stewart, BC) rated by month and season 228
Table 4-120. Terrestrial Ecosystem Mapping relationships for each Life Requisite of the Western Toad 228

Table 4-121. Relative suitability classes to be assigned to Western Toad habitat polygons 229
Table 4-122. Summary of habitat requirements for Western Toad by season and structural stage 229
Table 4-123. Habitat ratings assumptions table for Western Toad Reproducing-Eggs-Growing 230
Table 4-124. Summary of habitat suitability classes for Western Toad breeding habitat231
Table 4-125. Terrestrial habitat characteristics of the Coastal Tailed Frog survey stations 235
Table 4-126. Physical stream characteristics at Coastal Tailed Frog survey stations 237
Table 4-127. Deployment and detection summary of wildlife cameras installed within the LSA 240

LIST OF APPENDICES

Appendix 1. Breeding Birds Detected during Point Count Surveys
Appendix 2. Species Accounts and Habitat Models
Appendix 3. Field Verifications and Habitat Ratings within the LSA
Appendix 4. Habitat Suitability Maps for Select Species within the RSA
Appendix 5. Wildlife Observation Locations 2015/2016 Surveys
Appendix 6. Representative Photos

Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Acronym	*Definition*
AIR	Application Information Requirements
ATV	All-terrain Vehicle
BC	British Columbia
BCEAA	*British Columbia Environmental Assessment Act*
BCEAO	British Columbia Environmental Assessment Office
BCWA	*BC Wildlife Act*
BGC	Biogeoclimatic
BMP	Best Management Practice
CDC	Conservation Data Centre
CDWR	Critical Deer Winter Range(LRMP)
CEA	Canadian Environmental Assessment Agency
CEAA	*Canadian Environmental Assessment Act*
CEE	Cumulative Environmental Effects
CMA	Coastal Mountain Heather Alpine
CMWR	Critical Moose Winter Range (LRMP)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWD	Coarse Woody Debris
CWH	Coastal Western Hemlock
DBH	Diameter-at-breast-height
EA	Environmental Assessment
ECAR	Ecological Community At Risk
EIS	Environmental Impact Statement
FRPA	*Forest and Range Practices Act*
FSR	Forest Service Road
GBPU	Grizzly Bear Population Unit
GIS	Geographic Information System
GPS	Global Positioning System
GWM	General Wildlife Measure
GWR	Goat Winter Range
IWMS	Identified Wildlife Management Strategy
LRMP	Land and Resource Management Plan
LSA	Local Study Area
LU	Landscape Unit
MBCA	*Migratory Birds Convention Act*
MBR	Migratory Birds Regulations
MELP	Ministry of Environment, Lands and Parks
MH	Mountain Hemlock
MOE	Ministry of Environment

Acronym	***Definition***
MOF	Ministry of Forests
MOFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MOFR	Ministry of Forests and Range
MU	Management Unit
MWLAP	Ministry of Water, Land and Air Protection
MWR	Moose Winter Range
NAD	North American Datum
OGMA	Old-growth Management Area
PEM	Predictive Ecosystem Mapping
RIC	Resources Inventory Committee
RISC	Resources Information Standards Committee (formerly RIC)
ROW	Right-of-way
RSA	Regional Study Area
SARA	*Species At Risk Act*
SFMP	Sustainable Forestry Management Plan
TEM	Terrestrial Ecosystem Mapping
TMF	Tailings Management Facility
TRIM	Terrain Resource Information Mapping
TLUS	Traditional Land Use Study
TSA	Timber Supply Area
UTM	Universal Transverse Mercator
UWR	Ungulate Winter Range
VC	Valued Component
VRI	Vegetation Resource Inventory
WHA	Wildlife Habitat Area
WHR	Wildlife Habitat Ratings
WNS	White-nose Syndrome

1.0 Introduction

1.1 Project Description

The Red Mountain Underground Gold Project (the Project) is situated in northwest British Columbia approximately 18 km east-northeast of Stewart, BC. The mine site lies within the Bitter Creek watershed with the target ore deposits found between 1,700 to 2,000 masl (metres above sea level). Red Mountain lies between the Cambria Icefield to the east and Bromley Glacier to the south.

1.2 Study Objectives

Wildlife baseline studies were conducted to support the assessment of potential effects of the Project on terrestrial wildlife. The key objectives of the wildlife baseline study included:

- Conducting wildlife and wildlife habitat inventories and assessments on select species within the Local Study Area (LSA).
- Determining the presence and/or relative abundance of selected wildlife species within the LSA;
- Identifying, rating, and quantifying suitable habitat for all selected wildlife species within the LSA; and
- Quantifying habitat suitability within the Regional Study Area (RSA) for a selected sub-set of species.

Eighteen species of wildlife were listed as valued components (VCs) and were the focus of this baseline study. The wildlife VCs included:

- Mammals:
    - Mountain Goat (*Oreamnos americanus*), Grizzly Bear (*Ursus arctos*), Moose (*Alces americanus*), Marten (*Martes Americana*), Wolverine (*Gulo gulo*), Hoary Marmot (*Marmota caligata*), Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*)
    - Keen's Myotis (*Myotis keenii*) was not listed as a VC but has been included in this baseline report based on the probability of occurrence within the LSA;
- Migratory Breeding Birds:
    - Olive-sided Flycatcher (*Contopus cooperii*), McGillivray's Warbler (*Geothlypis tolmiei*), Common Nighthawk (*Chordeilles minor*), Black Swift (*Cypseloides niger)*;
- Marbled Murrelet (*Brachyrampus marmoratus*);
- Raptors:
    - Northern Goshawk (*Accipiter gentilis laingii*), Western Screech-Owl (*Megascops kennicottii kennicottii*);

- Upland Game Birds:
  - White-tailed Ptarmigan (*Lagopus leucura*), Sooty Grouse (*Dendragapus fulginosus*); and
- Amphibians:
  - Western Toad (*Anaxyrus boreas*),
  - Coastal Tailed Frog (*Ascaphus truei*) is not listed a VC however it was a focal species during the 2015 field surveys and results are presented in this report.

1.3 Study Area

1.3.1 Local Study Area (LSA)

The Project is located in the Bitter Creek watershed 15 km northeast of Stewart, BC (Figure 1-1, Table 1-1). For the purpose of this report, the Project LSA encompasses the area (14,594.6 hectares) from the mouth of Bitter Creek to the headwaters at the base of the Bromley Glacier and the edge of the Cambria Icefields (Figure 1-1).

Table 1-1. Administrative boundary summary for the study area

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

The study area is within the South Boundary Ranges Ecosection and includes the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain-Heather Alpine (CMAun) biogeoclimatic zones (Table 1-2).

Table 1-2. Ecosystem classification for the study area

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)

Ecosystem Classification	*Description*
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1) BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp) BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

The Coastal Western Hemlock, wet maritime subzone (CWHwm) occupies the valley bottoms of the Bear River and Bitter Creek from sea level to approximately 600 m elevation. The CWHwm subzone is the most northerly subzone of the CWH and is characterized by heavy annual snowfall, very steep rugged topography, and low plant diversity. Dominant tree species are Western Hemlock (*Tsuga heterophylla)* and Sitka Spruce (*Picea sitchensis).* The CWHwm zone encompasses 1,969 ha (approximately 13.5%) of the LSA. Immediately above the CWHwm subzone is the Mountain Hemlock (MH) moist maritime subzone and windward variant (mm1).

The MHmm1 subzone (800 to 1,200 m elevation) is characterized by cold wet climate year round with heavy snow packs (up to 3 m) that insulate the soil from freezing. Forests are dominated by Mountain Hemlock (*Tsuga mertensiana*) and Aamabilis Fir (*Abies amabilis)*. Yellow Cedar (*Chamaecyperus nootkatensis*) is also infrequently present. Approximately 16% of the LSA is classified as MHmm1. Above the MHmm1 subzone is a non-forested transition zone from forested ecosystems to true alpine. This transition zone is the Mountain Hemlock, moist maritime, parkland (MHmmp) subzone and contains a mixture of discontinuous forest and alpine shrub/herb vegetation. The MHmmp subzone occupies a very narrow band of elevation just above 1,200 m to approximately 1,300 m, comprising 23% of the LSA.

Above 1,300 m is the Coastal Mountain Heather Alpine undifferentiated subzone (CMAun). The CMAun alpine ecosystem is by far the largest ecosystem within the LSA at 8,223 ha (56%). The CMAun is characterized by low stunted vegetation in areas that are somewhat protected from wind. Recent glaciers, wind, and long lasting snow contribute to a very harsh climate with an extremely short growing season, severely limiting vegetation growth. A large portion (approximately 10%) of the CMAun in the LSA is covered by bare rock recently uncovered by receding glaciers. The glaciers and permanent snow make up 30% of the CMAun within the LSA.

Anthropogenic disturbance within the LSA is limited mainly to the lower portions of Bitter Creek and the confluence with the Bear River. At the lower end of Bitter creek, highway 37A connects the town of Stewart, BC with the rest of the interior. The highway runs along the Bear River and bisects the lower Bitter Creek floodplain. Paralleling the highway is a hydro power transmission line Also down at the lower elevation northeast corner of the LSA is a forest recreation campsite at Clements Lake. This is a small site with two designated campsites with picnic tables and fire pits as well as a small day use area. A forest recreation trail heads up into the alpine from Clements Lake to the top of Ore Mountain. An old deactivated logging road starts from highway 37A and winds its way along the east bank of Bitter Creek to a series of old logging blocks approximately 13km upstream. Only the first 1.8km is still accessible by small pickup or all terrain vehicle (ATV). The rest of the road is completely grown over with dense shrubs, has numerous washouts and landslides and all stream crossing structures have been removed. Previous mining activities are present within the alpine portions of the LSA in the Goldslide Creek Basin where old mine shafts and previous exploration roads are evident. Currently there is a temporary mining camp set up in the basin.

Figure 1-1. Local Study Area and Regional Study Area boundaries

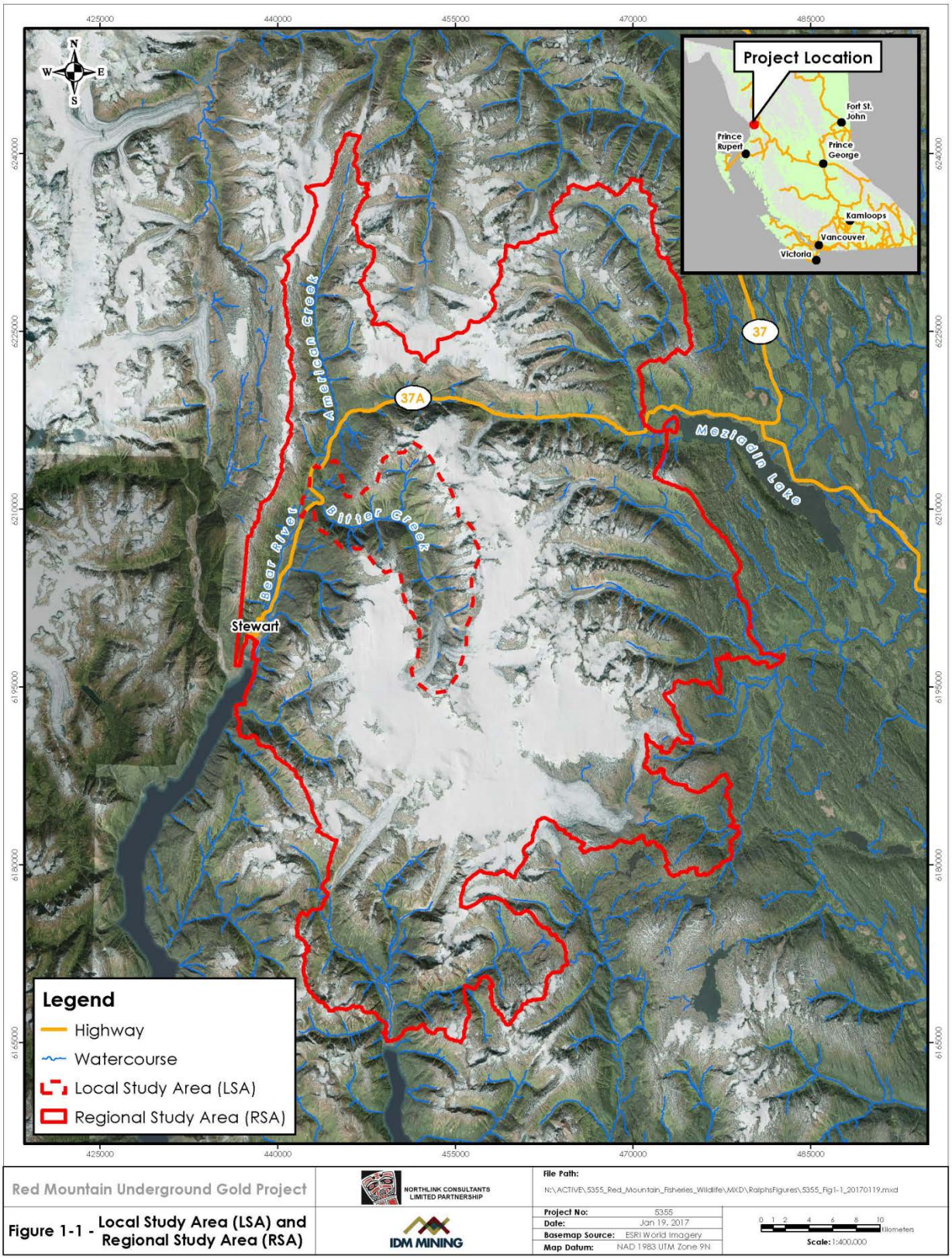


Table 1-3 provides an overview of the Biogeoclimatic Ecosystem Classification (BEC), including some of the more common site associations of the study area. Figure 1-2 provides a map of the distribution of the major BEC zones and subzones within the LSA and RSA.

Table 1-3. Biogeoclimatic Ecosystem Classification of both the Local Study Area and Regional Study Area

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	Sk	Sk	Shrub krummholz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	Sk	Sk	Shrub krummholz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	00	RI	River

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummholz
	00	Sc	Shrubland

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

1.3.2 Regional Study Area (RSA)

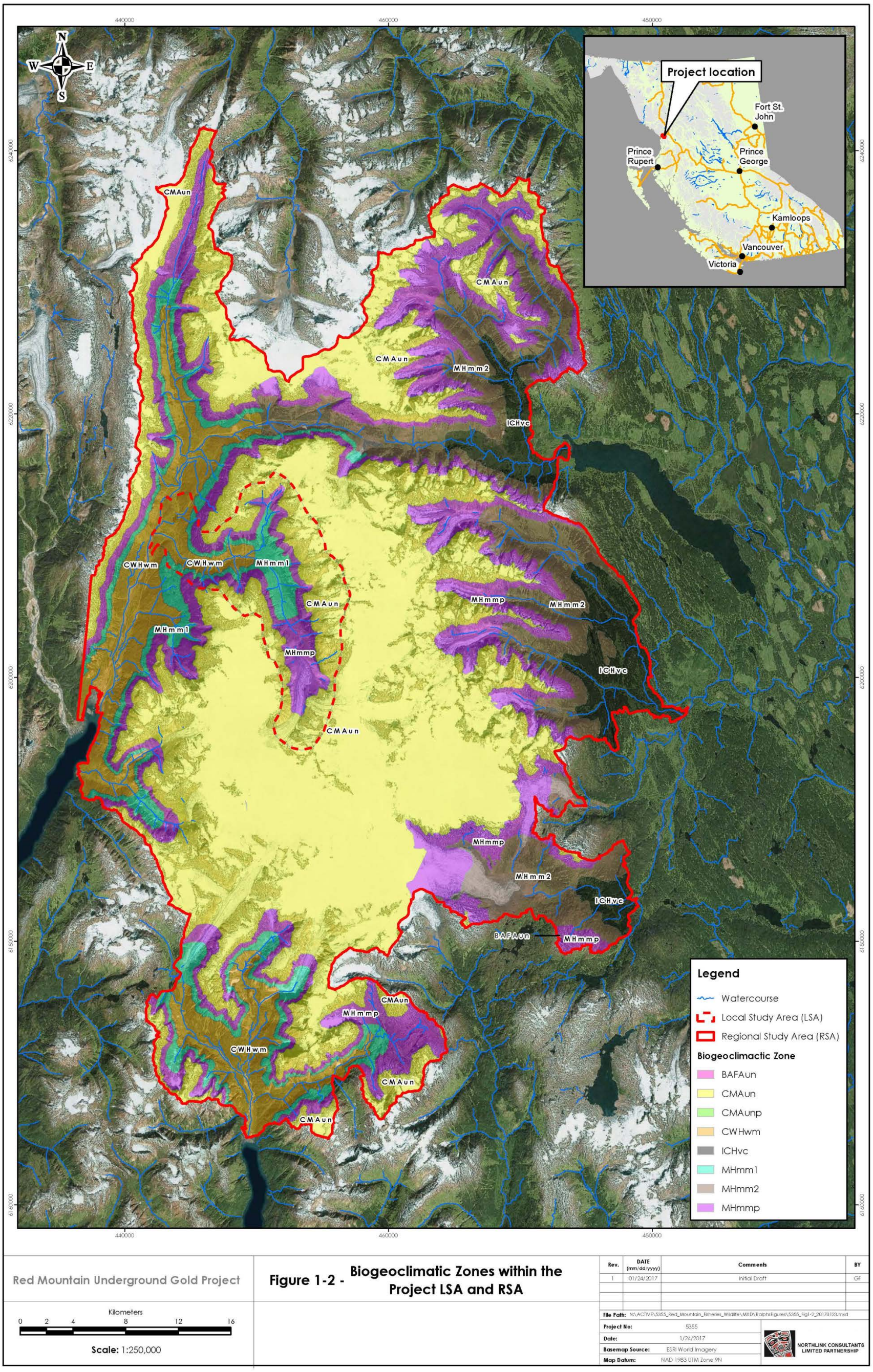
The RSA was delineated to provide a regional context to the wildlife and wildlife habitat found within the LSA (Figure 1-1). The RSA encompassed 205,350 ha, from Meziadin Lake in the east to the head of the Portland Canal in the west, and from Hastings Arm in the south to the upper end of the American Creek watershed to the north. The RSA was also intended to provide regional context for the LSA and to provide an assessment of wide ranging species such as Grizzly Bear and Wolverine.

1.3.3 Protected Areas

There are no protected areas located within the LSA, however, one protected area, the Bear Glacier Park, occurs within the RSA. Bear Glacier Park is a Class "A" Provincial park with an area of 542 ha. The park's mandate is to protect part of a large glacier and a glacial lake.

The Hanna-Tintina Conservancy was established in 2013 as a result of the Nass South Sustainable Resource Management Plan and the Gitanyow Huwilp Recognition and Reconciliation Agreement (BC Parks 2017). The total size of the Conservancy is 23,702 ha adjacent to the northeastern boundary of the RSA. No part of the conservancy is located within the RSA, however it has extremely high ecological significance in the region. Approximately 75% of the Sockeye Salmon in the Nass River watershed spawn in this area. The Hanna-Tintina Conservancy area also provides Provincially significant grizzly bear habitat and high value moose winter range.

Figure 1-2. Biogeoclimatic Zones within the Project LSA and RSA



2.0 Background Review

2.1 Species of Management Concern

An online search of the Conservation Data Centre database was conducted for the Kalum Forest District and the Regional District of Kitimat-Stikine for potential wildlife species (BC Conservation Data Centre 2016). A total of 18 records (15 blue-listed, 2 yellow-listed and 1 no status) were returned from the search (Table 2-1). For a complete listing of conservation rankings including Federal and Provincial status, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and a full description of the BC list, Identified Wildlife, and the *Species at Risk Act* (SARA), see BC Conservation Data Centre (2016).

Table 2-1. CDC Database search results

English Name	*Scientific Name*	*BC List*[1]	*Identified Wildlife*[1]	*COSEWIC*[1]	*SARA*[1]	*Potential to Occur within the LSA*
Band-tailed Pigeon	*Patagioenas fasciata*	Blue	No	SC (2008)	SC	Moderate
Barn Swallow	*Hirundo rustica*	Blue	No	T (2011)	No	Low
Caribou (northern mountain population)	*Rangifer tarandus* pop. 15	Blue	Yes	E/SC (2014)	T/SC	No
Coastal Tailed Frog	*Ascaphus truei*	Blue	Yes	SC (2011)	SC	Low
Common Nighthawk	*Chordeiles minor*	Yellow	No	T (2007)	T	Moderate
Eared Grebe	*Podiceps nigricollis*	Blue	No	No	No	No
Fisher	*Pekania pennanti*	Blue	Yes	No	No	No
Great Blue Heron, *herodias* subspecies	*Ardea herodias*	Blue	Yes	No	No	Low to Moderate
Grizzly Bear	*Ursus arctos*	Blue	Yes	SC (2002)	No	High
Little Brown Myotis	*Myotis lucifugus*	Yellow	No	E (2013)	E	moderate
Marbled Murrelet	*Brachyramphus marmoratus*	Blue	Yes	T (2012)	T	Moderate to High
Mountain Goat	*Oreamnos americanus*	Blue	No	No	No	High
Olive-sided Flycatcher	*Contopus cooperi*	Blue	No	T (2007)	T	Moderate
Peregrine Falcon, *pealei* subspecies	*Falco peregrinus pealei*	Blue	No	SC (2007)	SC	Low to Moderate
Rusty Blackbird	*Euphagus carolinus*	Blue	No	SC (2006)	SC	Low
Western Screech-Owl	*Megascops kennicottii*	No Status	No	T (2012)	SC/E	Low
Western Toad	*Anaxyrus boreas*	Blue	No	SC (2012)	SC	Moderate
Wolverine, *luscus* subspecies	*Gulo luscus*	Blue	Yes	SC (2014)	No	Moderate

[1]**Source:** British Columbia Conservation Data Centre (2016)

Search criteria used for the CDC search included:
Search Type: Animal; AND
Species Subgroups:

- Amphibians (Frogs, Toads, Newts and Salamanders); OR
- Reptiles & Turtles (Lizards, Skinks, Snakes, and Turtles); OR
- Birds, All Species; OR Birds, Species Breeding in BC; OR
- Mammals; AND

Forest Districts:

- Kalum Forest District (DKM) (Restricted to Red, Blue, and Legally designated species); AND

MOE Regions:

- 6- Skeena (Restricted to Red, Blue, and Legally designated species); AND

Regional Districts:

- Kitimat-Stikine (KSRD) (Restricted to Red, Blue, and Legally designated species)

Sort Order:

- Scientific Name Ascending

2.2 Valued Components (VC)

One of the objectives of this baseline study is to provide information on a select list of species (Valued Components) that have been identified based on their conservation status (see Table 2-1), species that are biologically, socially, economically, or culturally important, or species that are sensitive to disturbance. The VCs outlined in Table 2-2 were the focus of the wildlife baseline studies for the Project.

Table 2-2. Valued components (wildlife)

Valued Component	*Common Name*	*Scientific Name*	Species Code
Mammals	Mountain Goat	*Oreamnus americanus*	M-ORAM
	Grizzly Bear	*Ursus arctos*	M-URAR
	Moose	*Alces americanus*	M-ALAL
	Marten	*Martes americana*	M-MAAM
	Wolverine	*Gulo gulo*	M-GUGU
	Hoary Marmot	*Marmota caligata*	M-MACA
	Bats:		
	• Little Brown Myotis	*Myotis lucifugus*	M-MYLU
	• Northern Myotis	*Myotis septentrionalis*	M-MYSE
Birds	Migratory Breeding Birds		
	• Olive-sided Flycatcher	*Contopus cooperii*	B-OSFL
	• McGillivray's Warbler	*Geothlypis tolmiei*	B-MACW
	• Black Swift	*Cypseloides niger*	B-BLSW
	• Common Nighthawk	*Chordeilles minor*	B-CONI
	• Marbled Murrelet	*Brachyrampus marmoratus*	B-MAMU
	Raptors		

Valued Component	***Common Name***	***Scientific Name***	**Species Code**
	• Northern Goshawk (Queen Charlotte subspecies)[1] • Western Screech-Owl Non-Migratory Upland Game Birds • White-tailed Ptarmigan • Sooty Grouse	*Accipiter gentilis laingii* *Megascops kennicottii kennicottii* *Lagopus leucura* *Dendragapus fulginosus*	B-NOGO B-WSOW
Amphibians	Western Toad	*Anaxyrus boreas*	A-ANBO

[1] For the purpose of this report "Northern Goshawk" will refer to *A. gentilis* generally whereas "Queen Charlotte Goshawk" will refer specifically to the *A. g. laingi* subspecies.

3.0 Methodology

The wildlife studies used a combination of field studies and habitat suitability modelling to describe baseline conditions within the LSA for all 18 species and also predict habitat suitability within the RSA for a subset of valued components.

3.1 Habitat Modelling for Valued Components

Wildlife habitat modelling can be performed to determine the importance of an area to wildlife species in two ways: in its best condition (seral stage), termed habitat capability, and in its current state, termed habitat suitability. This process involves assigning a value that reflects the relative importance of mapped ecological units (i.e., map polygons) to a wildlife population, and is used as a tool for informing land management decisions. For the baseline studies, a two pronged approach was used to model habitat suitability. Terrestrial Ecosystem Mapping (TEM) combined with field collection of habitat data, was used to provide detailed habitat analysis for the full 18 species, listed as wildlife VCs, within the LSA; and Predictive Ecosystem Mapping (PEM), developed by Ecologic (2017) was used to provide habitat analysis for a subset of species within the greater RSA.

3.1.1 Model Development

Habitat modelling for the Project was primarily based on the techniques outlined in the British Columbia Wildlife Habitat Ratings Standards (RIC 1999). Several species including Northern Goshawk and Wolverine used different approaches based on specific knowledge of that species. Northern Goshawk nesting habitat suitability was modelled using a Habitat Suitability Index (HSI) approach similar to Mahon et al (2008). Wolverine habitat suitability was modelled using methods outlined in Lofroth and Krebs (2007). Species accounts were developed for the target species following the suggested format (RIC 1999). Species accounts include information on species conservation/management status, distribution, biology, and habitat requirements. Existing species accounts were reviewed and adapted to reflect habitat conditions present within the study area. A detailed literature review of existing information, previous habitat modelling, and local knowledge was used to inform the species accounts. Detailed species accounts are found in Appendix 2.

Rating schemes assigned to individual species depended on the level of knowledge regarding habitat associations for that species. Species that have been studied in depth allowed the use of a 6-class rating scheme, and for species for which there was only a moderate amount of information, only a 4-class rating scheme was warranted (Table 3-1). When information on habitat use is very limited, as is the case for many bat species, a 2-class rating scheme was used.

Table 3-1. Relative Habitat Suitability Rating (HSR) schemes

Rating Class	*Rating Code*			*Upper Limit (%)*	*Relative Quality (Percent of Provincial/Regional Best*
	6 Class	**4 Class**	**2 Class[1]**		
High	1	1	U	76-100	Equivalent
Mod. High	2			51-75	Slightly less
Moderate	3	2		26-50	Moderately less
Low	4	3		6-25	Substantially less
Very Low	5		X	1-5	Much less
Nil	6	4		0	Habitat or attribute is absent

Source: RIC (1999)

[1]2 Class system is used when information on habitat use is limited. U = Useable; X = Likely no habitat value

Initial polygons for wildlife habitat ratings were based on preliminary TEM conducted by Northlink's ecologists during the growing seasons of 2015 and 2016. Wildlife species chosen for habitat modelling were based on the VCs identified for the Project, their potential for occurrence within the study area, and on ecosystem attributes that are readily available in the GIS layers. GIS database layers included Forest Cover, Vegetation Resource Inventory (VRI), Terrain Information Mapping (TRIM), and ortho-imagery. All 18 target species (identified as VCs for the Project) were chosen for habitat mapping (Table 3-2) within the LSA. A subset of VCs were selected for habitat modelling in the RSA using PEM, based on a combination of home range size, sensitivity, regional importance, and habitat data availability. Species selected for habitat modelling in the RSA included Mountain Goat, Grizzly Bear, Moose, Marten, and Wolverine (Table 3-2).

Table 3-2. Target wildlife species life requisites and rating scheme for the Project

Species	*Life Requisite*	*Season*	*Rating Scheme*	*LSA, RSA or Both*
Mountain Goat	Living	Summer	6 Class	Both
Mountain Goat	Living	Winter	6 Class	Both
Grizzly Bear	Feeding	Early Spring (P_E)	6 Class	Both
Grizzly Bear	Feeding	Late Spring (P_L)	6 Class	Both
Grizzly Bear	Feeding	Summer (S)	6 Class	Both
Grizzly Bear	Feeding	Fall (F)	6 Class	Both
Grizzly Bear	Denning	Winter (W)	6 Class	Both
Moose	Living	Summer (S)	6 Class	Both
Moose	Living	Winter	6 Class	Both
Marten	Living	Winter (W)	4 Class	Both
Wolverine	Living	Winter (W)	4 Class	Both
Hoary Marmot	Living	Growing (S)	4 Class	LSA Only
Hoary Marmot	Denning	Winter (W)	4 Class	LSA Only

Species	*Life Requisite*	*Season*	*Rating Scheme*	*LSA, RSA or Both*
Keen's Myotis	Living	Summer (S)	2 Class	LSA Only
Little Brown Myotis	Living	Summer (S	2 Class	LSA Only
Olive-sided Flycatcher	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
MacGillivray's Warbler	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
Common Nighthawk	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
Marbled Murrelet	Reproducing-Eggs	Growing (G)	6 Class	LSA Only
Northern Goshawk	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
Western Screech-Owl	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
Sooty Grouse	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
White-tailed Ptarmigan	Reproducing-Eggs	Growing (G)	4 Class	LSA Only
Western Toad	Reproducing-Eggs	Growing (G)	4 Class	LSA Only

Preliminary wildlife habitat ratings tables were completed for each target species as required by the RIC (1999) standard. Within these tables a habitat rating was applied to each ecosystem unit in the study area as outlined in the species account and Wildlife Habitat Suitability Ratings Tables (WHSR Appendix 3). Habitats were rated as a percentage of the province's best known habitat (Provincial Benchmark) for that species. When benchmarks were not available, the ecosystem attributes and habitat features deemed important based on the best available literature were used to inform ratings. Previous models for select species were reviewed and adapted where applicable in the development of site-specific models for the study area. The 6-class rating scheme used for Marbled Murrelet ratings was adjusted from the RIC standard as described by Burger et al. (2003). Northern Goshawk habitat was rated using a Habitat Suitability Index (HSI) based on the method developed by Mahon et al. (2008). Wolverine habitat was rated using a modified version of the rating schemes described in Lofroth and Krebs (2007). Habitat ratings for both Northern Goshawk and Wolverine were modified and adapted to the 4 class rating scheme (RIC 1999).

3.1.2 Model Verification

Field verification for wildlife habitat ratings within the LSA was conducted on August 10 to 16, 2015 and June 5 to 12, and July 4 to 11, 2016, concurrent with surveys for species at risk, mammals, breeding birds, raptors, and amphibians. The 2015 focal species included:

- Mountain goat;
- Grizzly Bear;
- Northern Goshawk;
- Western Screech-owl;
- Olive-sided Flycatcher; and
- Western Toad

Field visits for wildlife habitat ratings were conducted by a crew of two biologists and one Nisga'a technician in 2015. A total of 40 ground plots were conducted in 2015 and habitat suitability ratings were assigned to the above listed focal species at each plot.

In 2016, additional surveys were conducted by one biologist and one Nisga'a technician totalling an additional 94 plots. Wildlife habitat suitability ratings were assigned for the full set of VCs at each plot. The crews conducted full ground plots (examples of data collected are shown in Table 3-3) and visual inspections at 134 plots representing a broad range of the habitat conditions found within the LSA. This roughly reflects a reconnaissance survey intensity level 5 (5 to 14% of polygons inspected) as suggested for a study area between 10,000 and 1,000,000 ha (RIC 1999). Based on the original preliminary TEM developed in 2015 the actual survey intensity was 13.2%. The goal of field verification was to assess wildlife habitat suitability on the ground and adjust the preliminary habitat ratings given based on mapped ecosystem attributes. Results of field verifications and habitat ratings are presented in Appendix 3.

Table 3-3. Minimum data collected at habitat plots

Form ID	*Form Description*	*Categories*	*Description*
FS1333	General Plot Information	Plot identification	Unique plot identifier and GPS location
		Site features	Elevation, slope, aspect, surface topography, slope position
		Stand attributes	Stand age, stand height, canopy composition, structural stage, successional status
		Vegetation characteristics	% cover by layer (tree, shrub, herb, moss), dominant tree and shrub species
		Photos	Minimum 5 photos (north, east, south, west, and ground cover), additional photos (canopy closure, specific wildlife habitat features, wildlife, evidence of use)
FS882-5	Wildlife Habitat Assessment	Wildlife habitat rating	Ratings for target species, life requisites, and season
		Habitat features	List wildlife habitat features in the plot
		Suitability	Overall suitability of the habitat to provide food, shelter/security, and thermal (if necessary) for each target species
		Evidence of use	Evidence of habitat use (both target species and incidental observations)

Source: BC MOFR and BC MOE (2010)

Adjustments to ratings assumptions were made in the field, where applicable. Preliminary wildlife habitat ratings were reconciled with field data to produce the final ratings table and wildlife habitat suitability maps for the study area.

In addition to rating habitat for wildlife suitability, all incidental wildlife observations were recorded and evidence of use was documented while travelling through polygons from plot to plot. GPS track logs recorded the travel route through the study area, and any direct wildlife observations or evidence of use were geo-referenced and recorded.

Within the larger RSA, field verification was conducted with two separate helicopter flights covering the entire 205,350 ha. The main purpose of the flights was to conduct an

overview assessment and provide aerial confirmation of habitat types and evidence of use, especially for Mountain Goat, Grizzly Bear, and Moose. Overview flights were conducted in the beginning of July and the end of August 2016, covering a total of 694 km.

3.2 Field Surveys

Field visits to identify species presence and, where possible, relative abundance were conducted in 2015 and 2016. Surveys conducted consisted of a combination of ground and aerial surveys depending on the focal species. Field surveys focused on the species identified as valued components (VCs) and their specific habitats. Survey methods and the appropriate standards are outlined separately for each individual species below.

3.2.1 Mountain Goat

3.2.1.1 Aerial Surveys

Aerial surveys with Mountain Goat observations were recorded during both the 2015 and 2016 field visits. In 2015 during the August 10 - 16 field visit, Mountain Goat surveys were primarily conducted on an opportunistic basis while accessing the site or during other surveys. The LSA and RSA were divided into survey blocks (Figure 3-1). A total of four survey blocks were established within the LSA and the RSA was divided into 25 additional survey blocks. 2016 Aerial surveys within the LSA were conducted June 5th to 11th and July 4th to 9th following RIC (2002) standards. Surveys concentrated on habitat above the treeline and flight lines were generally between 1,200 and 1,400 m elevation. Survey speeds ranged from 35 to 60 knots. Effective observation distances from either side of the flight line were estimated to be approximately 300 m. Surveys focused on obtaining complete coverage of the non-forested areas within each survey block. Mountain Goats were classified into adult and juvenile. Where possible, sex of the animals was determined during the initial sighting, however, no additional attempts to verify sex were made in order to minimize disturbance to the Mountain Goats. Data sheets and handheld GPS units were used to record all observations. Data collected during aerial surveys included:

- Survey start and end time;
- Weather (during survey and previous 24 hours);
- Waypoint (each animal or group of animals were geo-referenced with handheld Garmin GPS);
- Survey block;
- Classification (adult male, adult female, adult unclassified, juvenile);
- Comments; and
- Photos were taken opportunistically without additional disturbance to the goats.

Surveys were flown under appropriate weather conditions (clear or high overcast) to maximize visibility. Based on the estimated effective observation distance and flight line length, the amount of effective survey area (square kilometres) was calculated and the

proportion of the total survey block sampled. Mountain Goat observations are presented as the density of goats (adults and juveniles/km^2) within each survey block.

Aerial Mountain Goat surveys within the RSA were conducted as part of the aerial overview assessment. The northern half of the RSA was surveyed on July 09, 2016 and the southern half of the RSA was surveyed on August 31, 2016. Surveys were conducted in a similar manner as described above. Due to the size of the RSA, only a representative sample of each block was flown. Effective observation area was also considered to be 300 m on either side of the flight line. Aerial surveys were conducted using either an Astar 350B2 or a Bell 407 helicopter with two observers (one First Nation technician and one Wildlife Biologist) and the pilot.

3.2.1.2 Ground Surveys

Ground based Mountain Goat surveys within the LSA were conducted July 6th and 8th 2016 by establishing fixed observation stations at key vantage points (Figure 3-2) on both sides of the Bitter Creek valley. Vantage points were selected based on locations that maximized visibility of summer Mountain Goat habitat. Vantage points were selected well above the treeline with a focus on providing a full unobstructed view across the Bitter Creek and Roosevelt Creek valleys. Vantage points were also located in relatively easily accessible locations (by helicopter) to allow for repeated observations. A total of nine survey stations were established. Observation effort was standardized for one hour at each station. Surveys were conducted during clear weather with high visibility using high powered binoculars (10 power or greater) and spotting scopes (20 to 60 power). All Mountain Goats observed were tallied and classified into adult, sub-adult, or kid (young of year). Additionally, adults were further classified to male/female whenever possible. For each Mountain Goat observation data collected included:

- Azimuth bearing (degrees);
- Distance from observation station (estimated);
- Elevation relative to the observation station (e.g., 100 m above or same elevation as observation station); and
- Age, class, number of individuals, activity, and terrain/habitat type.

Mountain Goat habitat assessments were conducted during the August 10 -16, 2015, June 6 – 11, and July 4 – 9, 2016 field visits. Wildlife habitat ratings (WHR) field verification was conducted during the 2015 field season in conjunction with the preliminary Terrestrial Ecosystem Mapping (TEM) surveys. The WHR field verification followed standards outlined in the manual Describing Terrestrial Ecosystems in the Field (Province of BC 2010). Both summer and winter habitat was rated for Mountain Goat during the field visits. At each plot location, a search for evidence of use including hair, scat, beds, scrapes, or tracks was conducted. These field ratings were later used to verify habitat modelling results (see section 3.1.2). All data were recorded on field forms as described in Table 3-3.Data was entered manually into excel for subsequent analysis. Both model results and field ratings are presented within the Mountain Goat results, Section 4.1. In

addition to the field plots, wildlife cameras were located along well used Mountain Goat trails, identified during the 2015 field visit, to verify habitat use. Cameras were installed during the 2016 field visits at five specific locations that had indications of high Mountain Goat use (see section 3.2.17: Table 3-4 and Figure 3-11).

Figure 3-1. Mountain Goat survey blocks

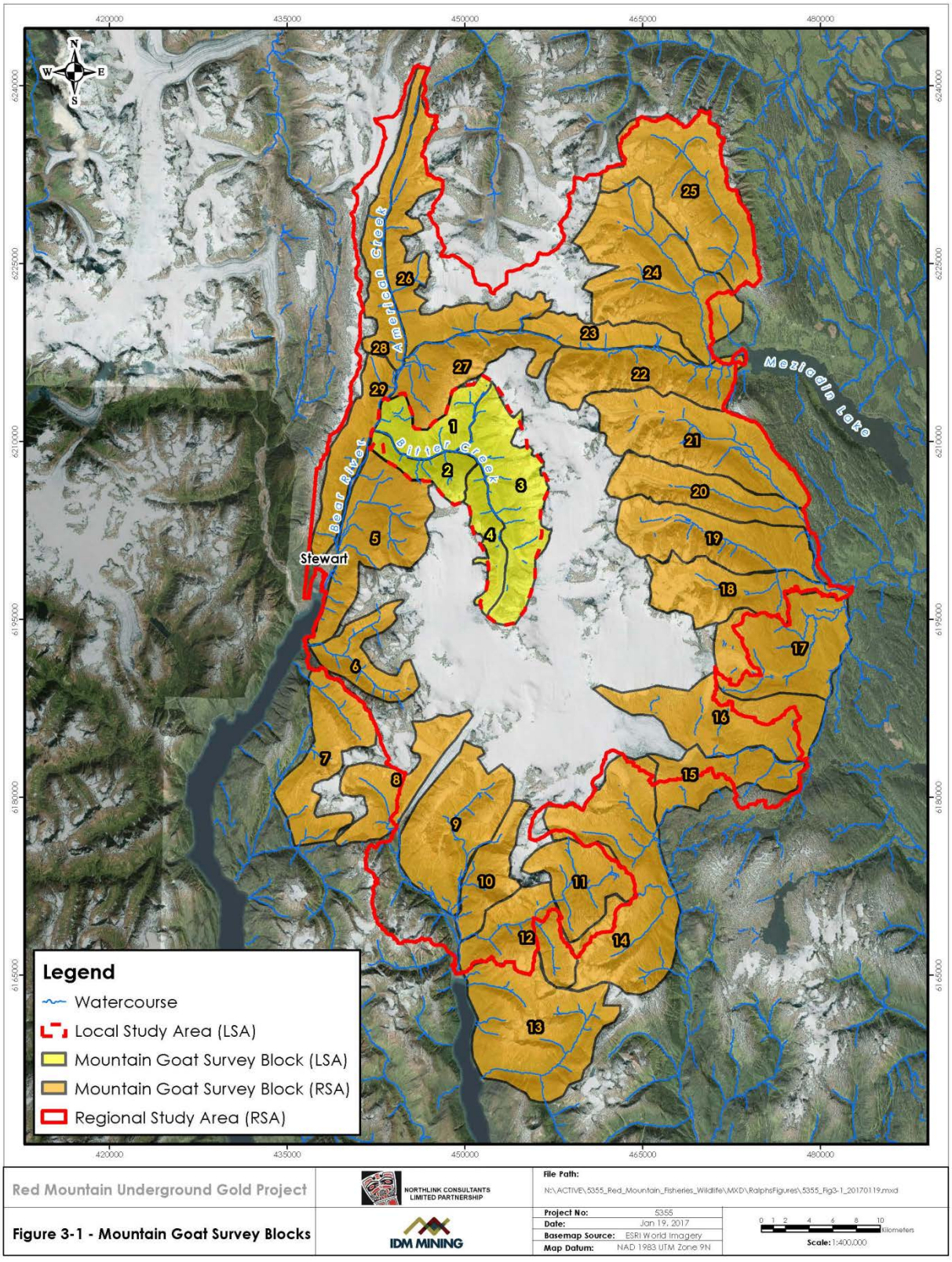
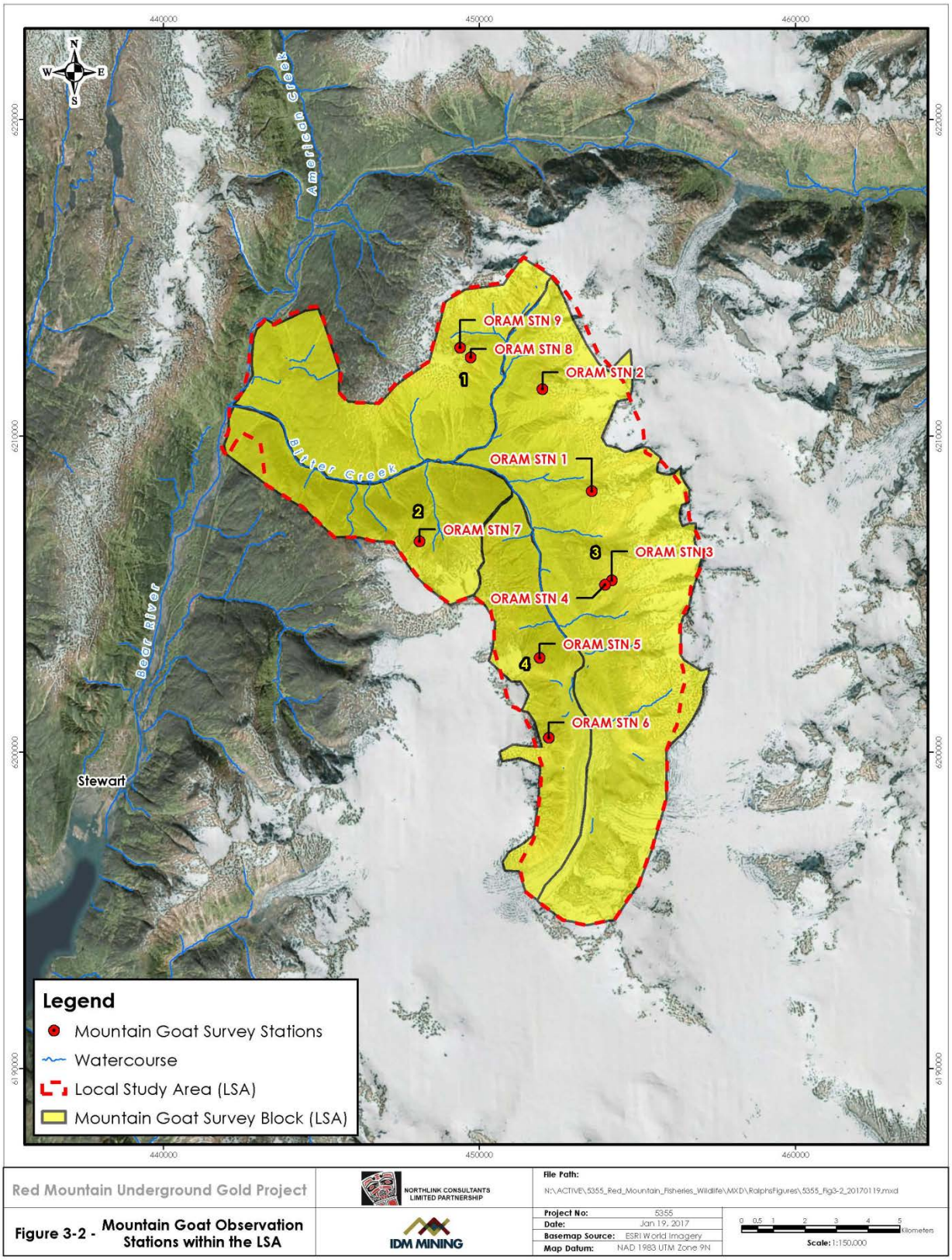


Figure 3-2. Mountain Goat observation stations within the LSA



3.2.2 Grizzly Bear

In both 2015 (August 10 – 16) and 2016 (June 5 – 11 and July 4 – 9), opportunistic wildlife surveys were conducted throughout the LSA. Part of those surveys included searching for Grizzly Bear sign, including: individuals, tracks, scat, trails, and rub or bite trees. Wildlife cameras were installed in areas where significant Grizzly Bear sign had been observed or where travel corridors were suspected. As new Grizzly Bear evidence was discovered, additional wildlife cameras were installed to verify use (See section 3.2.17 for details on wildlife camera methods).

An aerial den survey was conducted on August 15, 2015, loosely following standards outlined in RIC (1998d). The surveys focused on optimal denning habitat, primarily steep north facing slopes at or near the treeline (Figure 3-3). Searches focused on finding signs of excavation including large mounds of exposed soil and burrow entrances. Searchers also looked for possible cave entrances at the base of cliffs that may provide denning features. Aerial surveys were conducted using either an Astar 350B2 or a Bell 407 helicopter with three observers (one First Nation technician, one Ecologist, and one wildlife Biologist/navigator) and the pilot.

3.2.3 Moose

Moose surveys were conducted both opportunistically (2015) and systematically (2016) within suitable portions of the LSA. Reconnaissance surveys targeting potential Moose areas (such as the riparian area around Clements Lake and the Bear River floodplain) focused on searching for Moose sign including pellet groups, tracks, and evidence of browse. On June 09, 2016, systematic transects were conducted within an area with the highest potential Moose habitat (Figure 3-4) following Provincial standards (RIC 1998e) using a combination of pellet group counts and browse assessments along a triangular transect. The transect was 1.5km in length and habitat plots were conducted every 250m. Additional incidental surveys for Moose, conducted between June 4th and July 9th 2016 were focused on other areas with potential for overwintering habitat. These areas were in the valley bottom near Clements Lake and the lower floodplains of Bitter Creek and the Bear River. Survey intensity was conducted at a presence/not detected level and used a combination of encounter transects and habitat plots. Searches were conducted mainly for pellet groups and browse utilization as well as tracks, antler rub marks, and bark stripping. A total of 17.7 km of transects were surveyed specifically for Moose in the valley bottom portions of the LSA (see Figure 3-4 above for survey locations).

3.2.4 Marten and Wolverine

During the 2015 and 2016 field visits, wildlife reconnaissance surveys were conducted throughout the LSA. Opportunistic searches included looking for all potential signs of Marten and Wolverine including tracks and scat, while conducting other field work. All Marten and Wolverine sign was recorded, photographed, and geo-referenced using a handheld Garmin GPS.

3.2.5 Hoary Marmot

Surveys for Hoary Marmot were conducted opportunistically whenever suitable habitat was encountered. Surveys focused on areas of suitable habitat in the CMAun and MHmmp subzones including large boulder fields and Mountain Heather meadows (Map Appendix 5-4). Surveys involved looking for burrows and listening for the distinct high pitched whistles that Hoary Marmots make when they are alarmed.

Figure 3-3. 2015 Grizzly Bear aerial surveys

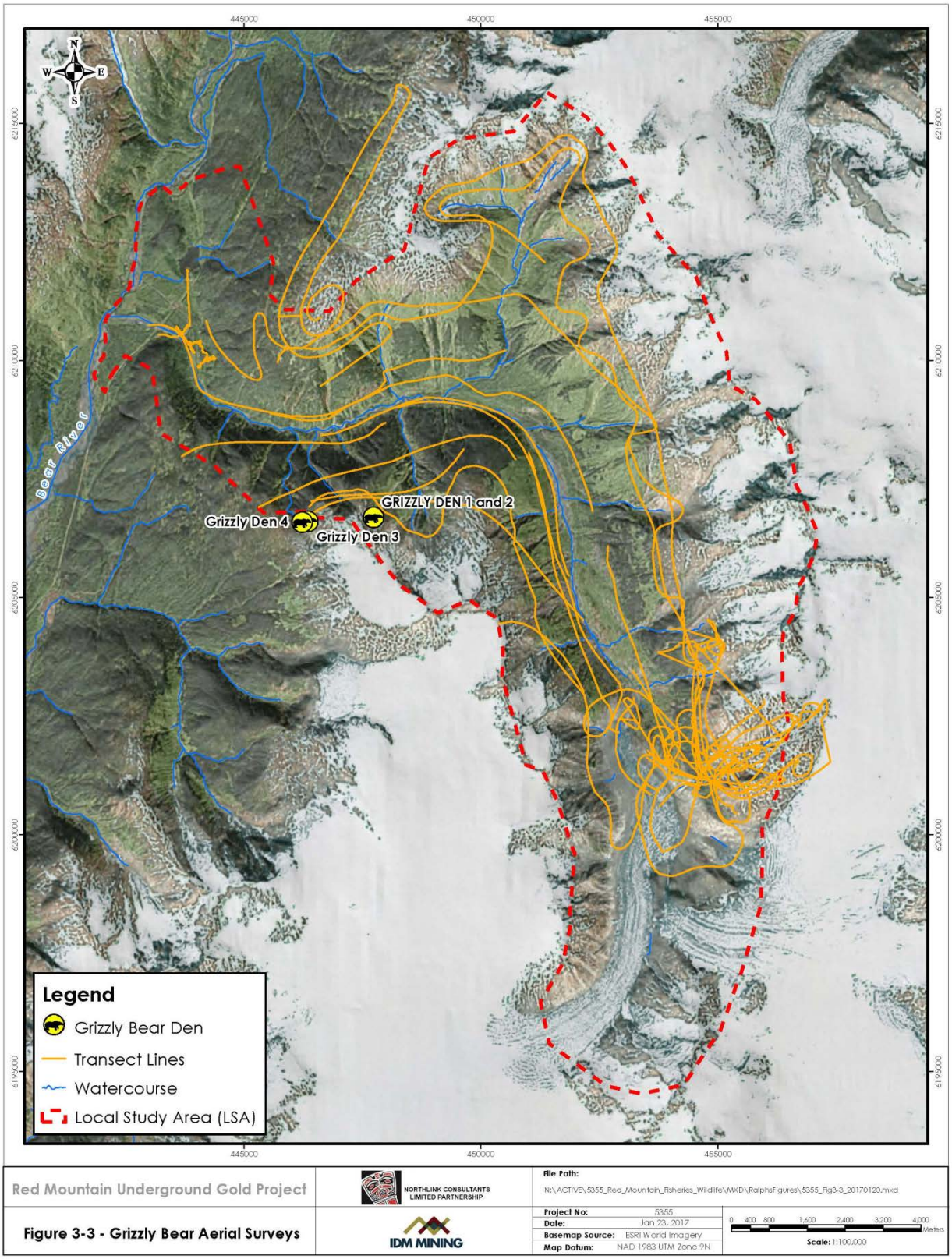
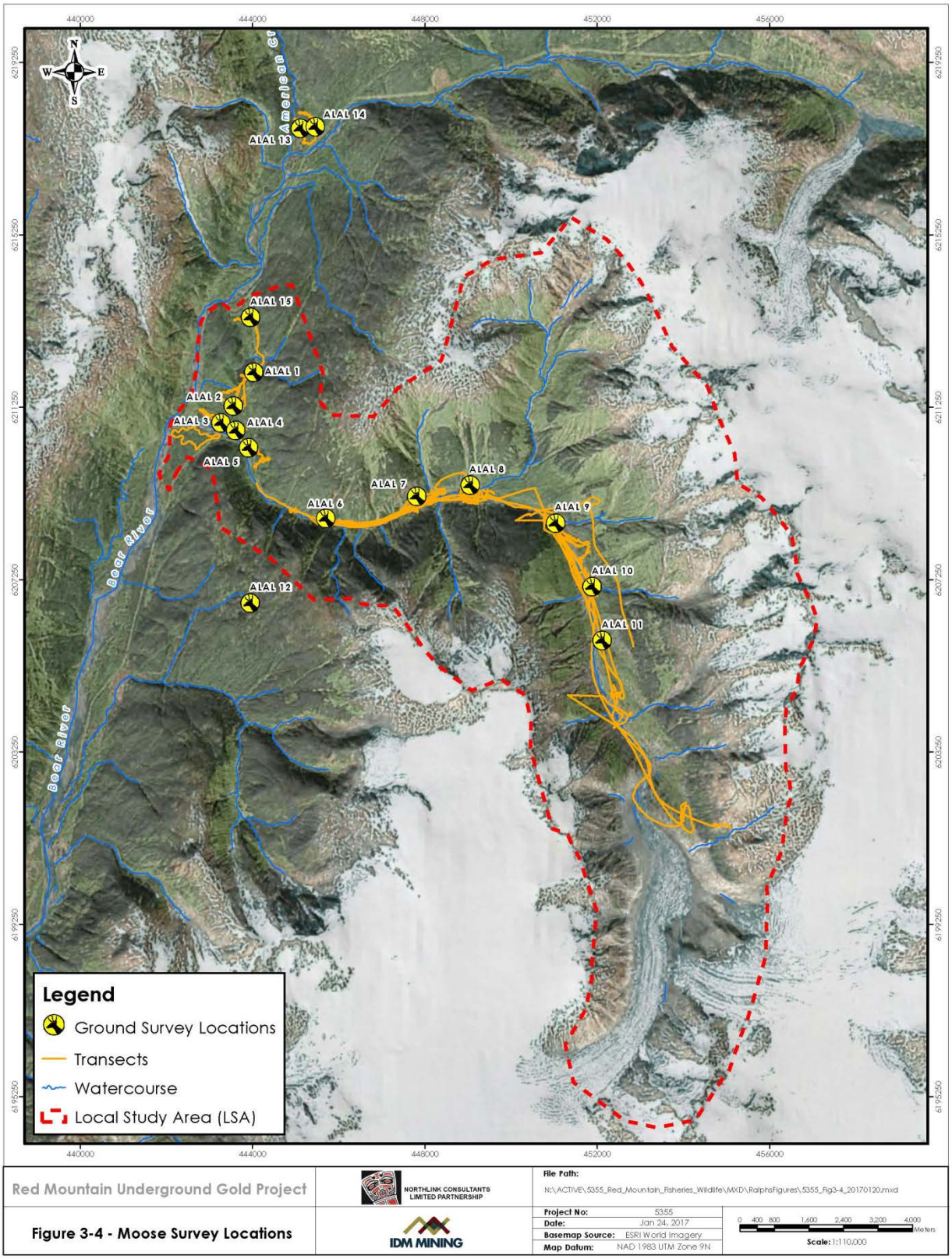


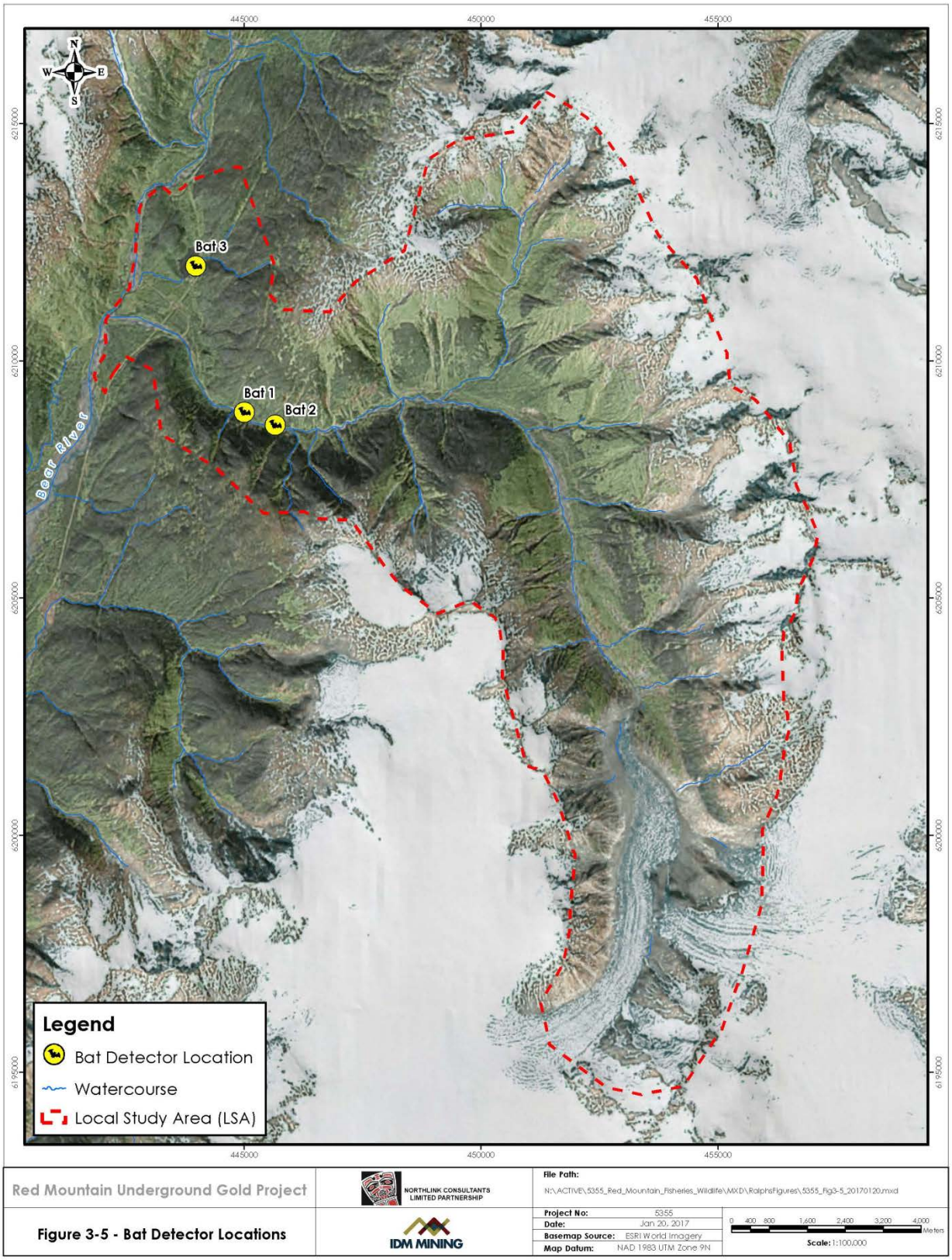
Figure 3-4. Moose survey locations



3.2.6 Bats

Bat surveys were conducted at a presence/not detected level (RIC 1998g). In From June 5th to 11th, 2016, field work focused on identifying areas of potential bat habitat. These areas were identified as the key areas for deployment of bat detectors. Areas chosen were based on forest structure providing old growth trees and snags for roosting in proximity to open areas for foraging opportunities. Two sites along the east bank of Bitter Creek were selected based on good density of snags and large old Sitka Spruce. The third site was along the forested edge of Clements Lake. This site had a good combination of mature Western Hemlock adjacent to open water and marshy lake edges with high insect production. SM3BAT detectors from Wildlife Acoustics were deployed at three potential sites (Figure 3-5) within the LSA from June 8 to August 31, 2016. SM3BAT detectors were used because of their ability to simultaneously record both ultrasonic sound that bats produce and audio sound that birds produce. The detectors were set to record from 1 hour before sunset to 1 hour after sunrise, allowing for maximum detection of a wide range of species. Ultrasonic and audio data were downloaded at the end of the 2016 field season and analyzed using Kaleidoscope Pro software from Wildlife Accoustics.

Figure 3-5. Bat detector locations



3.2.7 Breeding Birds

3.2.7.1 Field Surveys

Songbird point counts were conducted within the LSA between June 4 and July 10, 2016. Point count station locations were initially stratified by biogeoclimatic zone in order to obtain representative samples from each of the three zones (CWH, MH, and CMA). Unlimited radius point count surveys were conducted according to Inventory Methods for Forest and Grassland Songbirds (RIC 1999b) and Monitoring Bird Populations by Point Counts (Ralph et al. 1995). Point count stations were placed systematically (at a minimum of 400 m apart to avoid double counting) throughout the LSA (Figure 3-6), however count station placement was largely driven by accessibility (helicopter or on foot). Ten minute survey periods were used and all birds detected visually and/or audibly were recorded within that ten minute period.

Bird observation data recorded included:

- Interval (1 to 10 minute);
- Species (four letter codes from the American Ornithologists Union [2016]);
- Distance to the observer (estimated);
- Observation type (S=song, C= Call, V= Visual, D= Drumming/Hooting);
- Sex and age (male/female, juvenile/adult);
- Activity (e.g., feeding, defending territory); and
- General comments.

Teams of two observers (one Northlink Biologist and one First Nations Technician) visited each survey station between 0.5 hours after sunrise to approximately 4 hours later to ensure surveys were conducted during maximum bird activity. Bird surveys were conducted under optimal weather conditions as specified in the RIC (1999b) standards. All survey stations were accessed by vehicle, helicopter, or on foot. For survey stations accessed by helicopter, a minimum 15 minute wait period was implemented before the start of the survey to allow birds to return to normal activity.

3.2.7.2 Data Analysis

Breeding bird data was initially grouped into BEC zones and further into structural stages. Relative abundance, species richness and species diversity was calculated for each BEC zone. Species diversity was calculating using the Simpson's Diversity Index. Bird density calculations required the establishment of effective detection distances (EDDs) for each species within each of the three general habitat types. Based on these EDDs an effective monitoring area (Table 9) was determined as the basis for bird density calculations (Reynolds *et al* 1980).

Assumptions:

- Birds have an equal chance of occurring anywhere in the habitat surveyed;
- Birds do not have an equal probability of detection;
- Birds are detected exactly where they were prior to observer arrival (i.e. birds are neither attracted nor repelled by observers).

Birds detected during the point count surveys were further divided into two different groups for analysis. Birds were grouped into habitat associations ("guilds") and nesting strata associations based on nesting preference. Habitat associations were defined using the TEM data by identifying structural stages and specific map codes for individual habitat types. Nesting strata preferences were determined from literature and professional knowledge (Ehrlich et al. 1988; Birds of North America 2017).

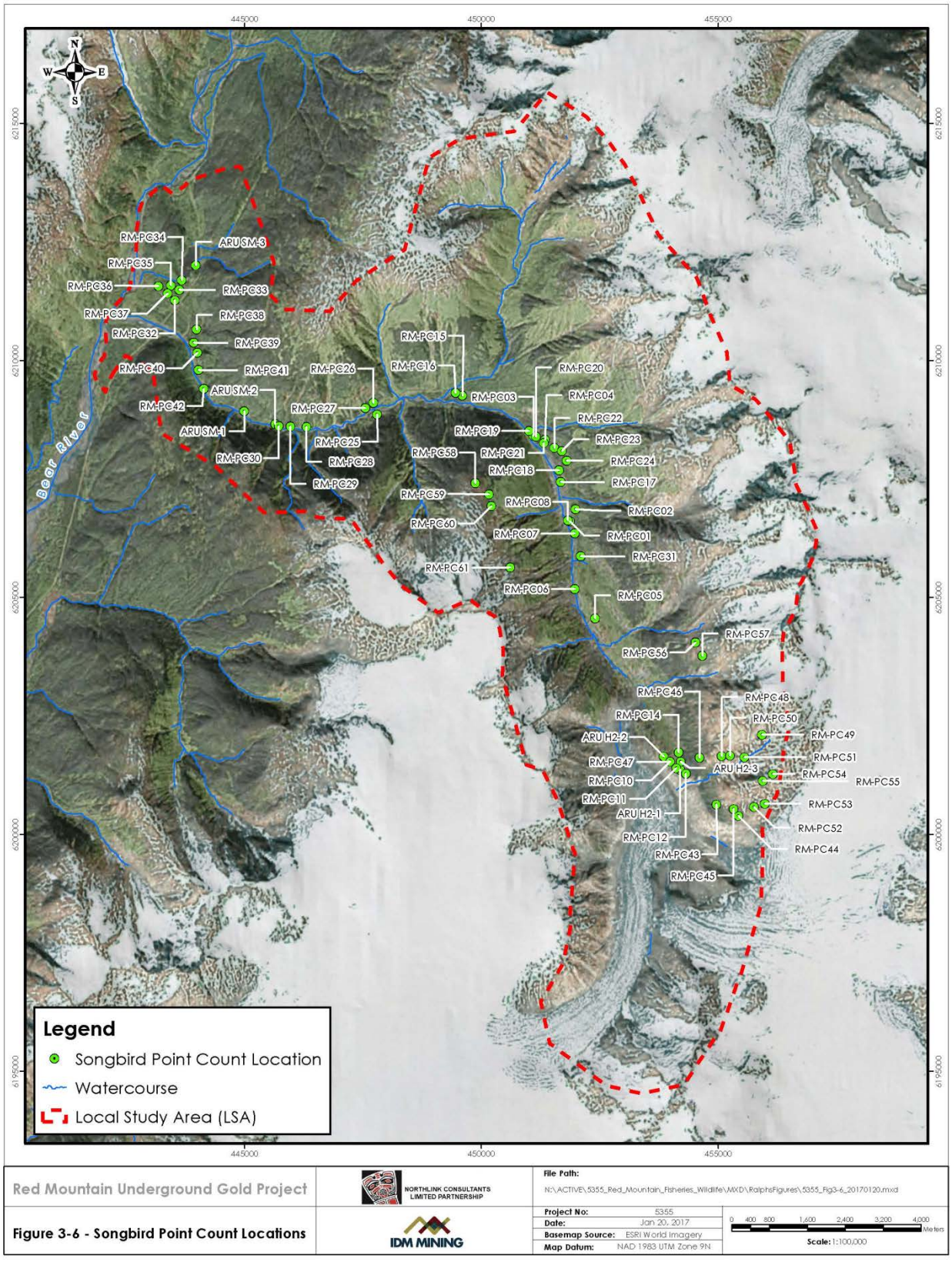
Bird Density Analysis

Effective detection distance (EDD) was established for each species observed during the point count surveys. Consistent with the methods laid out by Reynolds *et al.* (1980), the EDD was considered the outer edge of the detection distance band before the distance band where the number of birds detected declined by more than 50%. This distance was used to calculate the effective assessment area, based on the total number of point count survey stations used during the point count surveys. Bird density (birds/ha) for each species was then calculated for each species as follows:

Density, Species A (birds/ha) = *Number Observed in EDD / Effective Assessment Area* (ha)

Fly-bys and incidental observations were excluded from the above analysis.

Figure 3-6. Songbird point count locations

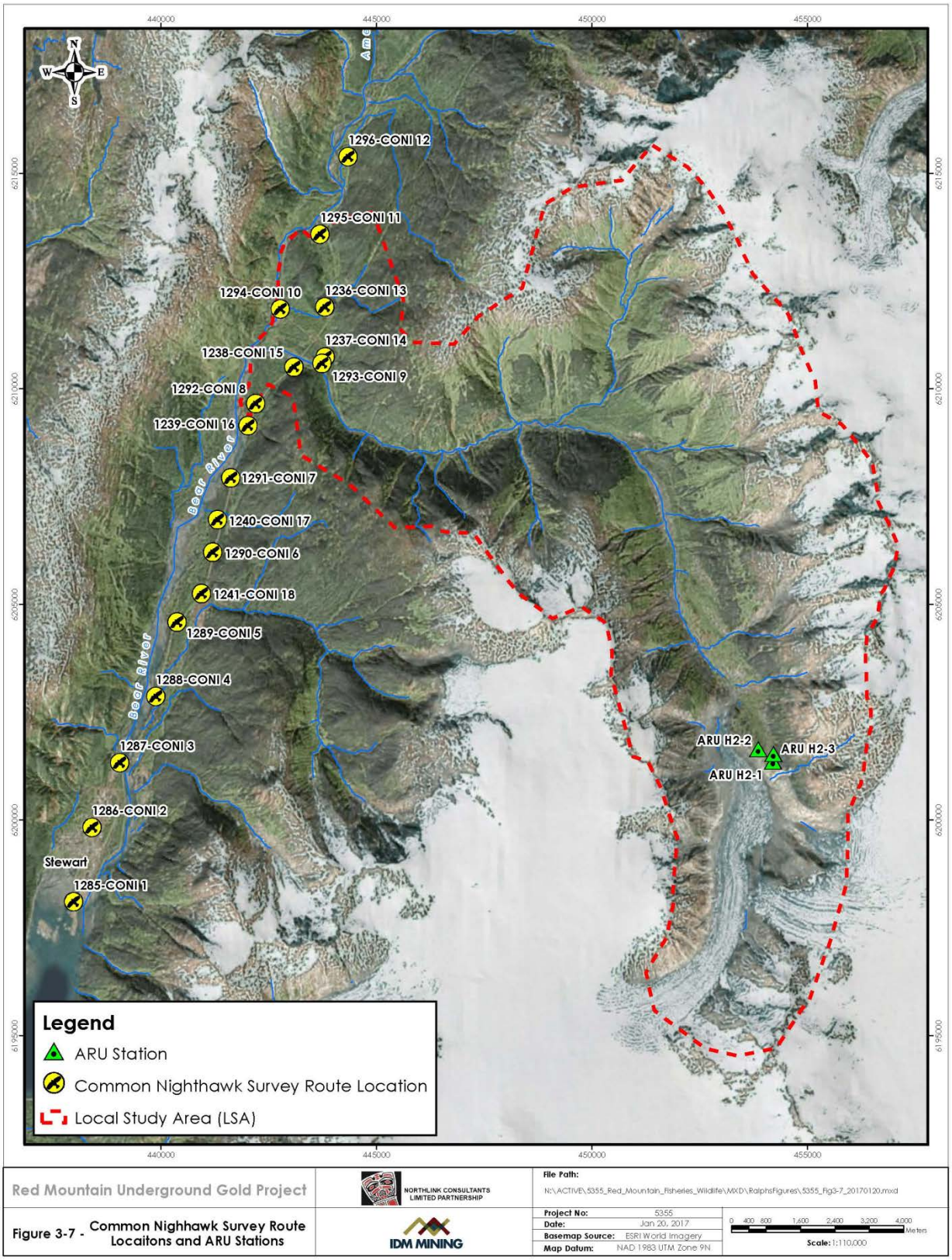


3.2.8 Common Nighthawk

To inventory Common Nighthawk, we used a combination of silent listening and call-playback surveys following the Canadian Nightjar Survey Protocol (Wild Research 2016), Inventory Methods for Nighthawk and Poorwill (RIC 1998f), and methods outlined in Hausleitner and Dulisse (1998). Two rounds of field surveys were conducted to inventory Common Nighthawk within the LSA. Survey stations were located within the lower elevation, accessible portions of the study area (Figure 3-7). Surveys were conducted at a presence/not detected level of intensity. Surveys were initially conducted on June 5th 2016. Part way through the survey the weather conditions deteriorated and the survey was abandoned. The survey was repeated on June 7th 2016 and a total of 18 stations were visited between 0.5 hours before sunset and 1.5 hours after sunset during the peak (crepuscular) activity times for Common Nighthawk. The initial survey was slightly earlier than the recommended June 15th start date therefore the same route was surveyed again on July 4th 2016. Each station was started with 2 minutes of silent listening (for spontaneous calling), followed by four 30-second calling bouts in four cardinal directions. Each calling bout was followed by a single "boom" presumed to be made by breeding males (RIC 1998; Poulin et al. 1996). Call-playback was conducted using a FOXPRO Spitfire digital game caller with pre-loaded sound files. A total of 6 minutes of calling and listening was conducted at each station.

Several areas within the LSA, identified as having potential habitat for Common Nighthawk, were accessible only by helicopter. Automated Recording Units (ARUs) were deployed at these sites between June 6 and July 10, 2016. Two types of ARU were deployed within the LSA: SM3BAT Songmeter (Wildlife Accoustics) and H2Next recorders (Model H2N). The recorders were set up to record sound from approximately 1 hour before sunset to 1 hour after sunrise.

Figure 3-7. Common Nighthawk survey route locations and ARU stations



3.2.9 Olive-sided Flycatcher and McGillivray's Warbler

Specific field surveys were not conducted for Olive-sided Flycatcher or McGillivray's Warbler. Both species were surveyed during the general breeding bird surveys using unlimited radius point count methods described in Section 3.2.7.

3.2.10 Northern Goshawk

Two subspecies of Northern Goshawk occur in British Columbia: *A. g. atricapillus* and *A. g. laingi.* The former subspecies breeds throughout the mainland and interior of British Columbia (Campbell et al. 1990). The latter subspecies, or Queen Charlotte Goshawk, occurs only on coastal BC (Campbell et al. 1990), mainly Haida Gwaii, Vancouver Island, and other large coastal islands (McClaren 2003; Cooper and Chytyk 2000). Although breeding for Queen Charlotte Goshawk has not been confirmed on the coastal mainland of BC (Campbell et al. 1990), it seems likely that the goshawks that breed on the north and central mainland coast are of this subspecies (Cooper and Chytyk 2000; McClaren 2003; Doyle 2003). The distribution map (Northern Goshawk Recovery Team 2008) for *A. g. laingi* includes the entire coastal mainland divided into four distinct conservation regions (South Coast, North Coast, Haida Gwaii, and Vancouver Island). The Project study area is well within the boundaries of the Queen Charlotte Goshawk range. For the purpose of this report "Northern Goshawk" will refer to *A. gentilis* generally whereas "Queen Charlotte Goshawk" will refer specifically to the *A. g. laingi* subspecies.

Northern Goshawk surveys were performed during the breeding season. Consistent with Resources Inventory Committee (RIC 2001) recommendations, surveys were performed using call-playbacks. During call-playback surveys, at each station a call is briefly broadcast after which trained personnel observe for response vocalizations from the target species and, if possible, attempt to locate the responding individual to visually confirm identification. The broadcast call may attract birds from some distance, allowing surveyors to search a large area efficiently. While not ideal for detecting nests, the direction from which a lured bird has come may give an indication of the location of a nest. In addition, if a nest is approached, birds may begin to alarm call while circling or mobbing overhead (RIC 2001).

Call-playback surveys were performed during daylight hours on days with favourable weather (dry or light precipitation, warm with low wind). An attempt was made to locate stations between 200 and 400 m apart to maximize detection probability while also covering the most possible area (RIC 2001). Stations were located in areas that were perceived to have the most suitable Northern Goshawk nesting habitat, that is, mature or old-growth stands with a relatively closed canopy and open understory on a gentle slope (Cooper and Chytyk 2000). A call-playback survey at each station adhered to the following protocol:

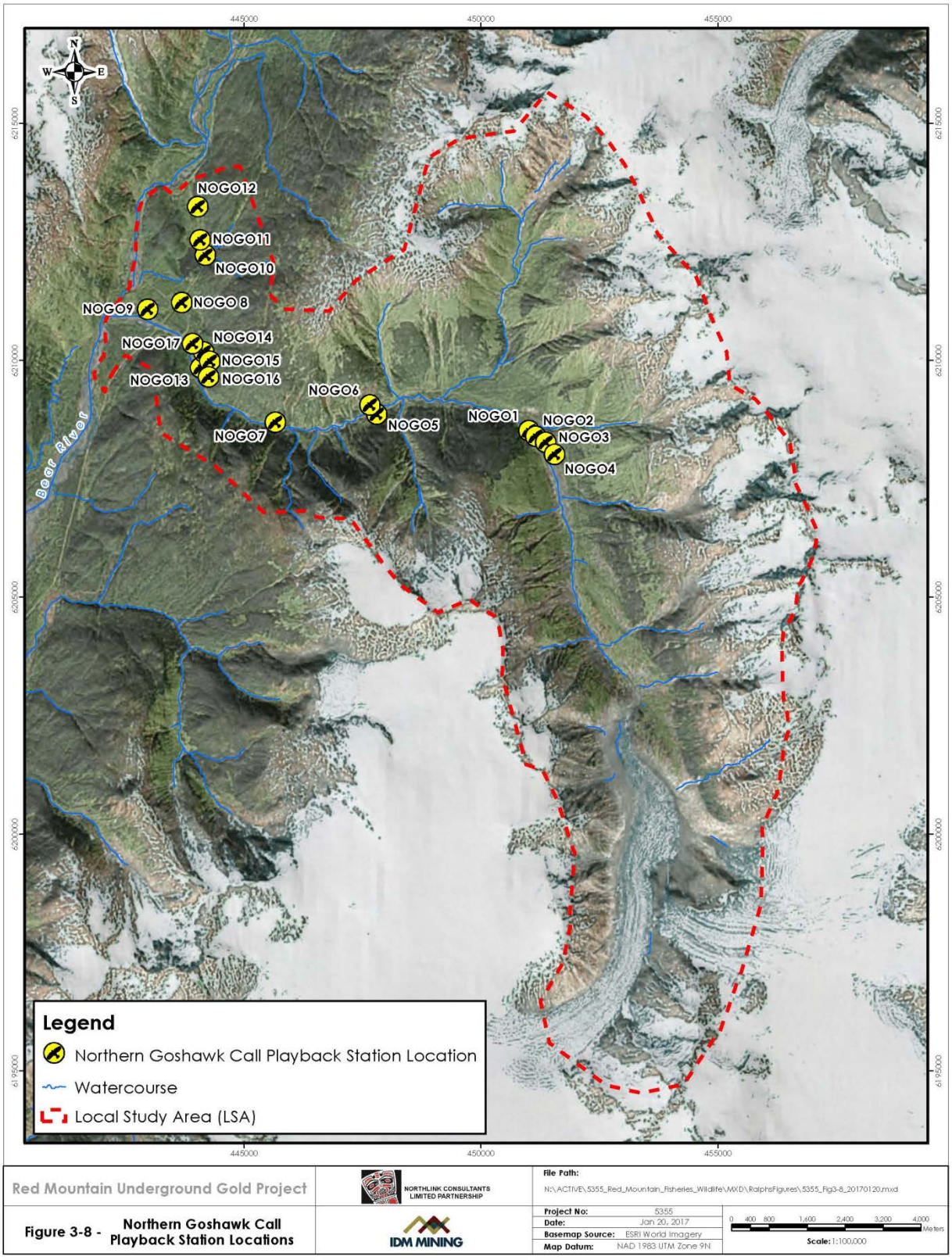
- 2 minutes of listening for spontaneous calling upon arrival at station
- 30 seconds of broadcasting call followed by 30 seconds listening (repeated twice for each cardinal direction)

- 2 minutes of listening for calls before leaving station
- Total survey time at each station was 12 minutes (broadcasting and silent listening).

As recommended by RIC (2001), for stations visited before July 1 Northern Goshawk male alarm calls were broadcast; after this time juvenile begging calls were used.

Initial opportunistic surveys for Northern Goshawk from August 10 to August 16 2015 focused on identifying areas of suitable habitat. As these areas of suitable habitat were encountered, opportunistic call-playback surveys were conducted using juvenile begging calls. In 2016, survey stations were located systematically throughout suitable habitat identified during the 2015 field trip. In order to sample the entire breeding season, two rounds of call-playback survey were conducted in 2016. Call-playback surveys were conducted from June 5 to 10 using adult male alarm calls and again from July 4 to 10 using juvenile begging calls. A total of 17 call-playback stations were surveyed during the 2016 field season (Figure 3-8).

Figure 3-8. Northern Goshawk call-playback station locations



3.2.11 Western Screech-Owl

Field assessments August 10 – 16, 2015 focused on habitat assessment for Western Screech-Owl. Call-playback surveys were not conducted since the field visits were conducted outside of the recommended (RISC 2006) breeding season (February to June). Based on the habitat assessments from 2015, call-playback surveys were not included for the 2016 field season. Since the 2016 field visits were conducted in June, July, and August, concerns were raised that call-playback surveys may draw predatory responses from Barred Owls (*Strix varia*). Therefore, only a combination of habitat assessments and silent listening (at the Common Nighthawk survey locations Figure 3-7) was used to assess Western Screech-Owl presence within the LSA.

3.2.12 White-tailed Ptarmigan

Inventories for White-tailed Ptarmigan within the LSA relied on a combination of unlimited radius point count surveys described in the RIC standard *Upland Game Birds* (RIC 1997) and the songbird point count surveys conducted to inventory breeding birds (See Figure 3-6 for point count locations). Encounter transects (Appendix 5-5) were conducted during both the August 10 -16, 2015 and June 5 – 11 and July 4 – 9, 2016 field seasons. All incidental observations of White-tailed Ptarmigan and their sign were also recorded along with photos and GPS coordinates.

3.2.13 Sooty Grouse

Inventories for Sooty Grouse within the LSA relied on a combination of unlimited radius point count surveys described in the RIC standard *Upland Game Birds* (RIC 1997) and the songbird point count surveys conducted to inventory breeding birds (See Figure 3-6 for point count locations). Encounter transects (Appendix 5-5) were conducted during both the August 10 -16, 2015 and June 5 – 11 and July 4 – 9, 2016 field seasons. All incidental observations of Sooty Grouse and their sign were also recorded along with photos and GPS coordinates.

3.2.14 Marbled Murrelet

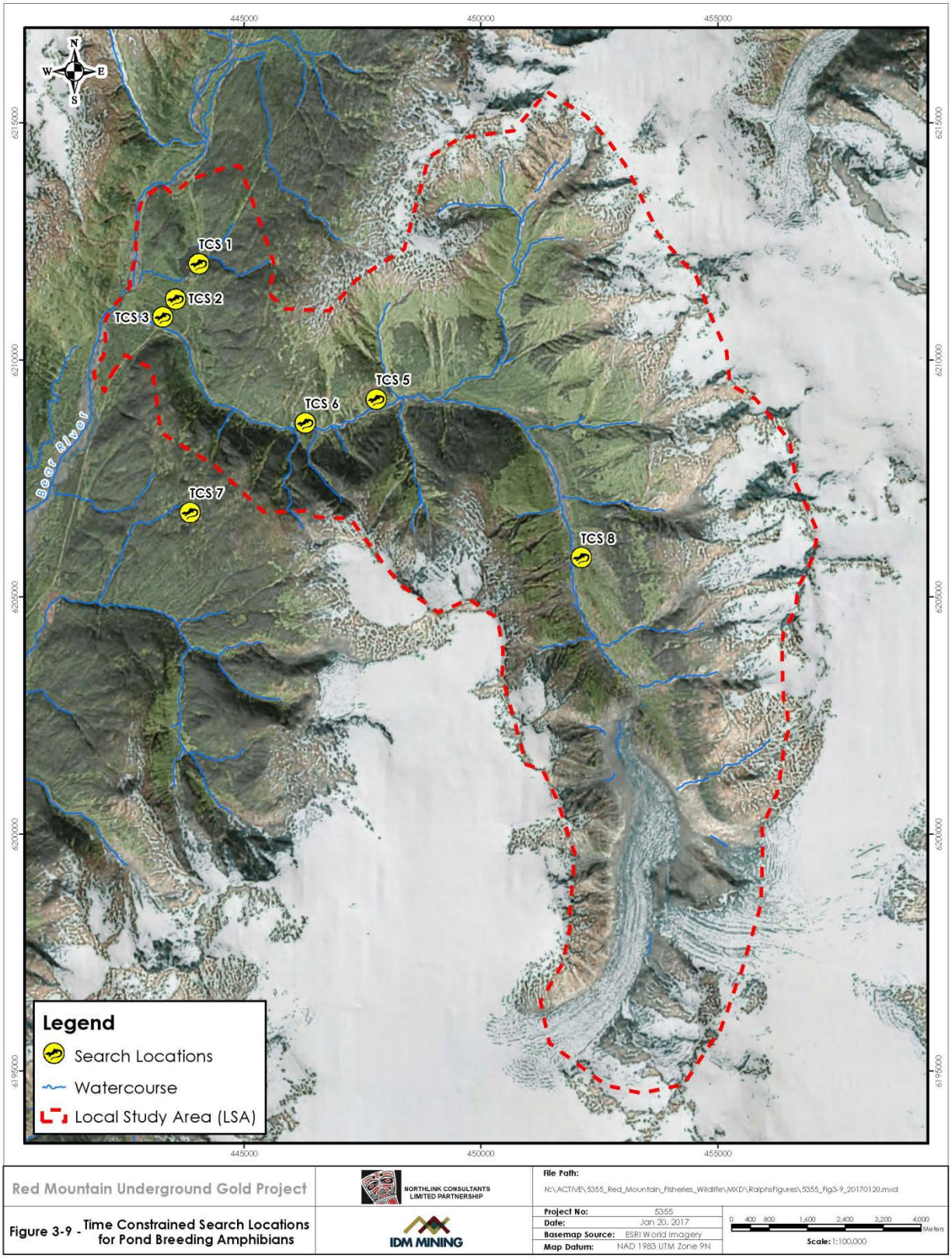
Marbled Murrelet assessments focussed on assessments of suitable nesting habitat. The basis for the assessments was the Provincial Marbled Murrelet Nesting Habitat Suitability Model (hereinafter the "BC Model") using model inputs and assumptions from Burger (2002) and the Coastal Marbled Murrelet Recovery Team (CMMRT 2003). The BC Model identified suitable nesting habitat based on a series of mapped forest cover attributes including stand age, tree height, canopy closure, vertical complexity, as well as distance from ocean, biogeoclimatic zone, slope, and elevation (Burger 2002; CMMRT 2003; Mather et al. 2010). Marbled Murrelet nesting habitat was modelled for the LSA using parameters identified in the BC Model and the TEM conducted for the Project. Suitable polygons within the LSA were identified using the WHS model in combination with the TEM model and formed the basis for field investigations. Polygons identified as class 1 or class 2 were prioritized for further field surveys. Field investigations, carried out on July 8th 2016, on these polygons were conducted using a combination of low level

aerial survey techniques outlined in Burger (2004) and ground assessments (RIC 2001). Those area ranked as Very High and High (rank 1-2) during the aerial surveys were further assessed on the ground where access allowed. Detailed systematic searches were conducted around suitable nest trees identified during the ground surveys. Searches were conducted in concentric circles around suitable nest trees to locate any egg shell fragments indicating potential nesting activity.

3.2.15 Pond Breeding Amphibians

Field sampling for pond breeding amphibians was limited to suitable breeding habitat identified within the LSA and was conducted at a presence/not detected level of intensity. Surveys focused primarily on Western Toad although all other species encountered were also recorded. Western Toads use a wide variety of ephemeral and permanent water bodies for breeding therefore all potential standing or slow moving water encountered was searched for the presence of Western Toads (Adults, tadpoles and egg strings). A series of time constrained searches (TCS) were conducted along the shoreline of Clements Lake, near the outlet, around several small ponds and wetlands within the LSA (Figure 3-9), and throughout the Bitter Creek riparian zone. These surveys consisted of a visual search of representative areas in the littoral zone and immediate shore of the lake, the wetted area of the wetlands and creeks, and their immediate riparian areas. Survey methods were consistent with protocols recommended by the Resources Inventory Committee (RIC 1998, 2000). Surveys were conducted during the August 10 -16 2015, June 5 – 11, 2016 July 4 – 9, 2016 and August 28 – 30, 2016 field visits.

Figure 3-9. Time constrained search locations for pond breeding amphibians



3.2.16 Coastal Tailed Frog

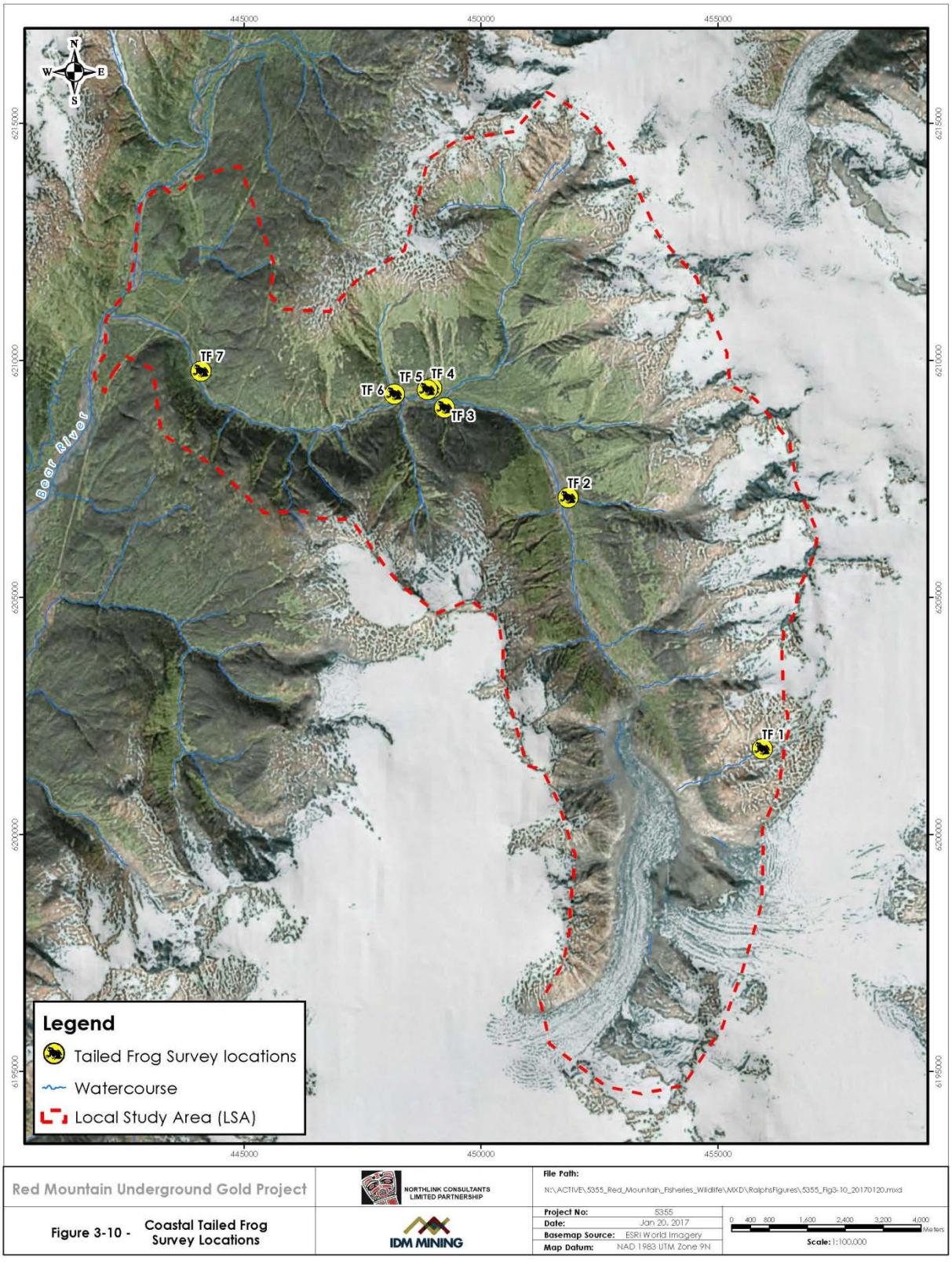
Candidate creeks with suitable habitat (Figure 3-10) were identified August 13, 2015 from the air and follow-up ground truthing on August 16, 2015 to verify accessibility and suitability for Coastal Tailed Frog. Field methods followed those outlined in Depuis and Friele (2003). A series of time constrained searches (TCS) were performed at each creek, usually within the lower reaches that were accessible by foot, in order to locate Coastal Tailed Frogs. The primary searches were limited to 30 minutes at each sampling location and involved close observation (i.e., turning over rocks) within the creek scanning for tadpoles and juveniles, as well as searches in the immediate riparian area for adults. Upon completion of the TCS, all substrate was returned to its original position within the stream. Searches followed procedures outlined in the Resource Inventory Committee's standards for sampling Coastal Tailed Frogs (RIC 2000). In the event Coastal Tailed Frogs were found, individuals would be classified according to size classes used to assign cohorts similar to those used by Gyug (2001).

At each of the sampling locations, detailed habitat data were also collected:

- Weather:
    - Cloud cover
    - Air temperature
    - Precipitation
- UTMs
- Aspect
- Elevation
- Water temperature
- Stream gradient
- Bankful width
- Wetted width
- Residual pool depth
- Substrate (% boulder, cobble, gravel, fines)
- Embeddedness rating (high, moderate, low)
- Channel morphology
- Riparian vegetation
    - Canopy closure
    - Structural stage
    - Stand age estimate

In 2016, Coastal Tailed Frogs were dropped as a VC however results are presented in this report as part of the field activity summary.

Figure 3-10. Coastal Tailed Frog survey locations



3.2.17 Wildlife Cameras

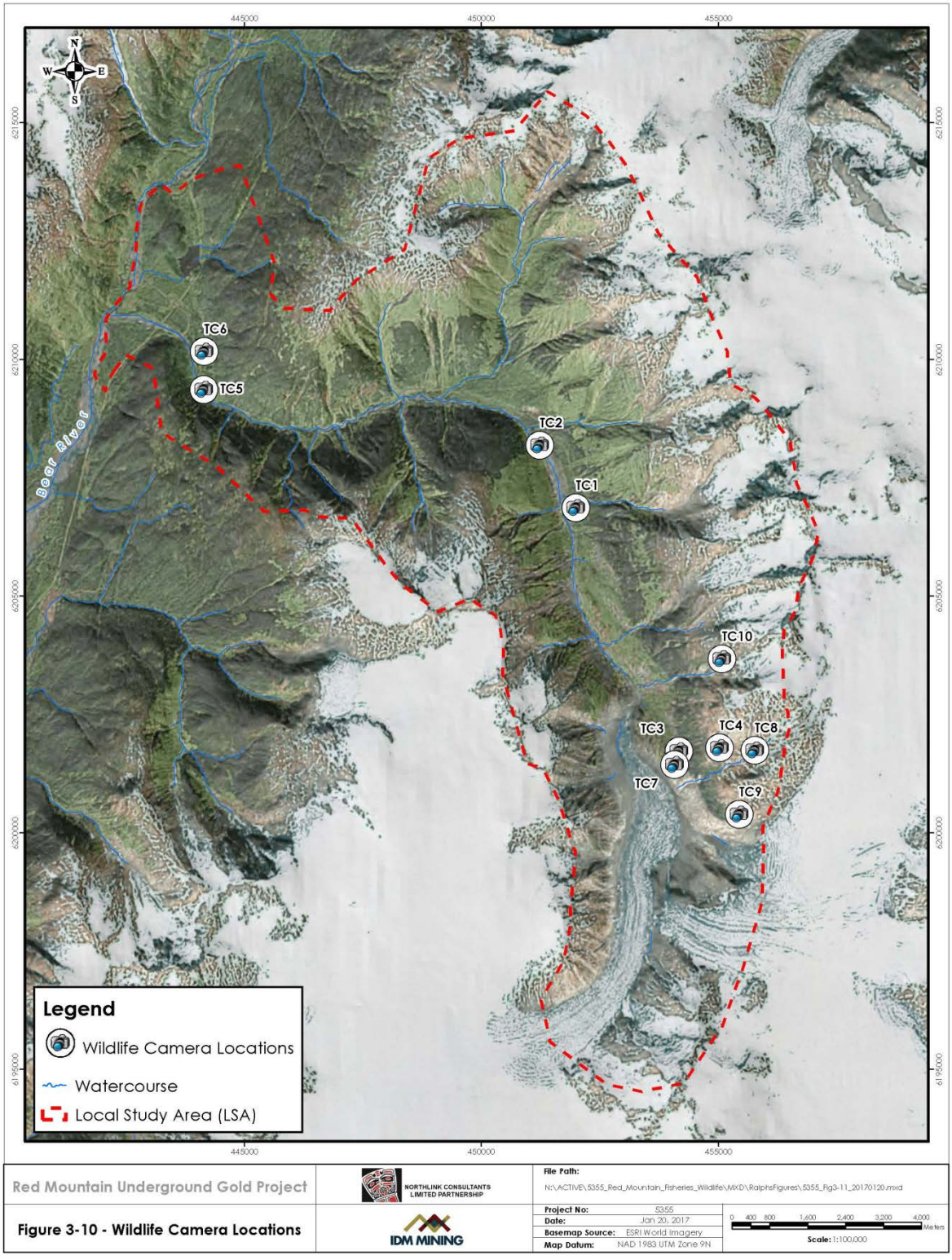
A total of ten wildlife cameras were installed throughout the LSA (Figure 3-11) attempting to provide coverage across all BEC zones. Cameras were placed strategically, based on known or potential movement corridors and high use areas determined by wildlife sign, trails, topographical features such as canyons, or other features constricting or funnelling wildlife movements (Table 3-4). Camera location was also determined in part by the location of proposed Project infrastructure such as the proposed access road location. Five of the ten cameras (TC3, 4, 8, 9, and 10) were located specifically within high use Mountain Goat areas and were designed to capture movement along major trails (identified during the August 2015 field visit) running mostly north-south along the area of the proposed administration and ancillary area (current mining camp) and the proposed access road (See Appendix 5-3a for map of all wildlife trails identified between 2015 and 2016). Habitat assessments were also conducted at each camera location and are presented in the results section. Two types of cameras were deployed: Bushnell Trophy XLT and Spypoint Solar trail camera. Both camera types utilize Passive Infrared (PIR) sensors that detect heat as well as motion. The Bushnell cameras were set to record images at 5 megapixels. Trigger speeds varied from 0.07 seconds (spypoint) to just under 1 second for the older Bushnell cameras. Maximum detection range was between 18 and 25 metres with field of view at 50 degrees.

Table 3-4 Wildlife Camera locations and habitat descriptions

Wildlife Camera	*UTM*	*BEC Zone*	*Elevation (m)*	*Habitat type*	*Wildlife Sign*	*Proposed infrastructure*
TC1	9 V 451986 6206878	MHmm1	382	Young Forest/Alder Old Road bed	Minor Wildlife Trail	Proposed access road location
TC2	9 V 451224 6208199	MHmm1	305	Mature Western Hemlock Riparian Forest	Bear trail and bear rub tree	Near proposed Access road location
TC3	9 U 454160 6201738	MHmmp	1008	Edge of Lateral Moraine and Sub-alpine forest	Well used Wildlife Trail	Proposed Access Road location
TC4	9 U 455018 6201801	CMAun	1530	Mountain heather meadow	Very well used Mountain Goat trail	500 m NW of current Mine Camp
TC5	9 V 444133 6209378	CWHwm	222	Old-growth Western Hemlock	Bear trail	Near proposed Access road location
TC6	9 V 444143 6210178	CWHwm	195	Young Western Hemlock Forest Previously Logged	Minor wildlife trail	
TC7	9 U 454069 6201445	MHmmp	1004	Dense Alder shrub complex	Close to escape terrain where high density of	Near proposed Access road location

Wildlife Camera	UTM	BEC Zone	Elevation (m)	Habitat type	Wildlife Sign	Proposed infrastructure
					Mountain Goat sign (beds, scrapes and pellet groups) were found	
TC8	9 U 455765 6201756	CMAun	1500	Mountain heather/Large blocky boulder area	Mountain Goat beds, tracks and wallows. Hoary marmot burrows	300 m NE of current mining camp
TC9	9 U 455430 6200395	CMAun	1390	Edge of Krummholz cliffs and escape terrain	Mountain Goat trail, pellet groups and beds	1.1 km South of Current mining camp
TC10	9 U 455069 6203681	CMAun	1570	Mountain Heather/Blocky talus	Mountain Goat trail coming from escape terrain	2.1 km North of current mining camp

Figure 3-11. Wildlife camera locations



4.0 Results and Discussion

4.1 Mountain Goat

4.1.1 Identification and General Ecology

Mountain Goats are medium-sized ungulates with long, shaggy white to cream coloured fur and 20 to 30 cm long, pointed horns which are present in both males and females. Males may weigh up to 144 kg and females up to 70. Lifespan is typically 10 to 11 years although one 18 year-old individual has been observed (Shackleton 2013).

Mountain Goats inhabit steep, mountainous terrain and have many adaptions for this environment. A stocky body with powerful shoulders and short legs allows for easy movement on mountainsides, and specially adapted soft pads on the base of the hoof provide excellent grip on rocks and ledges. The long fur provides excellent insulation during winter conditions (Shackleton 2013).

Females are capable of breeding after two years, however older females are more successful. Rutting occurs in November or December, during which time males intimidate other males, and will dig urine pits in which they will roll to attract females. Gestation is approximately six months, after which females will seek out an isolated location for birth (MELP 2000). Birth occurs within a short time period which is synchronized with optimal forage (Côté and Festa-Bianchet 2001). Kids weigh approximately 3 kg and are usually born singly, although twins do occur. Kids suffer from high mortality and over half may die in their first year (MELP 2000).

4.1.2 Habitat

Mountain Goats inhabit two ecotypes in British Columbia. In the interior, goats experience dry conditions which produce lighter, more mobile snow which allows Mountain Goats to occupy higher winter ranges, whereas coastal goats (such as those potentially found in the Project Area) experience a wetter coastal climate with dense snow and are generally found at lower elevations (Hebert and Turnbull 1977).

Mountain Goats generally occupy open alpine environments where escape terrain is present (Gilnber and Raedeke 1992). Escape terrain is important for protection from predators such as Grey Wolves (*Canis lupus*), Cougars (*Puma concolor*), and Grizzly Bears (*Ursus arctos*) which are likely the main predators in the LSA (MGMT 2010). Mountain Goats prefer to forage near steep cliffs which allow them to access escape terrain quickly (Foster 1982; Nietfeld et al. 1985; Gilbert and Raedeke 1992; MELP 2000; Taylor et al. 2006). In a study in Ketchikan in south-coastal Alaska, Smith (1983) found goats were most active between 51 and 65°. Steep terrain may only have sparse vegetation therefore Mountain Goats have adapted to consume a variety of forage (Shackleton 2013). Graminoids (grasses, sedges, and rushes), forbs, shrubs such as Snowberry (*Symphoricarpos albus*), and tree leaves and twigs from alder (*Alnus* spp.) and conifers may form part of the diet (Nietfeld et al. 1985; Smith 1983). Mountain Goats

may seek out mineral licks at mid to high elevations, but avoid those at low elevations (Poole and Heard 2003).

Winter habitat is considered the critical habitat for Mountain Goats. Although adapted to cold environments, goats still favour south-facing slopes which accumulate less snow due to their warmer aspect (MELP 2000). Mountain Goats often make extensive use of mature or old-growth forest areas with high canopy cover (50-60%) for snow interception (Smith 1983) but generally stay within 500 m of escape terrain (Poole and Heard 2003). Conversely, some research has shown that open areas such as burns or clearcuts may also be used in the winters with a low snowpack (Taylor et al. 2006). Winter forage includes Bunchberry (*Cornus canadensis*), Blueberries and Black Huckleberries (*Vaccinium* spp.), ferns (*Polypodium* spp.), Yellow Cedar (*Xanthocyparis nootkatensis*), Five-leaved Bramble (*Rubus pedatus*), Salmonberry (*Rubus spectabilis*), Hemlock (*Tsuga* spp.), lichens (*Lobaria* spp.), and mosses (Smith 1983). Gilbert and Raedeke (1992) reported coastal Mountain Goats in Washington State relied strongly on conifers for their winter diet when lower vegetation becomes inaccessible.

Summer habitat is less important than winter habitat. Warmer temperatures and absence of snow allow Mountain Goats to access higher elevation summer feeding areas where they aggregate to forage on short herbaceous vegetation (Nietfeld et al. 1985). Mountain Goats may be at risk of heat stress during high temperatures and goats may use areas with dirt or gravel substrates (Foster 1982) or other cool areas such as overhangs, caves, or canyons to avoid overheating (MELP 2000; MGMT 2010). Summer and winter habitats are usually located in the same area and Mountain Goats simply change their elevation, however migrations of up to 13 km have been reported (Poole and Heard 2003).

4.1.3 Study Area Distribution

Specific occurrences of Mountain Goats within or near the Project area are not mapped on distribution mapping compiled by E-Fauna BC (BC Conservation Data Centre 2016); however, other distribution maps indicate that they are present in the study area at moderate densities (Shackleton 2013). Mountain Goats are documented to occur in the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain-heather Alpine biogeoclimatic classification (BEC) zones, which occur within the study area. Within these zones, Mountain Goats are strongly associated with steep alpine and subalpine meadows and cliffs (Shackleton 2013). Baseline studies conducted near the Project include the Brucejack mine and the Kitsault mine projects. Both of these studies overlap with the RSA to a certain extent. Mountain Goats were observed in relatively high numbers during both studies (Rescan 2013; Amec 2011). The Ministry of Environment conducted aerial surveys for Mountain Goat on September 9, 2006 in management unit 6-14A and B. Management units 6-14A and B encompass a portion of the RSA west and north of the LSA as well as the entire LSA. A total of 22 observations with 41 Mountain Goats were made in the LSA and 61 observations of 142 Mountain Goats within the portion of the RSA covered by their surveys. Total Mountain Goat numbers for the September 9 2006 surveys was 183 (144 Adults and 39 Juveniles).

Elevational range of Mountain Goats varies by location, however Mountain Goats in BC can generally inhabit areas over 2,000 m (Innes 2011). Coastal Mountain Goats occupy lower elevations than interior populations (Hebert and Turnbull 1977). Foster (1982) documented Mountain Goats between 250 and 2,250 m in the Nass Range, with the majority of observations above the treeline. On the south coast of BC, Taylor et al. (2006) observed goats between 300 and 1,800 m depending on season, however most observations were between 600 and 1,200 m. Smith et al. (1983) observed goats between 150 and 760 m in coastal Alaska.

4.1.4 Habitat Suitability Modelling

4.1.4.1 Existing Habitat Models

Several habitat models have been developed for Mountain Goat. For a project approximately 65 km north-northwest of Stewart, Rescan (2013) performed habitat suitability modelling for Mountain Goat winter range. The model parameters included distance to escape terrain, aspect, elevation, and vegetation with the highest ratings for habitats that were on warm (southerly) aspects below 1,630 m that are within 75 m of escape terrain (barren areas with 40° to 70° slope). For another project approximately 125 km northwest of Stewart, RTEC (2010) modelled habitat using similar parameters to model both winter and summer habitat. Reid et al. (2004) incorporated similar parameters for modelling habitat in the Kispiox Forest District, but also included structural stage with the highest ratings for early seral (1 to 20 year old) forests which provide abundant herbaceous and coniferous forage, and old-growth (>120 year old) forests which also provide snow interception. The model described below is designed to identify and rate both summer and winter habitat. The full species account and habitat model description can be found in Appendix 2.

4.1.4.2 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Mountain Goat which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-1). Life Requisites include Feeding, Security, and Thermal.

Table 4-1. Life Requisites of the Mountain Goat within the Project area (near Stewart, BC) rated by month and season

Mountain Goat Life Requisites		
Month	**Season***	**Life Requisites**
January	Winter	Feeding/Security & Thermal
February	Winter	Feeding/Security & Thermal
March	Winter	Feeding/Security & Thermal
April	Growing (Early Spring)	Feeding/Security & Thermal
May	Growing (Late Spring)	Feeding/Security & Thermal
June	Growing (Summer)	Feeding/Security & Thermal

Mountain Goat Life Requisites		
Month	**Season***	**Life Requisites**
July	Growing (Summer)	Feeding/Security & Thermal
August	Growing (Summer)	Feeding/Security & Thermal
September	Growing (Early Fall)	Feeding/Security & Thermal
October	Growing (Late Fall)	Feeding/Security & Thermal
November	Winter	Feeding/Security & Thermal
December	Winter	Feeding/Security & Thermal

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.1.4.3 Wildlife Habitat Ratings

The attributes for suitable Feeding, Security, and Thermal Life Requisites in relation to specific ecosystem attributes are summarized in Table 4-2.

Table 4-2. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Mountain Goat

Mountain Goat Ecosystem Attributes	
Life Requisite	**TEM Attribute**
Feeding	• Site: site series, slope, aspect, site disturbance, elevation • Vegetation: % cover by layer, structural stage, and canopy closure
Security/Thermal	• Site: site series, slope, aspect, site disturbance, and elevation • Vegetation: % cover by layer, structural stage, and canopy closure

Habitat ratings for the Project LSA were based on a rating relative to the Provincial benchmark (Table 4-3) for the Coast and Mountains Nass Basin (NAB). Detailed information on Mountain Goat habitat requirements is available, therefore a 6-class rating scheme is used (Table 4-4).

Table 4-3. Provincial Benchmark habitat for Mountain Goat

Season	*Ecoprovince*	*Unit*	*BGC Subzone*	*Rating*
Growing	Coast and Mountains	NAR	AT AM - Alpine Meadow	B
Winter	Coast and Mountains	NAR	MHmm MF/6 - Mountain Hemlock-Amabilis Fir/RO - Rock	B

Source: Appendix H of BC Wildlife Habitat Ratings Standards (RIC 1999). Benchmarks are shown for each season. Benchmark for Southern Interior Mountains not shown. B = best overall benchmark habitat for the province.

Table 4-4. Relative suitability classes to be assigned to Mountain Goat habitat polygons (compared to the Provincial best)

Class	*Suitability*	*Lower Limit (%)*	*Upper Limit (%)*	*Relative Quality*
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

The habitat requirements for the Mountain Goat are summarized by season and structural stage in Table 4-5.

Table 4-5. Summary of habitat requirements for Mountain Goat by season and structural stage

Mountain Goat Habitat Requirements				
Season	*Food/Cover Life Requisite*	*Specific Life Requisite*	*Requirements*	*Structural Stage[1]*
Growing	Feeding (FD)	Living (Li)	High elevation, open alpine or subalpine meadows	1-3
Growing	Security (SH)		Steep, rocky slopes (40° to 70°) which provide escape terrain	1-3
Growing	Thermal (TH)		Topographic features (caves, overhangs, canyons) or old-growth forest cover, snow fields	1-3, 6-7
Winter	Feeding (FD)	Living (Li)	Forested areas with adequate forage	6-7
Winter	Security SH)		Steep, rocky slopes (40° to 70°) which provide escape terrain	1-3
Winter	Thermal (TH)		South facing slopes at lower elevation than during Growing season, mature forest with moderate to high canopy cover (50 to 60%)	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

4.1.4.4 Habitat Ratings Assumptions

During summer, security habitat is the most important feature for Mountain Goat habitat, followed by feeding habitat. Security habitat is escape terrain that has a slope of 40° to 70° with structural stage 1-3. Habitat quality decreases with distance from escape terrain and is Nil greater than 400 m away. Thermal cover is the least important

habitat requisite during the summer season during which time foraging occurs above the treeline. Access to food becomes much more important during the winter season and is equally as important as escape terrain. Thermal habitat is also more important but still secondary to food and security cover in winter. Winter thermal/security habitat includes areas with structural stage 6-7 with 50 to 60% canopy cover. Detailed ratings assumptions are provided in Tables 4-6 and 4-7.

Table 4-6. Detailed rating assumptions for Mountain Goat Living-Growing

Living – Growing (Li-G)	**General Habitat**	Steep mountainous terrain year round
	Key Habitat Requirements	
	Summer feeding areas are at high elevations and generally occur within 400 m of security habitat although the prime habitat is usually within 50 m. Summer diets of goats are more varied than in winter with a higher proportion of forbs, grasses, and sedges and less browse. Security habitat: Mountain Goats need steep (>80%) rugged terrain with cliffs, rock ledges, and talus slopes. Escape terrain should be within at least 400 m of forage sites (Schoen and Kirchoff 1981; Fox and Taber 1981) and most goats are found within 50 m of escape terrain.	
	Ratings	**Assumptions**
	1 (High) [76-100%]	CMAun, BAFun and MHmmp SS 1 – 3 All aspects with slopes >80%; and >10% vegetation cover
	2 (Mod. high) [51-75%]	CMAun, BAFun and MHmmp SS 1 – 3 All slopes and aspects within 400 m of escape terrain (>80%)
	3 (moderate) [26-50%]	MHmm1and 2 SS 1 – 3b All slopes and aspects within 100 m of escape terrain (>80%)
	4 (low) [6-25%]	MHmm1 and 2 SS 1- 3b All slopes and aspects within 100 – 400 m of escape terrain (>80%)
	5 (very low) [1-5%]	MHmm1 and 2 SS 4 - 7 All slopes and aspects within 100 m of escape terrain (>80%)
	6 (nil) [0%]	All units below 800 m; and All slopes and aspects >400 m from escape terrain

Table 4-7. Detailed Rating Assumptions for Mountain Goat Living-Winter

Living – Winter (Li-W)	**General Habitat**	Steep mountainous terrain year round
	Key Habitat Requirements	
	Winter feeding areas include wind-swept ridges (interior populations), steep cliffs, and high elevation, Mature and old-growth forests providing snow interception and adequate browse adjacent to escape terrain are key to coastal Mountain Goat winter ranges. Security habitat: Mountain Goats need steep (>80%) rugged terrain with cliffs, rock ledges, and talus slopes. Escape terrain should be within at least 400 m of forage sites (Schoen and Kirchoff 1981; Fox and Taber 1981) and most goats are found within 50 m of escape terrain.	
	Ratings	**Assumptions**
	1 (High) [76-100%]	MHmm1 and 2, CWHwm and ICHvc with: Structural stage (SS) 6-7 and; Escape terrain (> 80%) and; All slopes within 100 m of escape terrain; and Warm aspects (135 – 285°)
	2 (Moderately high) [51-75%]	MHmmp, MHmm1 and 2, CWHwm and ICHvc with: SS 6 – 7 and; Within 100 – 400 m of escape terrain (>80%) and: Warm aspects (135 – 285°)
	3 (moderate) [26-50%]	MHmmp, MHmm1 and 2, CWHwm and ICHvc with: SS 6 – 7 and Within 400 m of escape terrain (>80%) and Cool aspects (135 – 285°)
	4 (low) [6-25%]	MHmm1 and 2, CWHwm and ICHvc SS 4 - 5 All slopes within 400 m of escape terrain (>80%) and All aspects (135 – 285°)
	5 (very low) [1-5%]	MHmm1 and 2, and CWHwm SS 1 to 3 Cool aspects (285 - 135°)
	6 (nil) [0%]	CMAun and BAFun all units MHmmp in SS 1 - 5 All units greater than 400 m from escape terrain Permanent snow, ice field, and glaciers

4.1.4.5 Habitat Ratings Adjustments

Final ratings adjustment considerations included downward adjustments for less suitable structural stage, elevation, aspect, and distance to escape terrain. These adjustments have been included in the final wildlife habitat suitability ratings table (WHSR) found in Appendix 3-2. Since escape terrain is a key component of Mountain Goat habitat suitability the distance from escape terrain (slopes > 80%) was incorporated as a limiting factor to habitat suitability. Habitat suitability was downgraded based on distance from escape terrain (Tables 4-6 and 4-7) up to a maximum distance of 400m. Habitat greater than 400m from escape terrain was assumed to be nil value.

4.1.4.6 Habitat Suitability Modelling Results

The models developed for the Project identified suitable habitat for Mountain Goat during the growing (summer) season (LSA: Figure 4-1; RSA: Appendix 4-1) and the winter season (LSA: Figure 4-2; RSA: Appendix 4-2). Table 4-8 provides an area breakdown of each habitat class within the LSA and RSA. High and moderately high summer Mountain Goat habitat was identified throughout all areas of the RSA and LSA. Particularly high values were identified in the Marmot River and Kate Ryan Creek watersheds near Mount McLeod in the western portion of the RSA. Both the Kshwan and Sutton River watersheds in the southern portion of the RSA had both high and moderately high summer and winter habitat identified. The highest concentration of both summer and winter habitat in the eastern portion of the RSA was found in the Willoughby, Del Norte, and Nelson Creek watersheds and a smaller more isolated area of high suitability winter range was located in the upper reaches of the Flat River watershed. Both Surprise Creek and American Creek watersheds, in the northern portion of the RSA, showed abundant high and moderately high summer and winter habitat. Bitter Creek and the LSA, located relatively centrally within the RSA, have significant amounts of both high value summer and winter habitat.

Table 4-8. Habitat Suitability summary for each habitat class within both the LSA and RSA

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area[1] (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
Living-Growing	High	10,126	4.9	802	5.5	7.9
	Mod. High	33,290	16.2	1107	7.6	3.3
	Moderate	992	0.5	319	2.2	32.0
	Low	232	0.1	0.0	0.0	0.0
	Very Low	1,153	0.6	27	0.2	2.3
	Nil	191,787	77.7	12,340	84.6	6.4
Living-Winter	High	5,817	2.8	605	4.1	10.4
	Mod. High	6,850	3.3	879	6.0	12.8
	Moderate	7,878	3.8	787	5.4	10.0
	Low	1,530	0.7	437	3.0	28.5
	Very Low	8,482	4.1	646	4.4	7.6
	Nil	174,792	85.1	11,243	77.0	6.4

[1]Includes the area within the LSA

Summer Habitat within the LSA

High and moderately high suitability summer habitat of 1,909 ha (13.1%) was identified throughout the alpine (CMAun) ecosystems within the LSA (Figure 4-1). High value summer habitat is located on both sides of the Bitter Creek valley. Large patches of high and moderately high value habitat are found along the eastern side of Bitter Creek stretching from the Cambria icefield south of the proposed mine site all the way

north to Roosevelt Creek and Ore Mountain. Surveys during the 2015 and 2016 summer field seasons observed numerous Mountain Goats, trails, and other sign within these areas. A small patch of high value summer habitat identified by the model near the Bromely humps just above the toe of the Bromely glacier, was found to be covered with a very high density of Mountain Goat sign including beds, pellet groups, wallows, and scrapes. Steep escape terrain interspersed with Mountain Heather and other herbaceous alpine meadows occurs both immediately to the north and the south of the proposed administration and ancillary site along Goldslide Creek.

Winter Habitat within the LSA

Moderately high to high winter habitat was identified for 1,484 ha (10.1%) of the LSA (Table 4-8). Both high and moderately high value habitat was identified on the southwest facing slopes between Goldslide Creek and Rio Blanco Creek and between Rio Blanco Creek and Otter Creek. Some of this high value winter habitat lies within portions of the proposed access road. Due to the aspect, the vast majority of the Mountain Goat winter habitat is located on the eastern side of the Bitter Creek valley stretching from the proposed mine site at Goldslide Creek northward all the way to the south and west facing slopes of Ore Mountain above Clements Lake. The high and moderately high winter habitat was located at optimal distances from escape terrain that still provided adequate forest cover for maximum snow interception. The areas of high suitability winter range are generally located well above the proposed access route and transmission corridor except in the area around Goldslide Creek. Moderate suitability winter habitat was scattered throughout the LSA (5.4%) in areas of cooler aspects and greater distances from escape terrain. Provincially approved ungulate winter range U-6-002 identifies 2,418 ha (16.5%) of the LSA for Mountain Goat winter range. This corresponds to 2,271 ha (15.6%) of the LSA identified by our winter habitat suitability model as class 1 – 3 winter habitat.

4.1.4.7 Habitat Model Evaluation

As expected, the majority of the high and moderately high value habitat was identified in the higher elevation alpine and sub-alpine habitat. We compared the 2015/2016 field ratings (Appendix 3) to the model ratings and found that the winter suitability model agreed with the field ratings 85% of the time. Field and model ratings disagreement was based on areas where canopy closure was factored in to the field assessments; canopy closure was not a readily available layer that could be incorporated into the model. The field ratings that were in disagreement with the model ratings were all within one class (field ratings rated the habitat one class higher than the model). No further model modification was necessary for the LSA. Field verification was not conducted for the RSA, however the same model was used for both the LSA and RSA. The TEM data included detailed structural stage classes for each polygon, however the PEM data classified all polygons based on expected structural stage and lumped structural stages 5, 6 and 7 together. Since the Mountain Goat winter suitability model relied heavily on structural stage 6 and 7 (mature and old-growth) forests adjacent to escape terrain, a small overestimate of the available high suitability habitat likely occurred.

The summer habitat model verification was more complicated than the winter model. Forage values adjacent to escape terrain likely limited the model's ability to predict summer habitat in certain areas of the LSA. Large portions of the LSA are covered in bare rock or exposed soil where goats often bed down and spend significant amounts of time during the summer season. Based on foraging values adjacent to escape terrain, the habitat suitability model only agreed with the field ratings 47.5% of the time. 42.5% of the disagreement was a result of field ratings identifying habitat as class 1 (high) based on Mountain Goat sign observed in areas with either extremely sparse vegetation, bare soil, or rock, or Mountain Goat sign observed in areas with high forage value such as alpine meadows that were further away from escape terrain than the model allowed. These areas were not captured by the model due to the low forage values. This presented a problem with the model verification due to the inability to separate out some polygons or portions of polygons of bare rock, exposed soil, and other non-forage values that were still important to Mountain Goat summer habitat. In order to further evaluate the summer habitat model, we overlaid the results of the 2015 and 2016 summer Mountain Goat observations and found that 198 of the 277 observations (72%) were located within either High, Moderately High, or Moderately suitable (class 1 – 3) summer habitat. Inclusion of Mountain Goat observations on exposed soil, rock, and permanent snow resulted in 91.7% of observations in Class 1 – 3.

Figure 4-1. Mountain Goat Summer-Living habitat suitability map

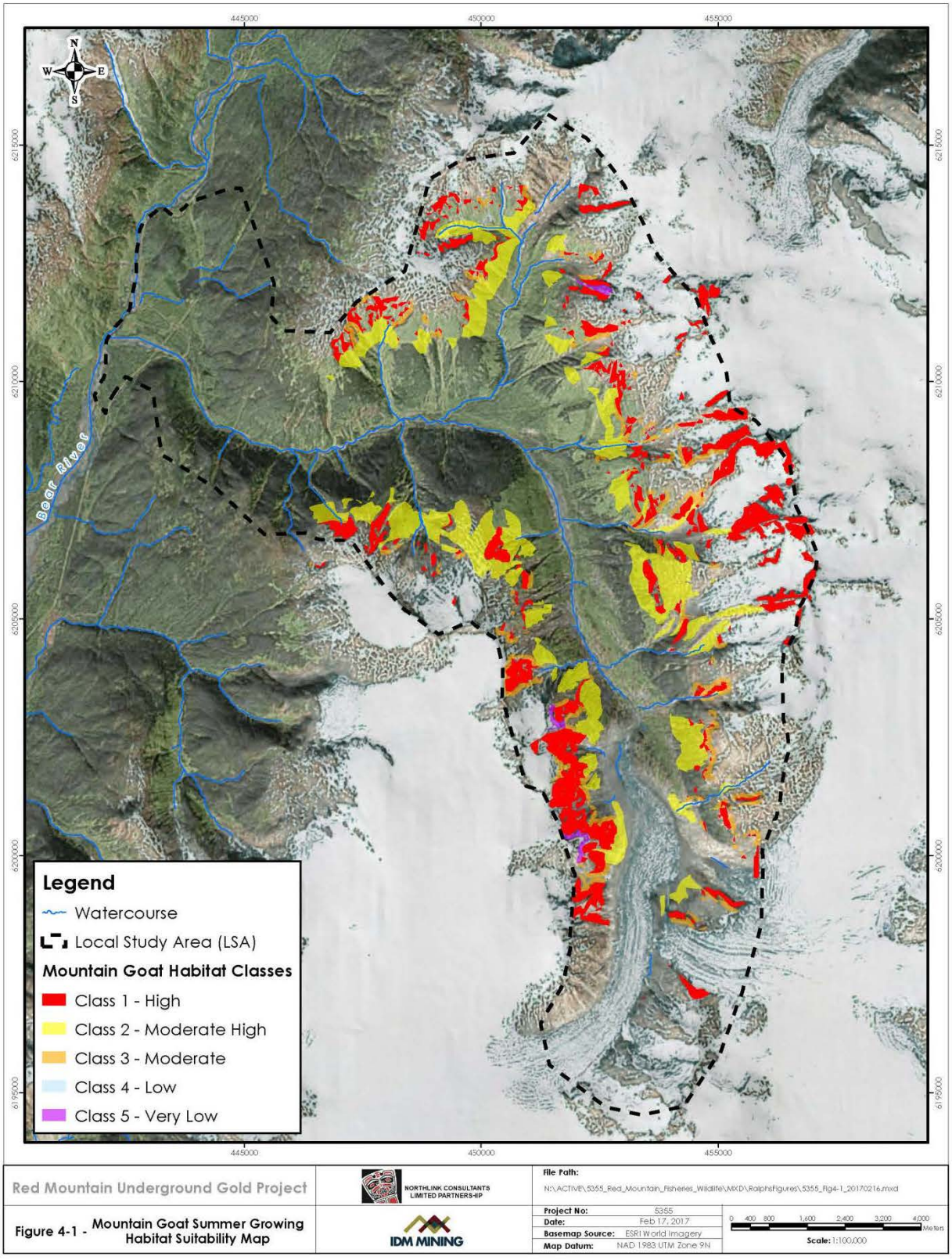
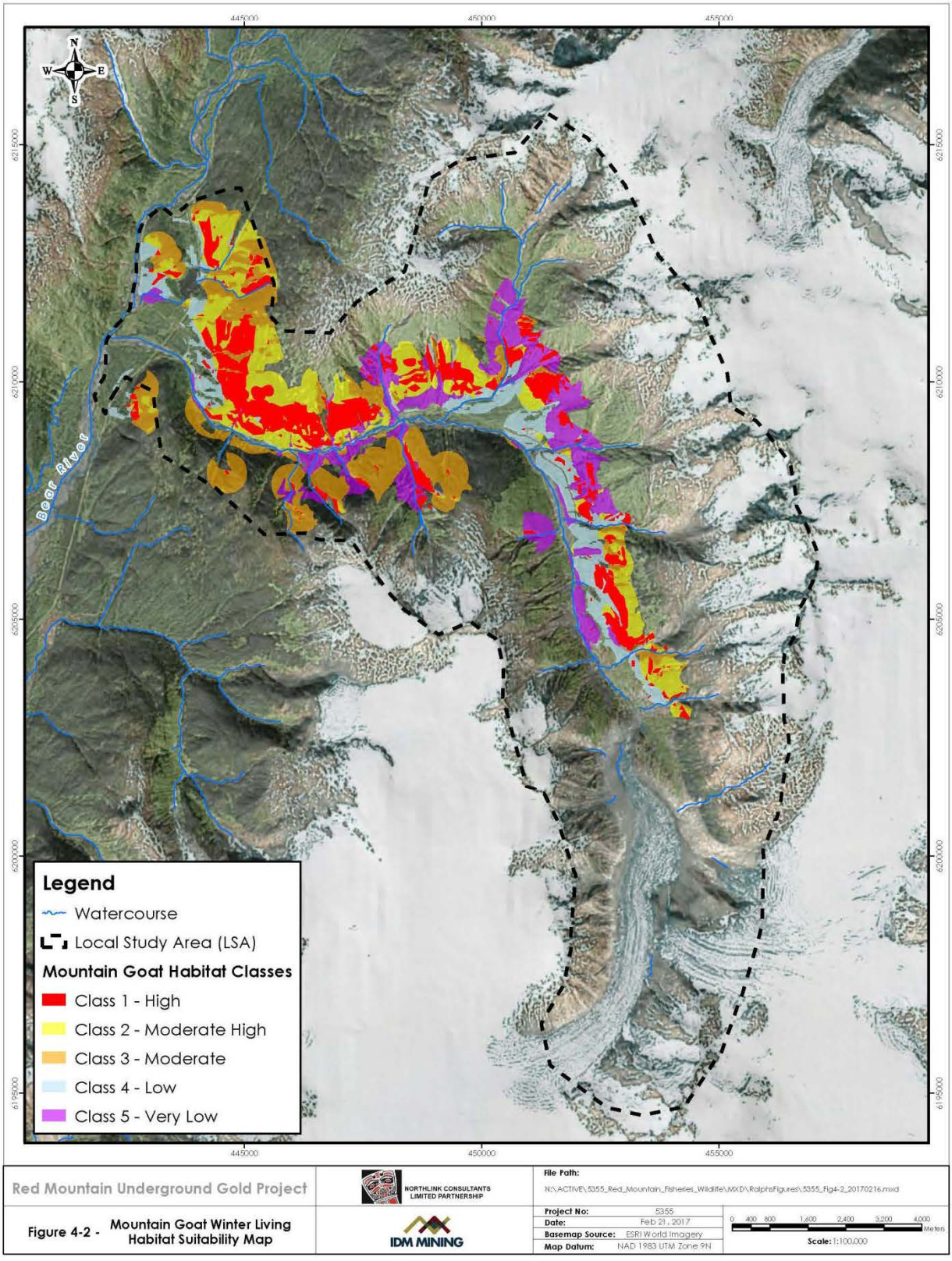


Figure 4-2. Mountain Goat Winter-Living habitat suitability map



4.1.5 Field Surveys

4.1.5.1 Aerial Surveys

Within the LSA, aerial surveys for Mountain Goat in 2015 were conducted in late summer (August 10 to 16) following protocols outlined in RIC (2002). Surveys concentrated on habitat above the treeline and flight lines were generally between 1,200 and 1,400 m elevation. Survey speeds ranged from 35 to 60 knots. Effective observation distances from either side of the flight line were estimated to be approximately 300 m. Aerial surveys were all conducted under ideal weather conditions with maximum visibility. A total of 65.6 km of flight lines were flown in 2015 resulting in an effective survey area of 39.4 km^2 (Table 4-9). Surveys across all four blocks within the LSA were conducted again during the early summer (June 6 to 8) and late summer (August 30) 2016. Aerial surveys once again focused on habitat above the treeline. In 2016, total early summer flight line distance was 55.5 km and late summer flight line distance was 92.5 km, resulting in a total effective survey area of 33.3 km^2 and 55.5 km^2 respectively. Table 4-10 summarizes the total number of Mountain Goat observations made within the LSA during aerial surveys in both 2015 and 2016. For a map of all goat observations made during 2015 and 2016 refer to Appendix 5.

Table 4-9. Mountain Goat LSA effective survey area summaries

	Survey Block	***Total Area (km^2)***	***Area above treeline (km^2)***	***Effective Survey Area (km^2)***
2016 Aerial Surveys	1	31.8	23.9	4.4 (3.9)*
	2	21.2	16.7	3.7 (3.2)*
	3	71.3	69.6	10.9 (13.7)*
	4	22.0	21.7	0.9 (5.2)*
2015 Aerial Surveys	1	31.8	23.9	7.7
	2	21.2	16.7	Not Surveyed
	3	71.3	69.6	27.8
	4	22.0	21.7	3.9

*Numbers in parentheses indicate late summer (August 30, 2016) survey effort.

Table 4-10. Summary of aerial Mountain Goat observations within the LSA

LSA	*Block*	*Total*	*Adults*	*Kids*	*Kidding (Kid/Adult)*	*Survey Area Density (Goats/km²)*	*Proportion of Total Summer Habitat Surveyed (%)*
2016 Aerial Surveys[1]	1	5 (33)	5 (30)	0 (3)	0 (0.10)	0.21(1.38)	31.0 (27.2)
	2	0 (1)	0 (1)	0 (0)	0 (0)	0 (0.06)	37.1 (32.9)
	3	31 (21)	22 (17)	9 (4)	0.41 (0.26)	0.45 (0.30)	26.2 (32.9)
	4	8 (11)	7 (11)	1 (0)	0.14 (0)	0.37 (0.51)	6.9 (40.1)
	Total	**105**	**98**	**17**			
2015 Aerial Surveys	1	15	9	6	0.67	0.40	53.5
	2	NS*	NS*	NS*	NS*	NS*	NS*
	3	36	32	4	0.13	0.40	66.5
	4	8	7	1	0.14	0.30	30.0
	Total	**59**	**48**	**11**			

[1]Numbers in parentheses indicate late summer (August 30 2016) survey

*NS = Not Surveyed

Mountain Goat aerial surveys within the RSA were conducted as part of the aerial overview flights. The northern half of the RSA was surveyed on July 9, 2016 and the southern half was surveyed on August 31, 2016. A total of 539.5 km of flight lines were flown in the RSA during the 2016 surveys, resulting in an effective survey area of 323.7 km² (Table 4-11). A total of 238 Mountain Goats (205 adults and 33 kids) were observed within the RSA in 2016 (Table 4-12; Map Appendix 5).

Table 4-11 Mountain Goat RSA effective survey area summaries

Survey Block	*Total Area (km²)*	*Area above treeline (km²)*	*Effective Survey Area (km²)*	*Proportion of total Summer Habitat Surveyed (%)*
1	23.9	31.8	Not Surveyed	Not Surveyed
2	16.7	21.2	Not Surveyed	Not Surveyed
3	69.6	71.3	Not Surveyed	Not Surveyed
4	21.7	22.0	Not Surveyed	Not Surveyed
5	72.0	53.2	2.8	5.2
6	33.1	28.9	17.4	60.3
7	58.1	57.8	20.6	35.5
8	45.1	45.0	15.6	34.8
9	77.5	64.8	8.6	13.3
10	31.8	25.3	9.0	35.5
11	44.2	44.0	15.6	35.5
12	50.7	43.1	14.1	32.8
13	103.2	81.7	17.5	21.4
14	122.0	120.0	18.5	15.4
15	44.3	43.9	5.2	11.9

Survey Block	*Total Area (km²)*	*Area above treeline (km²)*	*Effective Survey Area (km²)*	*Proportion of total Summer Habitat Surveyed (%)*
16	77.2	68.6	7.8	11.4
17	81.3	10.8	Not Surveyed	Not Surveyed
18	55.4	28.9	Not Surveyed	Not Surveyed
19	70.7	67.6	16.5	24.3
20	49.6	45.0	18.8	41.8
21	90.1	89.7	43.7	48.8
22	61.3	53.1	Not Surveyed	Not Surveyed
23	28.7	28.0	8.4	30.0
24	115.7	111.2	31.5	28.4
25	100.8	100.1	Not Surveyed	Not Surveyed
26	71.4	66.7	17.7	26.5
27	51.4	43.2	14.4	33.2
28	40.0	35.3	13.6	38.5
29	41.0	27.9	6.4	23.0
Total	**1,616.6**	**1,383.7**	**323.7**	**23.4**

Table 4-12. Summary of aerial Mountain Goat observations within the RSA

RSA	*Block*	*Total*	*Adults*	*Kids*	*Kidding (Kid/Adult)*	*Survey Area Density (Goats/km²)*	*Proportion of Total Summer Habitat Surveyed (%)*
2016 Aerial Surveys	1	NS*	NS*	NS*	NS*	NS*	NS*
	2	NS*	NS*	NS*	NS*	NS*	NS*
	3	NS*	NS*	NS*	NS*	NS*	NS*
	4	NS*	NS*	NS*	NS*	NS*	NS*
	5	0	0	0	0.00	0	5.2
	6	64	57	7	0.12	3.7	60.3
	7	50	40	5	0.11	2.4	35.5
	8	12	8	2	0.20	0.8	34.8
	9	6	2	2	0.50	0.7	13.3
	10	5	3	2	0.67	0.6	35.5
	11	24	19	5	0.26	1.5	35.5
	12	24	19	5	0.26	1.7	32.8
	13	6	4	1	0.20	0.3	21.4
	14	6	6	0	0.00	0.3	15.4
	15	0	0	0	0.00	0.0	11.9
	16	0	0	0	0.00	0.0	11.4
	17						Not Surveyed
	18						Not Surveyed
	19	17	15	2	0.13	1.0	24.3
	20	1	0	0	0.00	0.1	41.8

RSA	Block	Total	Adults	Kids	Kidding (Kid/Adult)	Survey Area Density (Goats/km²)	Proportion of Total Summer Habitat Surveyed (%)
	21	19	16	2	0.12	0.4	48.8
	22						Not Surveyed
	23	0	0	0	0.00	0.0	30.0
	24	4	4	0	0.00	0.1	28.4
	25						Not Surveyed
	26	0	0	0	0.00	0.0	26.5
	27	0	0	0	0.00	0.0	33.2
	28	0	0	0	0.00	0.0	38.5
	29	0	0	0	0.00	0.0	23.0
	Total	**238**	**205**	**33**			**23.4**

*NS = Not Surveyed

4.1.5.2 Mountain Goat Observation Stations

Mountain Goat observations were collected from fixed locations ("observation stations") during the July 2016 field visit. Effective survey areas (Table 4-13) for each block were estimated based on line of sight to all areas above the treeline. Summer Mountain Goat habitat was assumed to be all habitat above the treeline. A total of 113 Mountain Goats (95 adults and 18 kids) were observed from the fixed observations stations (Table 4-14; Map Appendix 5).

Table 4-13. Observability estimates and effective survey areas of each survey block

	Survey Block	Total Area (km²)	Area above treeline (km²)	Estimated Observability (%)	Effective Survey Area (km²)
2016 Observation Stations	1	31.8	23.9	60	14.3
	2	21.2	16.7	50	8.4
	3	71.3	69.6	75	52.2
	4	22.0	21.7	75	16.3

Table 4-14. Summary of Mountain Goat observations within the LSA from the fixed observation stations

LSA	Block	Total	Adults	Kids	Kidding (Kid/Adult)	Survey Area Density (Goats/km²)	Proportion of Total Summer Habitat Surveyed (%)
2016 Observation Stations	1	13	11	2	0.18	0.90	60
	2	5	3	2	0.67	0.60	50
	3	59	46	13	0.28	1.13	75
	4	36	35	1	0.03	2.20	75
	Total	**113**	**95**	**18**			

4.1.5.3 Ground Surveys

Habitat Plots

Mountain Goat habitat was assessed in the field during both the 2015 and 2016 field visits. Field verification of the preliminary wildlife habitat ratings was carried out on August 10 to 16, 2015. A total of 37 Mountain Goat habitat plots were established throughout the study area in conjunction with the TEM polygon assessments. Full Site Visit Forms (FS1333) and Wildlife Habitat Assessment Forms (FS882_5) were completed at each Mountain Goat Habitat Plot. A summary of field ratings is presented in Table 4-15. Visual assessments were conducted throughout the remaining 22 TEM polygons during travel between wildlife habitat plots. Visual assessments of the remaining polygons included verification of structural stage and dominant tree species, and inspection for evidence of use (Figure 4-3 and 4-4) by wildlife (both for modelled species and other incidental observations).

Table 4-15. Summary of field ratings of habitat plots

Mountain Goat Habitat Plot	*Zone*	*Easting*	*Northing*	*Habitat Field Rating Living-Growing*	*Habitat Field Rating Living-winter*	*Evidence of Use*
RM-01	9	444456	6209219	6	3	none
RM-02	9	452127	6205928	6	6	none
RM-03	9	452280	6205968	6	3	none
RM-04	9	444278	6210060	6	4	none
RM-05	9	444384	6210046	6	4	none
RM-06	9	444055	6210370	6	6	none
RM-07	9	443828	6210347	6	6	none
RM-08	9	443421	6210169	6	6	none
RM-09	9	443951	6210175	6	6	none
RM-10	9	443829	6210814	6	6	none
RM-11	9	443727	6210779	6	6	Black Bear bed and scat
RM-12	9	443586	6210744	6	6	Black Bear scat
ORAM-1	9	456801	6202423	3	6	Horned Lark
ORAM-2	9	456861	6201936	3	6	ORAM[1] scat (3), ORAM tracks (4A, 1J)
ORAM-3	9	456210	6201878	2	6	ORAM tracks (4A, 1J)
ORAM-4	9	456191	6201955	1	6	ORAM scat (2)
ORAM-5	9	456040	6201875	2	6	ORAM scat (11), ORAM tracks (3), ORAM beds (1), ORAM hair
ORAM-6	9	455757	6201748	2	6	ORAM beds (3),

Mountain Goat Habitat Plot	***Zone***	***Easting***	***Northing***	***Habitat Field Rating Living-Growing***	***Habitat Field Rating Living-winter***	***Evidence of Use***
						tracks (8)
ORAM-7	9	456265	6202954	6	6	none
ORAM-8	9	455082	6201950	2	5	ORAM tracks (6), well-worn trail, nanny with kid
ORAM-9/RM13	9	456719	6201613	1	6	ORAM tracks (3)
ORAM-10	9	456191	6201226	1	6	ORAM scat (1), track (1), wallow (1)
ORAM-11	9	456101	6201055	2	6	ORAM tracks (7), wallow (1)
ORAM-12	9	454944	6204017	1	6	ORAM tracks (2), trail (1), mineral lick (1)
ORAM-13	9	453882	6201555	2	2	ORAM scat (30+), beds (10+)
RM-14	9	455812	6201790	1	6	ORAM scat (2)
RM-15	9	454614	6203927	1	5	ORAM scat (3)
RM-16	9	453937	6201590	1	3	ORAM scat (10+)
RM-17	9	541699	6207409	6	6	nil
RM-18	9	451833	6207473	6	6	nil
RM-19	9	446641	6211008	1	5	ORAM tracks (10-12)
RM-20	9	445584	6210351	3	1	nil
RM-21	9	445399	6210212	4	1	nil
RM-22	9	445130	6210147	4	2	nil
RM-23	9	444948	6210028	4	2	nil
ORAM-14	9	446965	6211099	1	6	8 ORAM adults bedded down on bare soil/gravel slope
ORAM-15	9	454874	6201561	1	6	ORAM tracks (15)

[1]ORAM is the four letter species code for Mountain Goat

Figure 4-3. Habitat plot with Mountain Goat hair

Wildlife Cameras

Wildlife cameras detected Mountain Goats 2,072 times at four different locations throughout the LSA (Table 4-16). All cameras except camera TC 3 were located in the CMAun in Alpine Heath habitat. Camera TC 3 was located within the MHmmp zone just below the CMAun zone and is most likely along a trail that is used to access Mountain Goat winter habitat. All cameras that had goat detections (Table 4-16) were located less than 200m from escape terrain. Cameras TC4, 8, 9 and 10 were specifically set up to monitor Mountain Goat activity. During the field surveys in 2016 it became evident that there is significant Mountain Goat movement between portions of their summer range to the north of Goldslide Creek (where the current mine camp is located) and areas to the south above the Cambria icefield and the Bromely Glacier. Mountain Goat detections at wildlife cameras TC 4 and 9 confirmed activity on both sides of Goldslide Creek during July and August of 2016. Significant goat movement was documented in June 2016 from Camera 4 moving toward and away from the direction of Camera TC 9. Camera TC 10 was set up approximately 2.1 km north of the

temporary mine camp at Goldslide Creek in order to monitor undisturbed goat activity. Mountain Goat activity at Camera TC 10, during the same period, remained high and unchanged compared to Cameras TC 4 and TC 9. The back and forth movement decreased considerably toward the end of June. It is unclear whether or not this is due to seasonal preferences in specific areas of their summer range or coincidental with an increase in human activity at the temporary mine camp at Goldslide Creek.

Table 4-16. Summary of Mountain Goat detections by wildlife cameras

Wildlife Camera	*Location*	*Elevation (m)*	*Date Range (2016 field season only)*	*# Adults*	*# Kids*
TC 3	9 U 454160 6201738	1008	June 6 – August 31	42	12
TC 4	9 U 455018 6201801	1530	June 7 – August 31	928	234
TC 9	9 U 455430 6200395	1390	July 5 – August 31	238	30
TC 10	9 U 455069 6203681	1570	July 6 – August 31	488	100

Note: All cameras were deployed from June 4 to August 31, 2016.

Figure 4-4. Two nannies with kids (born this year) taken with wildlife camera TC4, feeding on Mountain Heather/Sedge/Lichen complex. Equipment from previous mining efforts in background.

Incidental Observations

Incidental observations of Mountain Goat and evidence of use were found throughout the higher elevations in the LSA on both sides of the Bitter Creek valley (Appendix 5-3 and 5-3a). Notable observations included several mid to lower elevation observations of tracks, hair beds, and scat indicating late winter and early spring use. Fresh tracks (less than one week old) and goat hair were observed on June 2016 in the valley bottom within the CWHwm BEC zone (UTM 9 V 447551 6209006). The tracks were heading downslope toward the river and across the gravel bar in the Bitter Creek valley, possibly indicating movement from the east side of the valley to the west side. Mountain Goat trails were observed at various locations within the LSA. Many of the trails are well worn (such as the trail in Figure 4-4 above) indicating years of repeated use. A map of the trails located during the 2015/2016 summer surveys can be found in Appendix 5-3a.

4.1.6 Conclusions

Overall, the LSA provides abundant habitat for both Mountain Goat winter and summer life requisites. The highest quality habitat (class 1 and 2) is associated with topographical features adjacent to vegetation that provides an ideal matrix of forage opportunities in close proximity to escape terrain. Approximately 16% of the LSA is in suitable winter range for Mountain Goats compared to only 9.9% within the RSA. The RSA contains much more gentle terrain especially along the eastern boundary near Meziadin Lake that is less suitable for Mountain Goats. Within the RSA over 80% of the habitat was rated very low to nil for both summer and winter which was similar to the LSA. Occupancy was verified throughout the summer habitat within the LSA during ground and aerial surveys. Occupancy of winter habitat was also observed on the ground, although at a much lesser rate due to the inaccessible nature of the escape terrain that goats utilize. Very high habitat use was observed in several places within the LSA. Most notably, the area around the proposed administration and ancillary site near Goldslide Creek was heavily used by goats during the summer. Goats were observed foraging above the current mining camp, and trails and fresh tracks indicated travel from north to south and vice versa along well established trails that crossed Goldslide Creek just downstream of the current mining camp site. This movement pattern extends northward toward Roosevelt Creek and the entire east side of the Bitter Creek valley is heavily utilized.

4.2 Grizzly Bear

4.2.1 Identification and General Ecology

Grizzly Bears are large, omnivorous mammals. They are predominantly crepuscular, although may be active at any time during the day or night (BC Conservation Data Centre 2016). In the Khutzymateen Valley just north of the Project area, Grizzlies were

found to be mainly diurnal in areas of low human use (MacHutchon et al. 1998). Home ranges of Grizzly Bears vary individually and geographically, however they follow a general rule that home range size is negatively correlated with habitat quality (Ross 2002). The abundance of high quality food and habitat results in coastal Grizzly Bears having smaller home ranges than interior bears (Hamilton and Bunnell 1987, MacHutchon et al. 1993). Male home ranges are larger than females and often overlap with the home ranges of many females (MacHutchon et al. 1993; McLoughlin et al. 1999; Gyug et al. 2004).

Breeding can occur quite soon after emergence from the dens, usually between late April and late June, and cubs are born between January and March during the denning period. Female Grizzly Bears have their first offspring when they are 5 to 7 years old and average litter size in the Project area is 2.4 cubs (MacHutchon et al. 1993). Grizzly Bears are mainly solitary animals aside from the social interaction within sibling groups and between mother and offspring, who stay together for multiple years (approximately 2.5) (Gyug et al. 2004).

4.2.2 Habitat

Grizzly Bears are opportunistic omnivores whose diet varies spatially and seasonally. In general, herbivory is the main feeding, with bears consuming a variety of plant types including roots, green vegetation, and berries (Gyug et al. 2004). The percent of meat in the diet is dependent on season, location, and availability, and it is generally preferred over readily available plant foods (Hilderbrand et al. 1999).

Grizzly Bear habitat selection and movements are reflective of food availability (Hamilton 1987). While some similarities exist, coastal and interior bears can be very different in terms of habitats used and foods consumed (Ross 2002, Gyug et al. 2004). For interior populations, plant roots and ungulate meat are important diet components in the early spring and late in the fall, while green vegetation is eaten throughout the summer and berries compose a key component in late summer (McLellan and Hovey 1995). Coastal bears feed on early season green vegetation after den emergence until early summer when berries begin to ripen and become the main food source. In fall, salmon becomes the primary food source (MacHutchon et al. 1993, Gyug et al. 2004). Coinciding with the location of preferred foods, coastal bears spend the majority of their active periods on forested low elevation mountain slopes, south facing avalanche slopes, and valley bottoms (Hamilton 1987, MacHutchon et al. 1993, Schoen et al. 1994). See Table 4-17 for an overview of important Grizzly Bear habitat features.

Table 4-17 Important habitat features for coastal Grizzly Bears used for each season

Season	*Habitat Features*[1]
Winter	Steep slopes, mid-high elevations, soil that stays frozen in winter, open canopy old-growth forest, large root masses or other vegetation that stabilizes the den's roof

Season	*Habitat Features[1]*
Spring	Avalanche tracks, estuaries, non-forested wetlands, and mature to old-growth forest
Summer	Early seral to old-growth floodplains, climax (mature and old-growth) Hemlock dominated forests
Fall	Salmon streams, young seral to old-growth floodplains, and climax (mature and old-growth) Hemlock dominated forests

4.2.3 Study Area Distribution

There are approximately 15,000 Grizzly Bears in BC that occupy an estimated 84% of the province (Mccrory et al. 1990, MFLNRO 2012). Grizzly Bears are found in every forest region and every biogeoclimatic unit except for Bunchgrass (BG) and Coastal Douglas Fir (CDF). They are not found on Vancouver Island or Haida Gwaii and are considered extirpated in southern and south-central areas of the province (Gyug et al. 2004).

Grizzly Bears are well documented in BC through observations and harvest records (BC Conservation Data Centre 2016). The Project RSA and LSA are entirely within the Stewart Grizzly Bear population unit which encompasses 1, 174,043 ha from Kincolith in the south, along the Nass River and Meziadin Lake to the east, up to Ningunsaw Park in the north over to the Canada and Alaska border along the Portland Canal to the west. There are an estimated 358 individuals in the Stewart Population Unit which is considered viable (MFLNRO 2012). Grizzly Bears are known to the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain Heather Alpine (CMA) biogeoclimatic classification (BEC) zones, which occur within the study area (BC Conservation Data Centre 2016). As habitat generalists they may be found in many different habitat types within these zones depending on the season (COSEWIC 2012).

4.2.4 Habitat Suitability Modelling

4.2.4.1 Existing Habitat Models

Numerous Grizzly Bear habitat mapping projects have been completed in BC along the coast and coast interior transition since 1999. MacHutchon (2007) lists 15 different projects between 1999 and 2007 mapping Grizzly Bear habitat and rating habitat polygons. These projects developed a range of mapping products including Standard TEM mapping to Grizzly Bear habitat polygons with buffers. In 2007, MacHutchon developed the draft Mapping Methods for Important Coastal Grizzly Bear Habitat. These mapping methods form the basis for the Grizzly Bear habitat model development for the Project.

4.2.4.2 Habitat Use – Life Requisites and Seasons

Five seasons are rated for Grizzly Bear: early spring, late spring, summer, fall, and winter. Life requisites for each month are outlined in Table 4-188.

Table 4-18. Monthly life requisites for Grizzly Bear near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Early Spring	Feeding/Security & Thermal
May	Late Spring	Feeding/Security & Thermal
June	Summer	Feeding/Security & Thermal
July	Summer	Feeding/Security & Thermal
August	Summer	Feeding/Security & Thermal
September	Fall	Feeding/Security & Thermal
October	Fall	Feeding/Security & Thermal
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC, 1999)

Grizzly Bear feeding habitat is considered the most important life requisite considering that habitat selection in the growing season (spring, summer, and fall) is reflective of food availability. For this reason, habitat ratings primarily depend on feeding habitat.

Grizzly Bear emergence from hibernation occurs from mid to late April. Southerly and west facing slopes and openings including meadows and low elevation avalanche chutes provide the most abundant early season green-up of vegetation (MacHutchon 2010). After emergence, individuals move down avalanche chutes and feed on emerging herbaceous vegetation and then on emerging herbs, sedges, and Skunk Cabbage (*Lysichiton americanum*) in valley bottoms (MacHutchon et al. 1993). Feeding in late spring is similar to early spring, with sedges still dominating the diet and herbaceous vegetation becoming a larger part of the diet as vegetation begins to grow. MacHutchon et al. (1993) defines three seasons of activity for Grizzly Bears on the North Coast; the first combines early and late spring and lasts from den emergence until berries are the predominant food item.

During summer, the main food types for Grizzly Bear are berries; therefore bears are associated with the floodplain and low elevation slopes that support these fruiting shrubs. Most commonly consumed species include Red Elderberry (*Sambucus racemosa)*, Devil's Club (*Oplopanex horridis)*, and Stink Current (*Ribes bracteosum)* (MacHutchon et al. 1993). At higher elevations huckleberries and blueberries (*Vaccinium* spp.) are important all the way up the slope to the alpine as the season progresses. Important berry producing species in the high alpine include Crowberry (*Empetrum nigrum*) and Lingonberry (*Vaccinium vitis-idaea*). Additional plants consumed during summer include *Umbelliferae* spp., Hedge Nettle (*Stachys* spp.), Stinging Nettle (*Urtica dioica)*, Common Touch-me-not (*Impatiens noli-tangere)*,

horsetail (*Equisetum* spp.), Skunk Cabbage, and Lady Fern (*Athyrium filix-femina*). Grizzlies can be found within 0 to 150 m of class 1 streams during this time (MacHutchon et al. 1993).

Salmon species are the main component of diets in the fall and, like in summer, bears are concentrated in the areas near salmon bearing streams. Bears consume both fresh and dead salmon when available. Additional foods eaten in the fall include Skunk Cabbage, Cow Parsnip (*Heracleum maximum*), and various berries.

Alpine and subalpine habitats with deep soils are considered important for hibernation. Dens are generally located at high elevations in areas of high snowfall and low snowmelt. Most excavated dens tend to be located on slopes from 55 to 90% (Harding 1976; Ciarnello et al. 2005). Most dens are situated in specific areas to ensure an early and long lasting snow cover to provide adequate insulation. MacHutchon (2007) speculates that snow cover for insulation may not be as important on the coast. Instead, colder aspect slopes at elevation where freezing remains constant and snow melt seepage is minimized may be more important. Excavated den sites generally consist of steep well-drained slopes with high density matted vegetation such as Mountain Heather and various herbs and shrubs that provide dense root structure to support the den roof.

4.2.4.3 Wildlife Habitat Ratings

Habitat features present in the Khutzymateen Valley as outlined by MacHutchon (2007) were used as the benchmark for Grizzly Bear habitat ratings (Table 4-19).

Table 4-19. Relative suitability classes to be assigned to Grizzly Bear habitat polygons

Class	*Suitability*	*Lower Limit (%)*	*Upper Limit (%)*	*Relative Quality*
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

Detailed information on Grizzly Bear habitat requirements is available, therefore a 6-class rating scheme is used (Table 4-13). Table 4-20 outlines the general habitat attributes for Grizzly Bear within the season of use. Detailed habitat assumptions for Grizzly Bear habitat suitability are described in Tables 4-21 through 4-25.

Table 4-20. Summary of general habitat attributes for Grizzly Bears

Habitat Use	*Attributes of Suitable Grizzly Bear Habitat*	*Structural Stage[1]*
Early Spring (PE) Feeding	• High forage plant diversity in lush herb layer with an abundance of skunk cabbage, grasses, sedges, horsetails, cow parsnip, angelica, stinging nettle, etc. • Floodplains, estuaries, valley bottoms, and warm aspect lower slopes of avalanche chutes with moist to wet soil moisture regimes and rich soil nutrient regimes	2-3, 6-7
Late Spring (PL) Feeding	• Similar to PE with additional shrubs and herbs greening up; salmonberry, thimbleberry, and devil's club new shoots • Warm sites as snow recedes up the hillside, mesic to hygric wetlands, floodplains, avalanche chutes	2-3, 6-7
Summer (S) Feeding	• Fruit producing shrubs and herbaceous plants are the main source of food. • High use habitats are submesic to hygric sites with medium to rich soil moisture regimes. • Young seral, mature seral, and old-growth floodplain forests, avalanche chutes with berry-producing shrubs, and open forest alluvial fans	3, 6-7
Fall (F) Feeding	• Salmon spawning areas and adjacent forests • Berry-producing forests close to salmon streams, e.g., floodplain forests, and avalanche chutes with berry-producing shrubs • Moist or wet forests with skunk cabbage • Some bears will move into sub-alpine areas with berry production.	3, 6-7
Security/ Thermal Cover	• Mixed young seral >2 m • Mixed conifer/deciduous older forest (5-7) • Mature to old conifer • Shrub cover >50%	3b, 5-7
Hibernating Habitat	• Dry, moisture-shedding site • Higher elevation (at or above treeline) • Steep slopes (30° - 40°) • Cool aspects (285° - 135°) • Heavy matted vegetation layer providing support to den roof	6, 7

Source: Adapted from MacHutchon (2007)

1 Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

4.2.4.4 Habitat Ratings Assumptions

General Rating Assumptions:

- Feeding habitat is the most important limiting factor for Grizzly Bear in the study area.

- Disease, intra-/inter-specific competition, hunting, and predation all affect Grizzly Bear population growth, viability, and distribution. This suitability model does not include these factors.
- Intra-specific competition/interactions and potential for human conflict greatly influence Grizzly Bear habitat use. The suitability model does not include these factors.

Detailed Rating Assumptions Early Spring Feeding Habitat (P_E-FD)

The detailed ratings assumptions for the LSA and RSA are listed in Table 4-15.

- Estuaries, low elevation (<600 m) wetlands, and low elevation (<600 m) avalanche chutes are rated as class 1.
- Low elevation riparian flood plains are rated class 2.
- Wet Forest Units with the presence of skunk cabbage, horsetails, cow parsnip, and other important forage species are rated class 3 for structural stages 2 or 3, class 5 for structural stages 4 and 5, and class 4 for structural stages 6 and 7.
- Dry to mesic forest units are rated class 4 for structural stages 6 and 7 and class 5 for structural stages 4 and 5.
- Roads, landings, or other grass covered openings are rated class 3 for early vegetation green-up but are adjusted down due to lack of security cover (see ratings adjustments).
- Openings in structural stage 2 or 3 are rated class 3.
- All areas above 600 m rated class 6.
- All other areas are rated class 6.

Detailed Rating Assumption for Late Spring Feeding Habitat (P_L-FD):

- Similar to Early Spring but assume slight shift to use of forage plant green-up from openings to underneath more mature forest canopy.
- Also slight shift in elevation up to 900 m.
- Estuaries, wetlands, and warm aspect avalanche chutes are rated class 1.
- Wet (subhydric) swamp forests with presence of skunk cabbage, horsetails, cow parsnip, or other forage plant species are rated class 2.
- Dry to mesic forest units are rated class 4 for structural stages 6 and 7 and class 5 for structural stages 4 and 5.
- Roads, landings, or other grass covered openings are rated class 3 for early vegetation green-up but are adjusted down due to lack of security cover (see ratings adjustments).
- Cutblocks in structural stage 2 or 3 are rated class 3.
- All other areas are rated class 6.

Detailed Ratings Assumptions for Summer Feeding Habitat (S-FD)

The detailed ratings assumptions for the LSA and RSA are listed in Table 4-16.

- Polygons in the MHmm1, MHmmp, and CMAun with large openings and berry producing shrubs are rated class 1.
- Dry to wet forest units (CWH and MH) with berry producing shrubs in structural stages 2 and 3 are rated class 2. Similar units in structural stage 6 or 7 are rated class 3.
- Floodplain forest units are rated class 2 if they are in structural stage 3 and class 3 if they are in structural stage 6 or 7. Structural stage 4 and 5 are rated class 5.
- Wet meadows/fens are rated class 4.
- Cutblocks in structural stage 2 or 3 are rated class 2.
- All other areas are rated class 6.

Detailed Rating Assumptions for Fall Feeding Habitat

The detailed ratings assumptions for the LSA and RSA are listed in Table 4-17.

- Salmon spawning streams are rated class 1.
- Floodplain forests (all structural stages) within 100 m of salmon spawning streams are rated class 1.
- All other habitat within 100 m of salmon spawning stream are adjusted up by a maximum of two rating classes.
- Floodplain forests in structural stages 2/3 and 6/7 are rated class 2.
- Openings (structural stages 2-3) and mature forests (structural stages 6-7) with berry producing shrubs are rated class 2.
- Wet (subhydric) swamp forests in structural stage 6 and 7, with presence of skunk cabbage, horsetail, cow parsnip, or other forage plant species, are rated class 2.
- Openings in structural stage 2 or 3 are rated class 4.
- Openings in structural stage 4 or 5 are rated class 5.
- All other areas are rated class 6.

Table 4-21. Detailed Early Spring habitat assumptions within the LSA

Grizzly Bear Early Spring Feeding Habitat	
Ratings	**Assumptions**
1 (High) [76-100%]	• CWHwm and ICHvc Structural stages 1 -3a (<600 m elevation) • Avalanche chutes with warm aspect (135 - 285°) • Low elevation wetlands (<600m).
2 (Moderately high) [51-75%]	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species:

Grizzly Bear Early Spring Feeding Habitat	
Ratings	**Assumptions**
	o CWHwm 04, 08 & 09 o ICHvc 03, 04, 05, & 06 • Low elevation (<600m) meadows, fields, right of ways, landings and other grass covered openings
3 (moderate) [26-50%]	• Low Elevation (<600 m) Riparian flood plains o CWHwm 05, 06, & 07 • Cutblocks and other openings in structural stage 2 or 3
4 (low) [6-25%]	• Wet forest units in structural stages 4 or 5 that have skunk cabbage, horsetails, cow parsnip, and other important forage species:
5 (very low) [1-5%]	• Dry to mesic forest units (Site series 01 – 04 in all BEC zones) in structural stages 4 to 7
6 (nil) [0%]	• All other habitats not listed above • All habitat above 600 m elevation

Table 4-22. Late Spring habitat ratings assumptions

Grizzly Bear Late Spring Habitat	
Ratings	**Assumptions**
1 (High) [75-100%]	• CWHwm Structural Stage 2-3 o 04, 05, 06, 07, 08, 09 • ICHvc Structural Stages 2-3 o 01, 01/02, 03, 04, 04/05, • Avalanche Chutes with warm aspect (135 - 285°) • Low elevation (<1,000 m) meadows, fields, right of ways, landings and other grass covered openings, • Meadows • Wetlands
2 (Mod. high) [50—75%]	• Wet forest units in structural stages 5/6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 08 & 09 o ICHvc 03, 04, 05, 06, & Fm03 • Wet forest units in structural stages 2-3 and 5-7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o MHmm1 03, 05, 06, 07 & 09 o MHmm2 05, 06, 07, & 09
3 (moderate) [25-50%]	• Mid Elevation (<1,000 m) Riparian flood plains o CWHwm 05, 06, & 07 o ICHvc Fl02 • Cutblocks in structural stage 2 or 3 • Roads, landings, or other grass covered openings • Avalanche chutes with cool aspect (285° to 135°)
4 (low) [5-25%]	• Wet forest units in structural stages 4 or 5 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09 o ICHvc 03, 04, 05, 06, & Fm03 o MHmm1 03, 05, 06, 07 & 09 o MHmm2 05, 06, 07, & 09
5 (very low) [1-5%]	• Dry to mesic forest units in structural stages 4 and 5 (Site series 01 – 04 in all BEC zones)
6 (nil) [0%]	• All other habitats not listed above • All habitat above 1,000 m

Table 4-23. Summer Habitat Ratings Assumptions

Grizzly Bear Summer Habitat	
Ratings	**Assumptions**
1 (High) [75-100%]	• Polygons with large openings (SS 2 & 3) and berry producing shrubs: o CWHwm 01, 03, 04 and 08 o ICHvc 01, 02 o MHmm1 & 2 and mmp 01, 02, 05, and 06 • Salmon spawning streams
2 (Mod. high) [50—75%]	• Dry to Wet Forest units with berry producing shrubs in structural stages 2 – 3 and 6-7: o CWHwm: 01, 03, 04 and 08 o ICHvc: 01, 02, 04, 06 o MHmm1 & 2: 01, 02, 04 and 06 o MHmmp • Riparian forest units in structural stage 3 within 100 m of water
3 (moderate) [25-50%]	• Wet meadows: o CMAun 00-Ah, 00-Am, , 00-Sk o MHmmp 00-Hm, 00-Sk, 00-Sc, 00-Vh, and 00-Vs o MHmm1 Wf50 and Fm50 • Wetlands Ws51 • Avalanche Chutes
4 (low) [5-25%]	• Wet forest units in structural stage 4 -7 o CWHwm 05 to 09 o MHmm1 05 – 07
5 (very low) [1-5%]	o Drier Forested Sites Structural Stage 4 o CWHwm 01 to 04 o MHmm1 01 to 04
6 (nil) [0%]	• All other habitats not listed above

Table 4-24. Fall Habitat Ratings Assumptions

Grizzly Bear Fall Habitat	
Ratings	**Assumptions**
1 (High) [75-100%]	• Salmon spawning streams • Floodplain forests (all structural stages) within 100 m of salmon spawning streams
2 (Mod. high) [50—75%]	• CWHwm, ICHvc and MHmm1 & 2 with: o Floodplain forests in structural stages 2, 3, 6 OR 7; or o Cutblocks and structural stage 3 natural openings with high percentage cover (> 50%) of berry producing shrubs (SS 3) in: ▪ CWHwm 01, 03, 04 and 08 ▪ MHmm1 and • Dry to Wet Forest units with berry producing shrubs in structural stages 6 and 7 o CWHwm 01, 03, 04 and 08

Grizzly Bear Fall Habitat	
Ratings	**Assumptions**
	o lCHvc 01, 02, 04, 06 o MHmm1 & 2: 01, 02, 04 and 06
3 (moderate) [25-50%]	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09 o lCHvc 04, 05, & 06 o MHmm1 03, 05, 06, 07 & 09 o MHmmp 01, 02, 05, and 06 • Wet meadows: o CMAun 00-Ah, 00-Am, , 00-Sk o MHmmp 00-Hm, 00-Sk, 00-Sc, 00-Vh, and 00-Vs o MHmm1 Wf50 and Fm50 • Wetlands • Avalanche Chutes • MHmmp
4 (low) [5-25%]	• Dry to mesic forest units (Site series 01 – 04 in all BEC zones) in structural stages 6 and 7
5 (very low) [1-5%]	• Dry to mesic forest units(Site series 01 – 04 in all BEC zones) in structural stages 4 and 5 • Cutblocks in structural stage 4 or 5
6 (nil) [0%]	• All other habitats not listed above

Table 4-25. Detailed Rating Assumptions for Winter Denning (Wi-DE)

Rating	*Assumptions*
1 - High	• CMA and MHmmp with 30°-40° slopes on cool aspects (285°-135°) with deep soils (site modifiers d and m) and good vegetative cover (structural stages 2 and 3 with herb/shrub cover >50%) • Structural stage 6 to7 in upper MHmm1 and 2 (>1,100 m) and transition to MHmmp with cool aspect (285°-135°) • Rock caves in CMA BAFun, MHmmp and MHmm1 & 2
2 –Mod. High	• CMA where vegetation cover not as dense (structural stage 2-3 with 20-50% herb/shrub cover) with: • Cool aspect (285°-135°) and • Slopes are 20° -29° or 40°-50° • MHmm1 & 2 and MHmmp with structural stage 5 and 30° -40° slopes
3 - Moderate	• CMA and MHmmp with warm aspect (135° -285°) • ESSFmm1 (>1,500 m) in structural stage 4 with slopes 30° - 40°, cool aspect (285°-135°) with good soils (site modifiers d and m) and vegetation cover (>50% cover)
4 - Low	• As class 3 above but shallow unstable soils (site modifiers s and v) • Structural stage 5 to 7 (<600 m) at MHmm1/CWHwm transition or MHmm2/lCHvc transition

Rating	*Assumptions*
5 - Very Low	• Structural stage 3 to 4 (<1,000 m) MHmm1 & 2
6 - Nil	• Scree, talus, or other unstable slopes • Wet seepages • Glaciers, Permanent Snow • Boulder fields or bedrock o Slopes with <50% vegetation cover

4.2.4.5 Habitat Ratings Adjustments

- No downward adjustments will be made to fall feeding habitat suitability within 100 m of salmon spawning streams regardless of human activity.
- Habitat suitability is adjusted downward by 2 classes for all habitat within 500 m of human activity.

4.2.4.6 Habitat Ratings Summary

The models developed for the Project identified suitable feeding habitat for Grizzly Bear during the early (Figure 4-5) and late spring (Figure 4-6), summer (Figure 4-7), and fall (Figure 4-8) seasons. The model also identified suitable denning habitat for Grizzly Bear during the winter (Figure 4-9). Table 4-26 provides an area breakdown of each habitat class within the LSA.

Table 4-26. Summary of habitat suitability within both the LSA and RSA for Grizzly Bear Feeding and Denning requirements

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*	
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**
Feeding-Early Spring	High	9,633	4.7	202	1.4
	Mod. High	4,451	2.2	1,036	7.1
	Moderate	464	0.2	220	1.5
	Low	457	0.2	309	2.1
	Very Low	9,455	4.6	19	0.1
	Nil	180,889	88.1	12,810	87.8
Feeding-Late Spring	High	6,536	3.2	740	5.1
	Mod. High	2,098	1.0	1,332	9.1
	Moderate	10,412	5.1	623	4.3
	Low	1,306	0.6	943	6.5
	Very Low	1,797	0.9	740	5.1
	Nil	183,201	89.2	10,217	70.0
Feeding-Summer	High	3,761	1.8	2,621	18.0
	Mod. High	39,742	19.4	2,494	17.1
	Moderate	29,160	14.2	1,093	7.5
	Low	359	0.2	253	1.7

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*	
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**
	Very Low	608	0.3	25	0.2
	Nil	131,720	64.1	8,109	55.6
Feeding-Fall	High	2,072	1.0	1,336	9.2
	Mod. High	28,568	13.9	394	2.7
	Moderate	42,346	20.6	1,969	13.5
	Low	0	0.0	22	0.1
	Very Low	510	0.2	1,350	9.2
	Nil	131,854	64.2	9,525	65.3
Denning-Winter	High	6,679	3.3	437	3.0
	Mod. High	490	0.2	497	3.4
	Moderate	3,177	1.5	335	2.3
	Low	404	0.2	280	1.9
	Very Low	3,472	1.7	622	4.3
	Nil	191,128	93.1	12,425	85.1

Suitable early spring habitat is limited to the lower elevation forest and wetlands within the LSA and makes up a total of 1,457 ha (10%). As spring progresses, bears move up in elevation and late spring habitat in the high and moderately high classes encompasses 2,695 ha (18.5%) of the LSA. During the summer Grizzly Bears are generally wide roaming and 6,208 ha (42.5%) of suitable summer habitat was identified within the LSA. Highly suitable fall habitat is partially limited by the availability of high protein foods such as salmon. High suitability (class 1) habitat is limited to the lower Bitter Creek near the confluence with the Bear River. Fall berry crops provide additional high quality food sources for bears. Overall 1,729 ha (11.9%) of high and moderately high fall feeding habitat were identified in the LSA. Winter denning habitat is fairly limited within the LSA with only 695 ha (4.8%) of the LSA providing suitable denning habitat. Despite denning habitat being limited within the LSA, five Grizzly Bear dens were identified within the LSA during the 2016 summer field visits.

4.2.4.7 Habitat Model Evaluation

Overall, the LSA Grizzly Bear habitat models correlated well with the field ratings. Early spring habitat modelled values agreed with 82.5% of the field ratings, whereas late spring feeding habitat was slightly lower at 80%. The summer feeding habitat model only agreed with the field ratings 67.5% of the time. This is most likely due to the fact that summer foraging opportunities vary much more widely than any other season and bears can be found in almost any habitat. The model agreed almost 100% with field ratings in areas with high berry producing habitat. Fall feeding habitat modelled values correlated with field ratings 87.5% of the time. Denning habitat correlation values were also high at 85% of field ratings. Dens discovered during the 2016 field season were all located in habitat rated as Class 1 by the denning model. Field ratings are presented in Appendix 3.

Field ratings were not conducted within the RSA although Grizzly Bears were observed in two locations during the overview flights (See map Appendix 4-13). The July overview flight observed three Grizzly Bears and all were located within areas that were rated Class 1 for both late spring and summer feeding habitat. The August 31 overview flight also recorded a Grizzly Bear within habitat rated as class 1 summer feeding habitat. Interestingly, the August overview flight observed 29 Black Bears within habitat rated as Class 1 Grizzly Bear summer feeding habitat.

Figure 4-5. Grizzly Bear Early Spring Feeding habitat suitability map

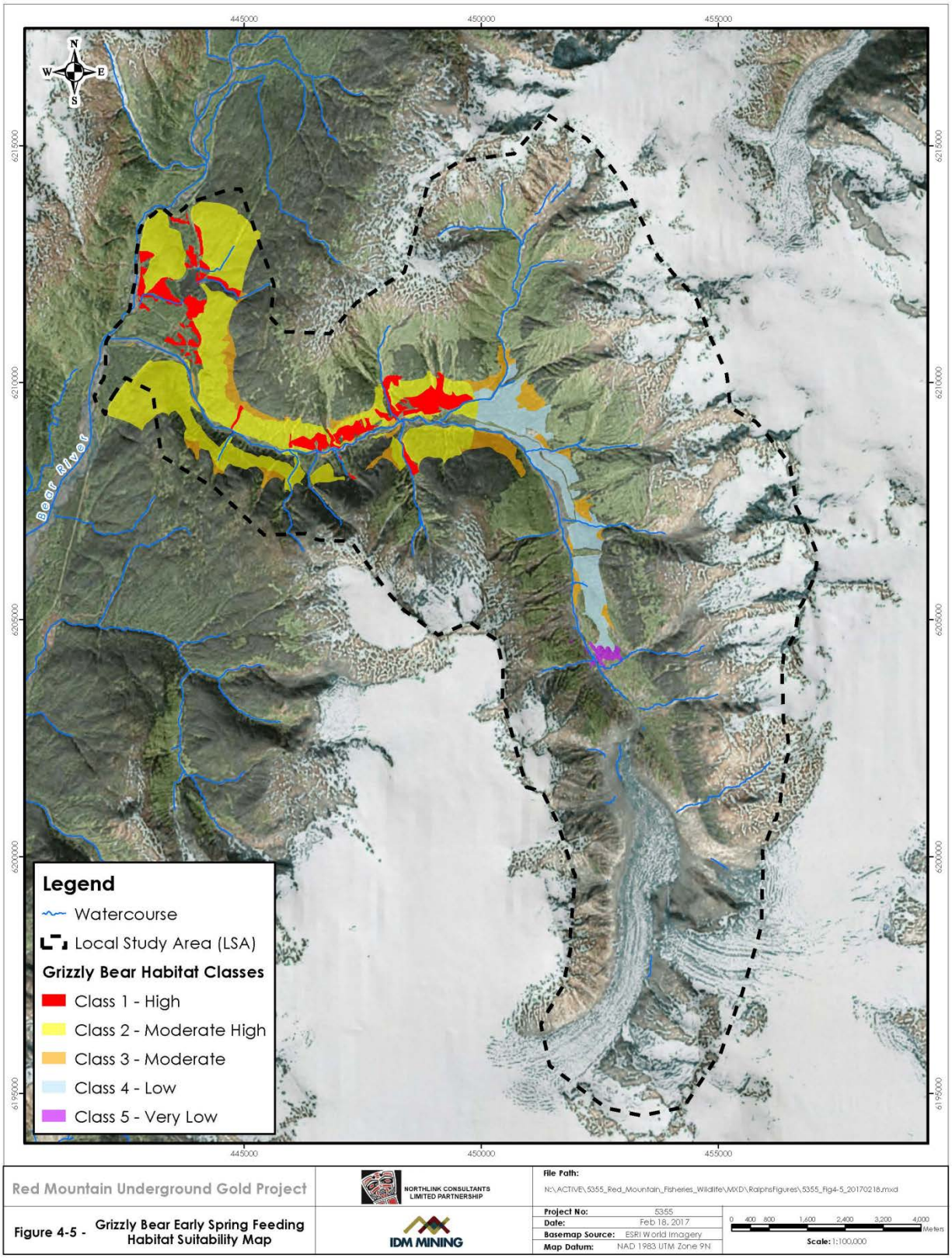


Figure 4-6. Grizzly Bear Late Spring Feeding habitat suitability map

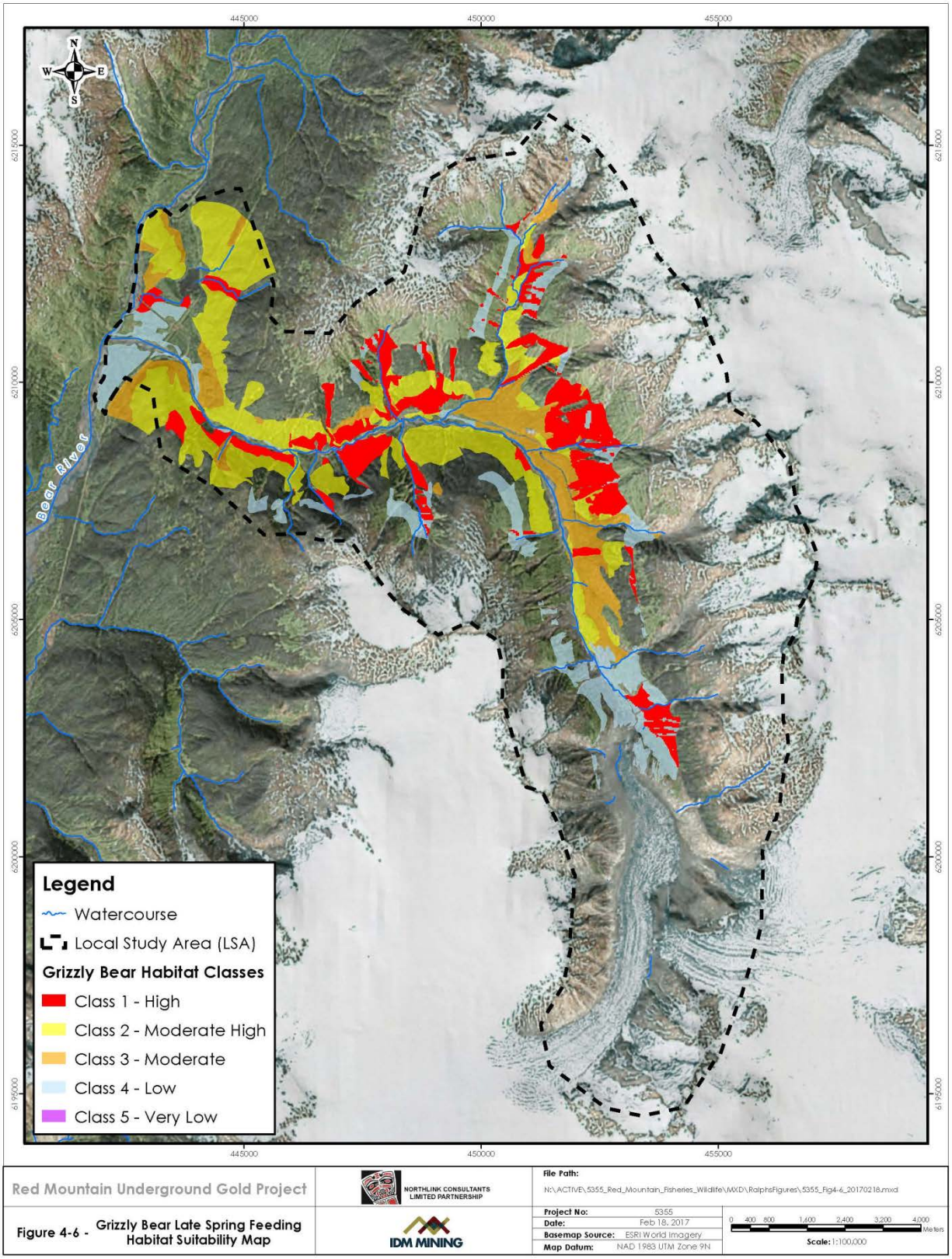


Figure 4-7. Grizzly Bear Summer Feeding habitat suitability map

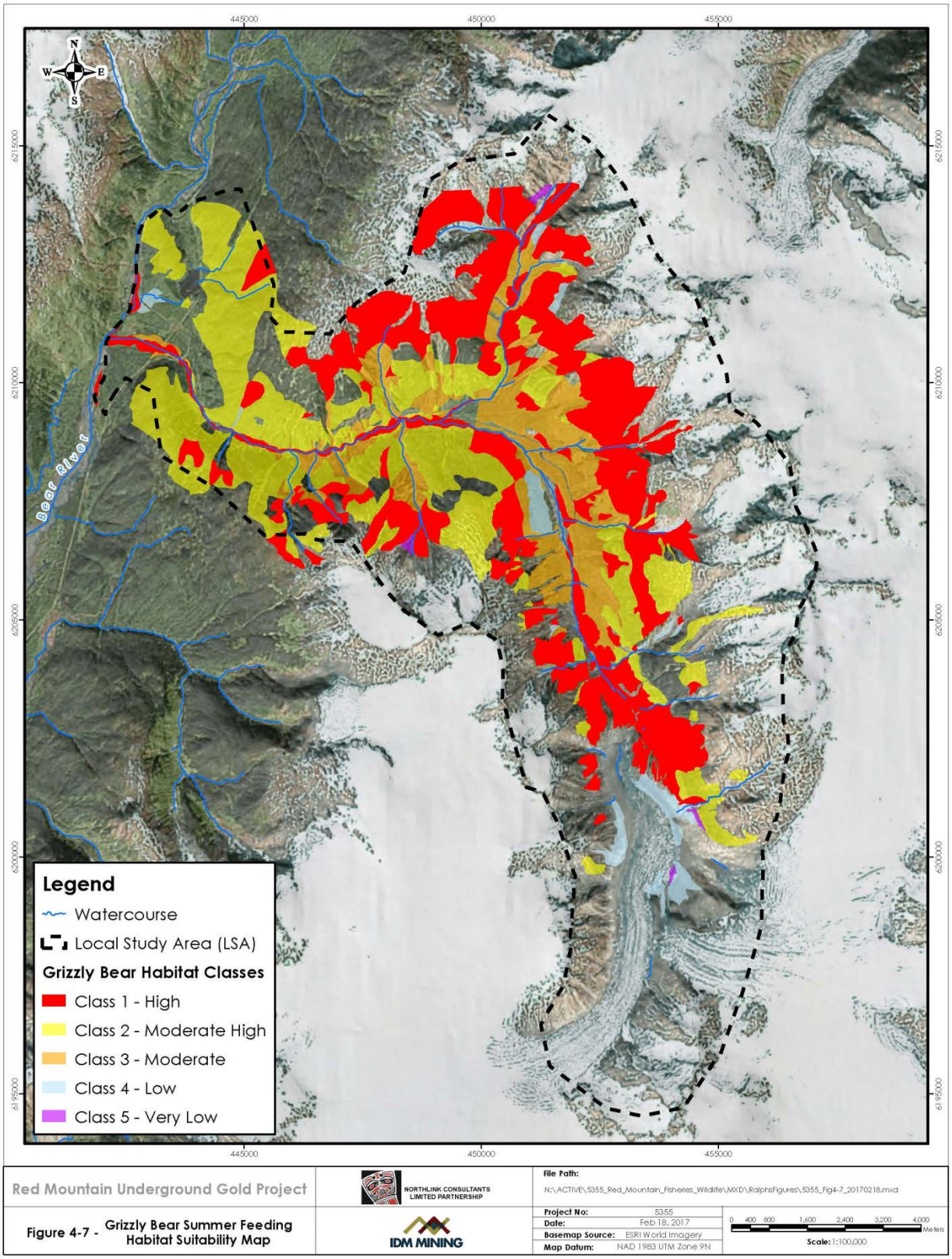


Figure 4-8. Grizzly Bear Fall habitat suitability map

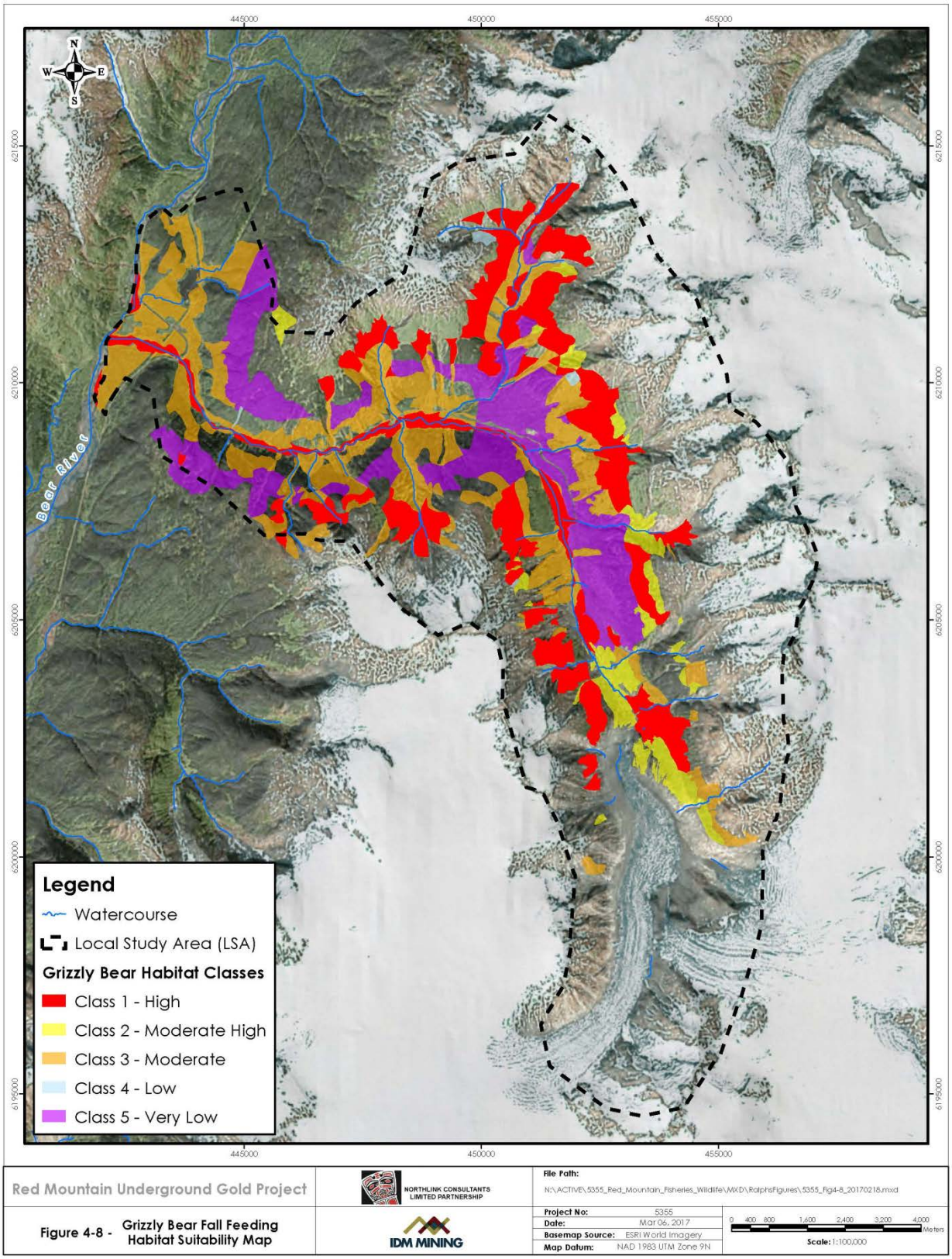
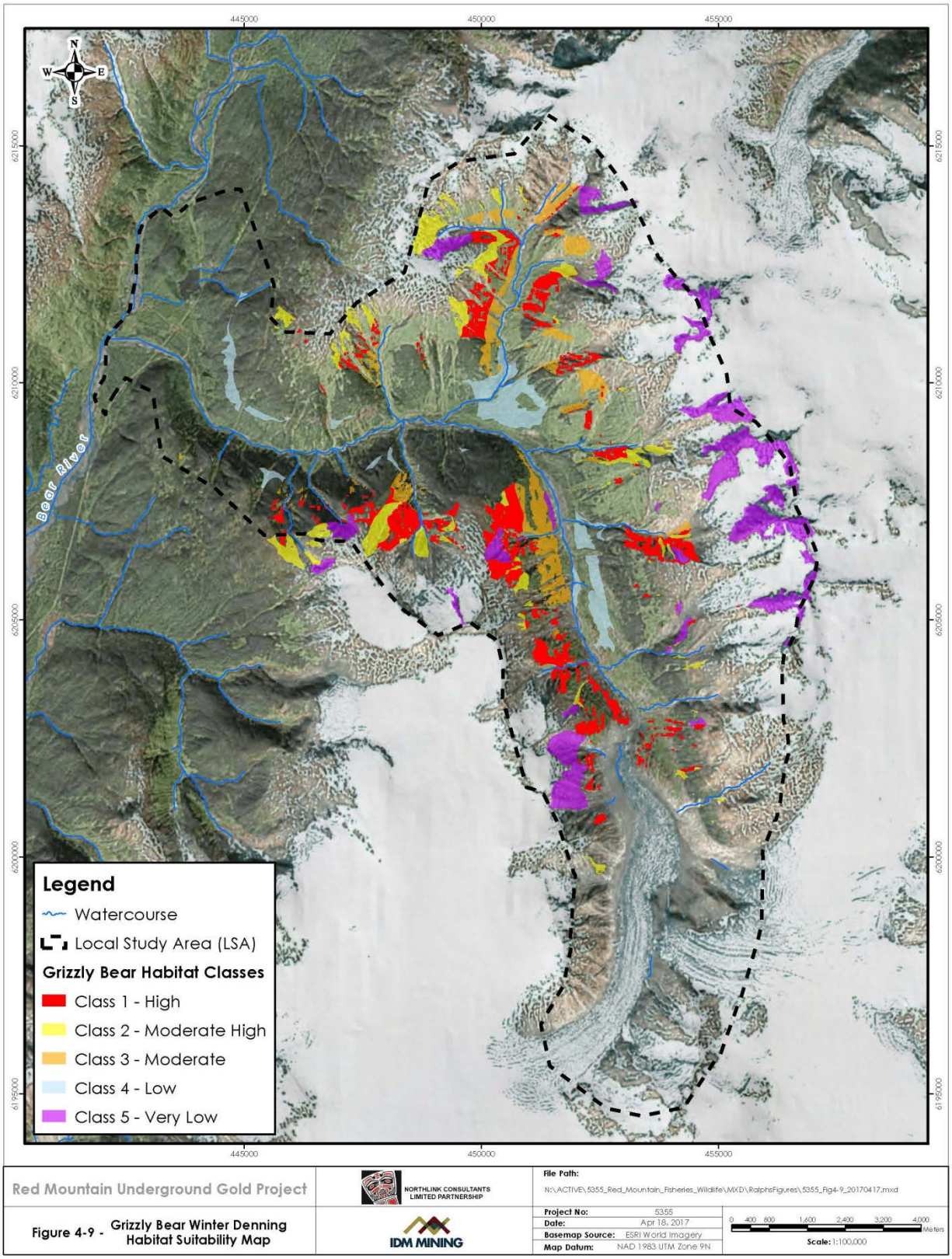


Figure 4-9. Grizzly Bear Winter Denning habitat suitability map



4.2.5 Field Surveys

Field surveys were conducted in both 2015 and 2016. Targeted surveys in 2015 included an aerial den survey conducted on August 15, 2015. A total of 71 km were surveyed near or above the treeline, especially on cooler aspect slopes with moderate to high vegetation cover (Figure 3-3). Observers searched for evidence of past or recent excavation and physical structures such as possible caves. All evidence of burrows including those of smaller mammals such as Hoary Marmot were recorded opportunistically as they were encountered. All other incidental wildlife observed was also recorded (Appendix 4-13). No Grizzly Bear dens were discovered during the 2015 surveys. Incidental observations of two den sites (Figure 4-10) were made in July 2016 during Mountain Goat surveys (Table 4-27). These dens were verified on the ground and detailed habitat assessments were completed. From the ground assessment, it was determined that these dens were occupied during the winter of 2015/2016. Several hair samples were collected from each of the den sites. An additional set of three dens (Figure 4-11 and 4-12) was observed during an August 30, 2016 Mountain Goat flight. These three dens were located approximately 1.4 km north of the two dens found in July 2016. All the den sites are at similar elevations (near or just above the treeline), on steep (>60%) slopes, in deep loose soils, and with a significant herb/dwarf shrub vegetation layer. Two of the three dens found in August appeared to have been excavated around the same time as the two den sites found in July. The third den appeared to be a little older, likely from the previous year (winter of 2014/2015).

Table 4-27. Habitat attributes of the Grizzly Bear den sites located within the LSA

Date	*UTM*	*Aspect*	*Slope*	*Elevation*	*Vegetation Cover*
July 7, 2016	9V 447724, 6206698	34°	68%	1,382 m	Heather/Partridgefoot
July 7, 2016	9V 447727, 6210096	34°	68%	1,382 m	Heather/Partridgefoot
Aug. 30, 2016	9 V 446338 6206613	291°	65%	1,290 m	Heather/Partridgefoot/ Krummholz
Aug. 30, 2016	9 V 446338 6206613	291°	65%	1,290 m	Heather/Partridgefoot/ Krummholz
Aug. 30, 2016	9 V 446338 6206613	291°	65%	1,290 m	Heather/Partridgefoot/ Krummholz

Figure 4-10. Photos showing Grizzly Bear dens with dense mat of White Mountain Heather and Partridgefoot above entrance

Figure 4-11. Grizzly Bear den found on August 30, 2016

Figure 4-12. Overview of slope with vegetation and den sites (arrows pointing to den sites)

4.2.5.1 Incidental Observations

Incidental observations during ground surveys observed Grizzly Bear tracks, scat, and signs of digging throughout different portions of the LSA. Table 4-28 provides a summary of incidental Grizzly Bear observations recorded during the 2015 and 2016 field surveys.

Table 4-28. Summary of incidental sightings of Grizzly Bears and/or sign within the LSA

Date	*UTM*	*Location*	*Sign*	*Activity*	*Habitat Type*
Aug. 14, 2015	9 U 454536 6203991	Above treeline east side of Bitter Creek	Scat	Recent Hoary Marmot Kill	Heather/ Krummholz meadow
Aug. 14, 2015	9 U 453937 6201590	Bromely Humps	Scat (5 – 6 piles)	Digging	Rocky Ridge interspersed with Alder
Aug. 15, 2015	9 V 446804 6211069	Ore Mountain	Excavation	Digging for Lupine roots	Alpine meadow
June 6, 2016	9 V 451756 6206966	Bitter Creek	Old Tracks	Travelling along River	Gravel bar
June 7, 2016	9 V 451968 6206362	Bitter Creek	Old Scat	Travelling along River	River bank
July 5, 2016	9 U 455736 6201716	Alpine Ridge	Fresh scat from this spring	Travelling along Mtn Goat trail	Alpine fellfield

4.2.5.2 Wildlife Cameras

Grizzly Bears were recorded on wildlife cameras 21 times on two separate cameras between June and August 2016 (Figures 4-13 and 4-14). Two of the occurrences were recorded in the sub-alpine zone and one occurrence along a major Mountain Goat trail in the alpine. These trail camera captures indicated that Grizzly Bears occasionally use the MHmmp and CMAun zones during June, July and August.

Table 4-29 Wildlife Cameras with Grizzly Bear detections

Camera	*Date Range*	*Hours deployed*	*Total Detections*	*Total Grizzly Bear Detections*	*Elevation (m)*	*# species*
TC 3	June 6 – August 31	2,082	127	12	1008	Mountain Goat (72%) Grizzly Bear (21%) Black Bear (5.1%) Stellers Jay (4.7%)
TC 4	June 7 – August 31	2,060	1,240	19	1530	Mountain Goat (84.5%) Grizzly Bear (7%) Hoary Marmot (7%) American Robin (1%) White-tailed Ptarmigan (0.5%)

Figure 4-13. Grizzly Bear caught on wildlife camera TC 3

Figure 4-14. Grizzly Bear caught on Wildlife Camera TC 4 in the alpine travelling along well-worn Mountain Goat trail

4.2.6 Conclusions

Grizzly Bears are opportunistic omnivores that utilize a wide range of habitats throughout the various seasons. Suitable spring habitat (early and late combined) is limited somewhat by long-lasting snowpacks to the lower elevation forests and wetlands within both the LSA and RSA. The total area of spring feeding habitat identified within the LSA was 4,152 ha (28.5%) and 33,596 ha (16.4%) within the RSA. During the summer, Grizzly Bears are generally wide roaming and 6,208 ha (42.5%) of suitable summer habitat was identified within the LSA and 70,041 ha (34.1%) within the RSA. Highly suitable fall habitat is partially limited by the availability of high protein foods such as salmon. High suitability (class 1) habitat is limited to the lower Bitter Creek near the confluence with the Bear River. Fall berry crops provide additional high quality food sources for bears. Overall, 1,729 ha (11.9%) of high and moderately high fall feeding habitat were identified in the LSA. Within the RSA, there was much greater opportunity for Grizzly Bears to exploit salmon streams. Areas with high value salmon streams were found within the Kshwan and Sutton River watersheds to the south, the White River and Meziadin Lake to the east, and the Bear River to the north and west. In the RSA, a total of 71,648 ha (34.9%) of fall feeding habitat was identified. Winter denning habitat is fairly limited within the LSA with only 695 ha (4.8%) of the LSA providing suitable denning habitat. Despite denning habitat being limited within the LSA, five Grizzly Bear dens were identified within the LSA during the 2016 summer field visits. Denning habitat

suitability is the same within the RSA where 10,346 ha (5%) of class 1 – 3 habitat was identified.

4.3 Moose

4.3.1 Identification and General Ecology

The largest members of the deer (Cervidae) family, Moose are identifiable by their overall size, humped shoulders, downturned top lip, and distinctive dewlap under the throat. This species exhibits sexual dimorphism and only males produce antlers which may reach almost 2 m from tip to tip. Antlers are different than those of other Cervids and are more flattened with less defined prongs, which give them more of a scoop shape. Antlers grow during the spring and are shed between late fall and early spring (Rea and Child 2007). Males are also larger than females and may reach over 2 m tall and up to 700 kg (Burt and Grossenheider 1976). Moose of both sexes are shades of brown but may take on a grey appearance in the winter, often the result of rubbing off guard hairs in an effort to reduce irritation from biting ticks (Eder and Pattie 2001). Tall legs allow for Moose to reach high browse and travel efficiently through deep snow, swamps, and other rough terrain. Moose are also excellent swimmers. Natural predators include Grizzly (*Ursus arctos*) and American Black Bears (*Ursus americanus*), which commonly predate on calves, and Grey Wolves (*Canis lupus*) which more commonly hunt adults (Rea and Child 2007).

Three subspecies of Moose are known to British Columbia which are distinguished through morphology and distribution, however genetic differences are controversial. The Shiras Moose (*Alces americanus shirasi*) is found in the southwestern area of the province and is the smallest of the subspecies. The Alaska Moose (*A. a. gigas*) is the largest subspecies and is found in Alaska and the Yukon. The Northwestern Moose (*A. a. andersonii*) is found in the remaining areas of the province (Innes 2010; Shackelton 2013). The Northwestern Moose is the subspecies known to occur in the RSA and may potentially occur within the LSA as well.

Males begin growing antlers in the spring which are used during the fall breeding rut to intimidate and spar with other males for mates. Antlers grow back larger over successive seasons. Males are sexually mature at two years but are often incapable of competing with larger males for mates until older (Rea and Child 2007).

Females are sometimes sexually mature as yearlings but will usually breed at two years old and usually produce only one or two calves during their life (average 7 to 8 years). During the rut, females produce a long call that travels several kilometres to attract mates. After a gestation period of about 230 days, cows give birth in the early summer. Normally one calf is produced, although twins are not uncommon in productive areas. Prior to giving birth, females chase away the previous year's calf, if still present. Calves are normally weaned before winter and for the first year are heavily reliant on their mother for protection (Rea and Child 2007).

4.3.2 Habitat

Moose Feeding, Security, and Thermal habitat are closely linked to each other. Early seral areas with an abundance of shrubs and grassy vegetation are important sources of forage, however treed areas are also important for security and thermal cover. Forests provide cover from predators as well as thermal protection from summer heat, and winter snow. For this reason, riparian areas, forest edges of cutblocks, linear developments, or burns are commonly exploited as they provide both food from the regenerating shrubs, and the ability to seek thermal cover and protection from predators (Rea and Child 2007).

Seasonally, habitat selection is largely determined by snow which in turn dictates available shrub and grassy forage. Moose are adapted to moving through deep snow and will stay at high elevation summer forage areas later than other ungulates. However, heavy snow during winter eventually restricts Moose movement and drives them to low elevation river valleys where snow pack is shallower and temperatures are warmer. Here, Moose select for areas with abundant shrubby vegetation such as wetlands, burns, and avalanche tracks to browse on willows (Salix spp.), Red-osier Dogwood (*Cornus stolonifera*), Black Cottonwood (*Populus balsamifera*), and other shrubs. In the summer months, most (particularly pregnant cows) follow the melting snow to higher elevations where they seek out aquatic vegetation in swamps and ponds to replenish minerals, especially sodium (Belovsky and Jordan 1981). Summer forage includes leaves of riparian shrubs and aquatic plants such as Horsetail (Equisetum spp.), sedges, and others (MELP 2000; Wall et al. 2011). High elevation summer foraging areas may be less productive than lower elevation areas and Moose appear to trade off increased security from predators (in the form of tree and shrub cover, and distance to open water) at the expense of reduced quality forage. However some Moose choose to stay at lower elevations where forage abundance and quality are greater, however the risk of predation is higher. Moose at lower elevations will choose habitats that are more open, but the distance to open water is reduced, to increase ability to see predators and use the open water as escape terrain (Rea and Child 2007).

4.3.3 Study Area Distribution

Moose is a Holarctic species and is known throughout much of Scandinavia, Eurasia, and North America (Rea and Child 2007). In North America it is common across most of Canada and Alaska. In the contiguous United States its range extends south along the Rocky Mountains, and into some northern states near the Great Lakes and east coast (Burt and Grossenheider 1976). The distribution of Moose covers almost all of BC with the exception of only the coast, Vancouver Island, and Haida Gwaii (Eder and Pattie 2001). It is most abundant in the Central Interior and Northern Interior and is generally uncommon or absent in the dry, Southern Interior (MELP 2000).

Specific occurrences of Moose within or near the Project area are not mapped on distribution mapping compiled by E-Fauna BC, however this species is known to reside

throughout most of British Columbia (Eder and Pattie 2001). The region 6 (Skeena) Moose population is considered relatively stable around 40,000 animals with a good calf recruitment (Kuzyk 2016). Demarchi (2000) estimated a population size of 2016 moose ±39% in the Nass Wildlife Area. Within this zone, Moose are associated with forested areas, particularly early seral stages and wetlands which provide abundant browse, however they often move to higher elevations for summer foraging. Moose is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the study area, however they are sporadic (Rea and Child 2007).

Depending on season, Moose can inhabit a range of elevations from low elevation valley bottoms to alpine. A study of Moose in the Nass Valley (near the Project area) observed Moose occupying elevations between 200 and 1,500 m (Demarchi 2003).

4.3.4 Habitat Suitability

4.3.4.1 Existing Habitat Models

Several habitat models have been created for projects and research in northern BC. Since there is a detailed level of knowledge on Moose habitat requirements, the models use a 6-class rating system and rate habitat for Food and Security/Thermal life requisites, however they differ in the seasons modelled. EBA (2002) modelled Food and Security/Thermal habitat year-round, grouped into two seasons: Summer (Growing) and Winter. Jacques Whitford AXYS (2010) only modelled winter habitat as it was considered limiting. For a nearby mining project near Stewart, BC, Rescan (2013) considered winter habitat to be the most critical, but divided the season into Early and Late Winter. These seasons did not necessarily correspond to specific dates; instead Early Winter was considered to be the time in winter before snow is deep enough to restrict Moose movement whereas Late Winter was the time when the snowpack has become deep enough to restrict Moose movement and drive them to lower elevations where snow is shallower.

Provincial benchmark habitat for Moose is available and is shown in Table 4-30. The attributes for suitable Feeding and Security/Thermal Life Requisites in relation to specific ecosystem attributes and seasons are summarized in Tables 4-31 and 4-32. The Terrestrial Ecosystem Mapping attributes for Moose are outlined in Table 4-33.

4.3.4.2 Habitat Model for the Project

For the purposes of the Project, living (forage, security, and thermal) habitat will be rated for two seasons: Growing and Winter.

Table 4-30. Provincial Benchmark habitat for Moose

Season	*Ecoprovince*	*Unit*	*BGC Subzone*	*Rating*
Growing	Boreal Plains	PEL	BWBSmw PR/1 – White Spruce-Balsam Poplar Riparian	B
Winter	Boreal Plains	PEL	BWBSmw BA/1 – Boreal White Spruce-Trembling Aspen	B
Growing	Coast and Mountains	NAB	ICHmc PR/1 – White Spruce-Balsam Poplar Riparian	3
Winter	Coast and Mountains	NAB	ICHmc BA/1 – Boreal White Spruce-Trembling Aspen	3

Source: Appendix H of BC Wildlife Habitat Ratings Standards (RIC 1999). Benchmarks are shown for each season. B = best overall benchmark habitat for the province.

Habitat use pertaining to the Life Requisites of Moose which spans all months/seasons has been rated according to RIC Standards (RIC 1999) within the Project area (Table 4-31. The life requisite for "Living" includes three major components: Food, Security, and Thermal habitat.

Table 4-31. Life Requisites of the Moose within the Project area rated by month and season

Moose Life Requisites		
Month	*Season**	*Life Requisites*
January	Winter	Living (Feeding, Security/Thermal)
February	Winter	Living (Feeding, Security/Thermal)
March	Winter	Living (Feeding, Security/Thermal)
April	Growing (Spring)	Living (Feeding, Security/Thermal)
May	Growing (Spring)	Living (Feeding, Security/Thermal)
June	Growing (Summer)	Living (Feeding, Security/Thermal)
July	Growing (Summer)	Living (Feeding, Security/Thermal)
August	Growing (Summer)	Living (Feeding, Security/Thermal)
September	Growing (Fall)	Living (Feeding, Security/Thermal)
October	Growing (Fall)	Living (Feeding, Security/Thermal)
November	Winter	Living (Feeding, Security/Thermal)
December	Winter	Living (Feeding, Security/Thermal)

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Table 4-32. Summary of general habitat requirements for Moose

Habitat Use	*Attributes of Suitable Moose Habitat*	*Structural Stage[1]*
Feeding (Growing)	Low to high elevation riparian, herb/shrub-dominated shallow water wetlands that can be temporary or permanent; shrubby burns, or clearcuts in younger age classes	2-3
Thermal	Forested areas for thermal protection; more mature	4-7

Habitat Use	*Attributes of Suitable Moose Habitat*	*Structural Stage[1]*
(Growing)	forests with denser canopy are preferred	
Security (Growing)	Dense Young to Mature forest providing visual cover; open water in close proximity to forested areas	3b-7
Feeding (Winter)	Low elevation riparian, herb-dominated shallow water wetlands that can be temporary or permanent; shrubby burns, clearcuts or avalanche chutes	2-3
Thermal (Winter)	Dense, mature forests for snow interception which provides thermal protection and security	6-7
Security (Winter)	Dense young to mature stands providing visual cover; broken and varied terrain including ridges and gullies that prevent line of sight	4-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80 years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 4-33. Terrestrial Ecosystem Mapping (TEM) attributes for Moose life requisites

Life Requisite	*TEM Attribute*
Food Habitat	• Site: site disturbance, elevation, slope, aspect, structural stage • Vegetation: Percent cover by layer, species list by layer, cover for each species for each layer
Security Habitat	• Site: elevation, slope, aspect, structural stage • Vegetation: total percent cover, percent cover by layer • Mensuration: tree species, diameter at breast height, height
Thermal Habitat	• Site: elevation, slope, aspect, structural stage • Vegetation: total percent cover, percent cover by layer • Mensuration: tree species, diameter at breast height, height

Habitat ratings for the Project LSA will be based on a rating relative to the Provincial benchmark (Table 4-30) for the Coast and Mountains Nass Basin (NAB). Detailed information on Moose habitat requirements is available, therefore a 6-class rating scheme is used (Table 4-34). Detailed habitat ratings assumptions are described in Tables 4-35 (summer) and 4-36 (winter).

Table 4-34. Relative suitability classes to be assigned to Moose habitat polygons

Class	*Suitability*	*Lower Limit (%)*	*Upper Limit (%)*	*Relative Quality*
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

Table 4-35. Habitat ratings assumptions for Moose Living during growing (LI-G)

Class	*Rating*	*Assumptions*
1	High	• CWHwm, ICHvc, MHmm1 and 2 in structural stages 2 and 3 with: o All slopes up to 80% o All aspects • Floodplains, productive benches, and riparian habitat • Shrub dominated wetlands (structural stage 3b)
2	Moderately High	• CWHwm ICHvc in structural stages 4 to 7 with: o All slopes up to 80% o All aspects
3	Moderate	• MHmm1 and 2 in structural stages 4 to 7 with: o All slopes up to 80% o All aspects
4	Low	• MHmmp tree patches in structural stage 3-7 o All slopes up to 80% o All aspects
5	Very Low	• CMAun structural stage 2 or 3a (low shrub)
6	Nil	• All non-vegetated areas • Areas with permanent ice and snow (glaciers)

Table 4-36. Habitat ratings assumptions for Moose Living during winter (LI-w)

Class	*Rating*	*Assumptions*
1	High	• CWHwm and ICHvc: o <600 m elevation o structural stages 6-7 o Canopy closure classes 6 to 9 (>60%) o All slopes up to 60% o Warm aspect (135°-285°) • Floodplains, productive benches, and riparian habitat below 600 m elevation • Disturbed sites (clearcuts and regenerating burns) within 100 m of structural stage 6-7 (mature and old-growth forest)
2	Moderately High	• CWHwm and ICHvc (<600 m) in structural stages 2 to 5 with: o All slopes up to 60% o Warm aspect (135°-285°)
3	Moderate	• CWHwm ICHvc (<600 m) with: o All structural stages o Cool aspects (285°-135°)
4	Low	• CWHwm and MHmm1 and 2 (<600 m elevation) o All slopes up to 60% o Warm aspects (135°-285°)
5	Very Low	• CWHwm, ICHvc, and MHmm1 and 2 (<600 m elevation) o All slopes up to 60% o Cool aspects (285°-135°)
6	Nil	• All non-vegetated areas • All habitat above 600 m • All slopes >60%

Class	Rating	Assumptions
		• Areas with permanent ice and snow (glaciers)

4.3.4.3 Habitat Ratings Assumptions

Living-Growing

- Feeding habitat is the dominant representation for habitat suitability ratings for the growing season.
- Floodplains, productive benches, and riparian habitat will be rated highest (Class 1).
- Wetlands, avalanche chutes, cutblocks, and regenerating burns with high shrub cover will be rated Class 1.

Living-Winter

- *Thermal Cover (Snow interception) habitat is the dominant representation for habitat suitability ratings for the winter season.*
- *Structural stage 6 and 7 forests along riparian corridors will be rated highest (Class 1)*
- *Wetlands, shrub dominated openings, regenerating burns or cutblocks below 600m elevation adjacent to structural stage 6 or 7 forests will be rated highest (Class 1)*

4.3.4.4 Habitat Ratings Summary

The models developed for the Project identified suitable winter (Figure 4-15) and summer (Figure 4-16) living habitat for Moose. Table 4-36 provides an area breakdown of each habitat class within the LSA and the RSA.

Table 4-37. Habitat suitability ratings summary for Moose

Life Requisite	Habitat Suitability Rating	RSA		LSA		Proportion of Habitat in the LSA relative to the RSA (%)
		Area (ha)	Area (%)	Area (ha)	Area (%)	
Living-Growing	High	3,510.8	1.7	41.7	0.3	1.0
	Mod. High	7,210.8	3.5	424.3	2.9	6.0
	Moderate	13,960.0	6.8	1,054.6	7.2	8.0
	Low	30,995.9	15.1	1,356.2	9.3	4.4
	Very Low	5,054.5	2.5	814.7	5.6	16.1
	Nil	144,618	70.4	14004	95.6	9.6
Living-Winter	High	583.2	0.3	122.0	0.8	20.1
	Mod. High	1,304.6	0.6	49.6	0.3	3.8

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
	Moderate	3,421.7	1.7	102.9	0.7	3.0
	Low	1,772.9	0.9	223.8	1.5	12.6
	Very Low	91.8	0.0	92.6	0.6	101
	Nil	198,176	96.5	10,903	74.7	5.5

Moose winter range (171.6 ha, just over 1%) is limited within the LSA to the floodplains along the lower reaches of Bitter Creek near the confluence with the Bear River and around the Clements Lake area. Areas of mature coniferous forest within these floodplains provide some good snow interception cover adjacent to winter forage. Summer habitat is more widely distributed within the LSA and there are numerous isolated patches of high and moderately high value habitat. A total of 466 ha (3.2%) of high and moderately high habitat was identified for the LSA. The steep (generally >80%) slopes along the Bitter Creek valley provide very little opportunity for movement between summer and winter habitat. Although some suitable habitat is present within the lower reaches of Bitter Creek, the lack of evidence of use suggests that Moose are not present within the LSA or may be a very infrequent visitor.

4.3.4.5 Habitat Model Evaluation

Field verification was carried out within the LSA during the 2015/2016 field seasons. The winter Moose model correlated with the field ratings 83.5% of the time whereas the summer model only agreed with the field ratings 75% of the time. Polygons where field ratings and model ratings disagreed where adjusted to reflect the field ratings. These adjustments are included in the final area breakdown (Table 4-36 and Figures 4-15 and 4-16).

Figure 4-15. Moose Winter Habitat suitability map for the LSA

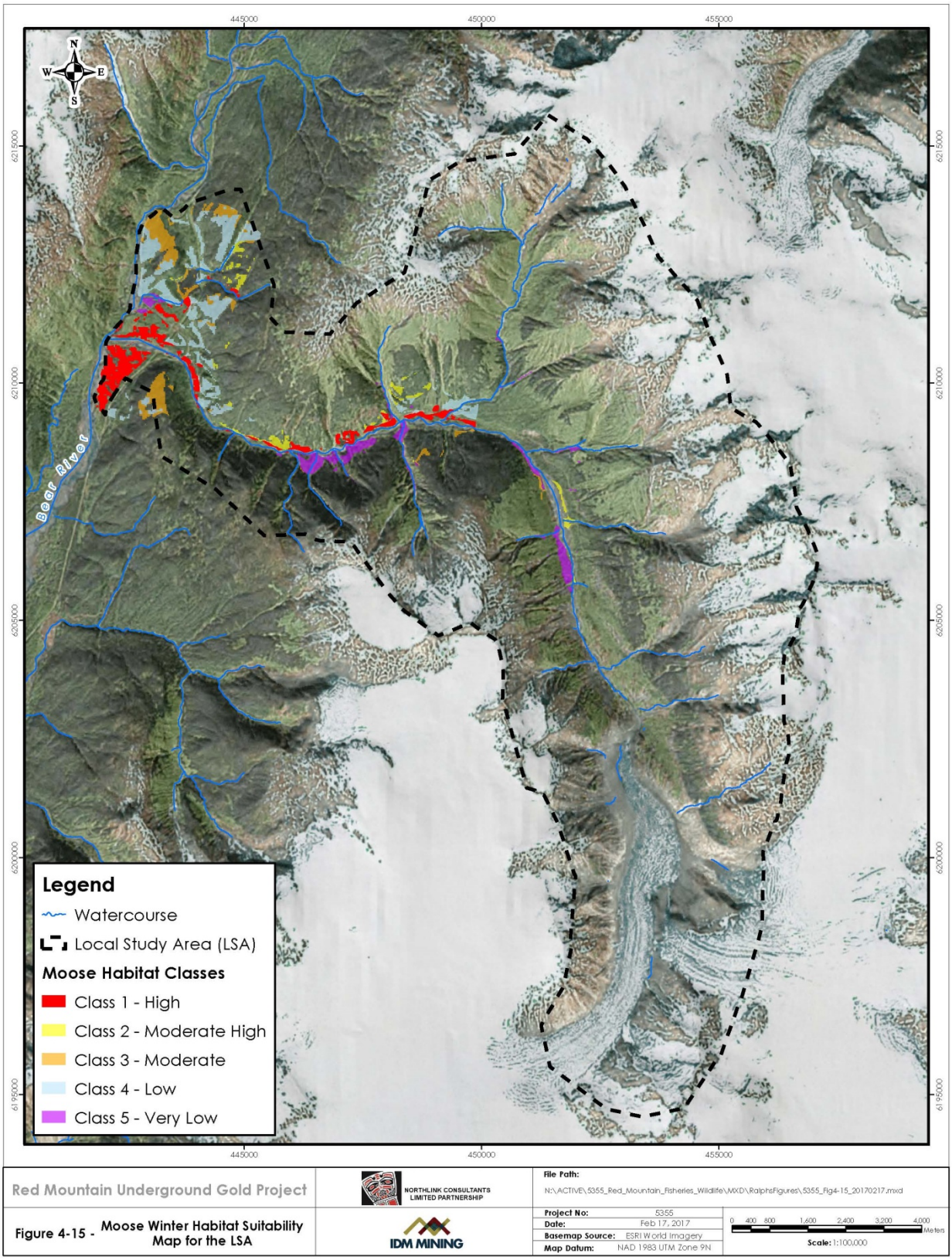
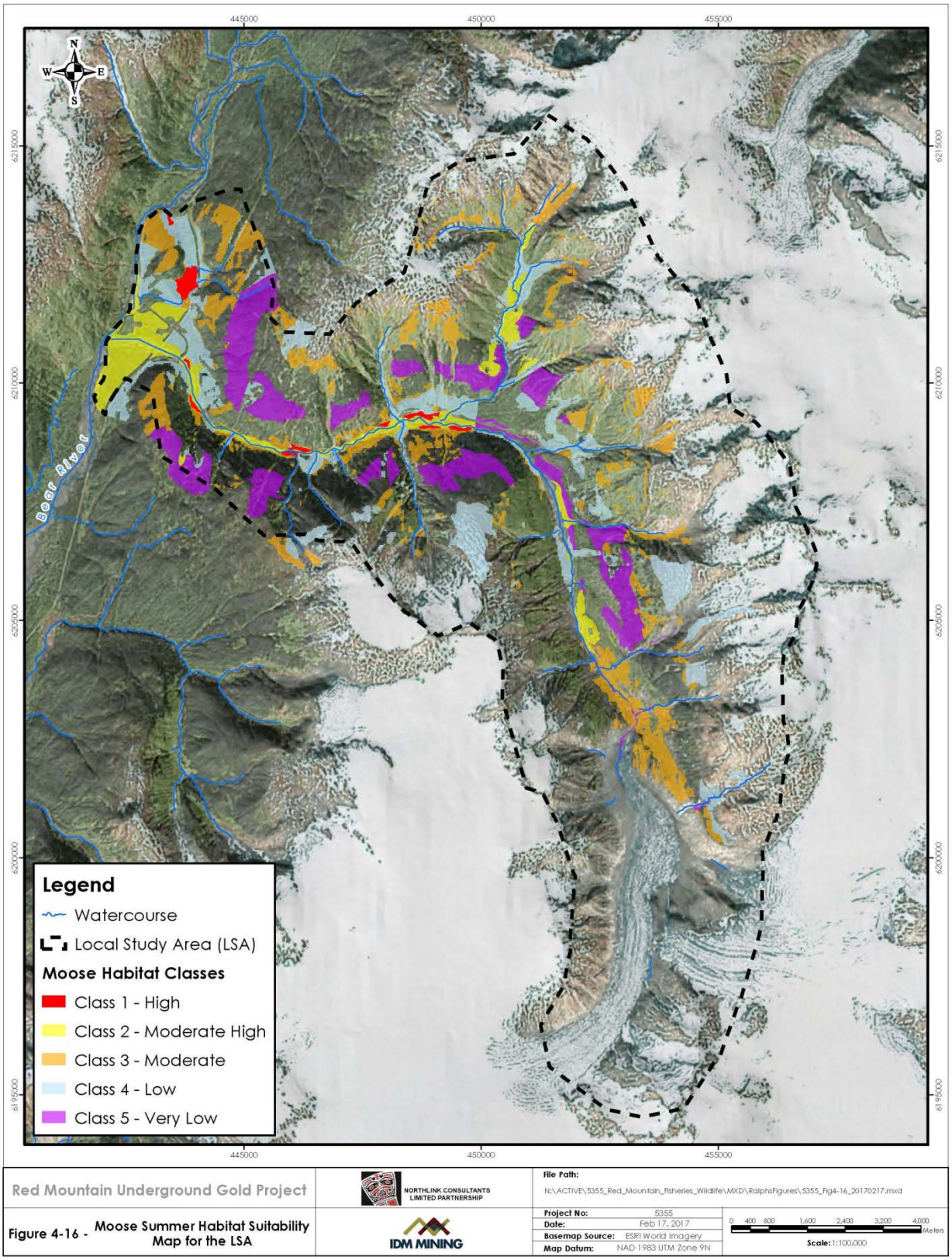


Figure 4-16 Moose Summer-Living habitat suitability map for the LSA



4.3.5 Field Surveys

Field surveys for Moose were focused on areas with the highest potential for overwintering. These areas were in the valley bottom near Clements Lake and the lower floodplains of Bitter Creek and the Bear River. Survey intensity was conducted at a presence/not detected level and used a combination of encounter transects and habitat plots. Searches were conducted mainly for pellet groups and browse utilization as well as tracks, antler rub marks, and bark stripping. A total of 19.2 km of transects were surveyed specifically for Moose in the valley bottom portions of the LSA (see Figure 3-4 above for survey locations). No signs of Moose or evidence of use were observed during any of the surveys in 2015 or 2016.

4.3.6 Conclusions

Overall the LSA provides very little high to moderate (class 1 – 3) Moose winter habitat. The majority of the suitable Moose habitat is found along the floodplains of the lower reaches of Bitter Creek and the confluence of the Bear River. Within the RSA, immediately adjacent (to the northeast) to the LSA, American Creek has highly suitable winter range distribution that is similar to Bitter Creek. Here the majority of high to moderately high habitat is also located in the floodplains near the confluence with Bear River. Elsewhere in the RSA Moose winter and summer habitat values are high in the Nelson and Willoughby drainages. These areas have extensive wetlands and riparian forests with high value snow interception cover and adjacent forage (see Appendix 6 for photos).

4.4 Marten

4.4.1 Identification and General Ecology

As of 2012, two species of Marten are recognized and found in British Columbia: American Marten (*Martes americana*) and Pacific Marten (*Martes caurina*) (Dawson and Cook 2012). The two species have been separated based on molecular and morphological variation, with no notable differences between their ecology (Dawson and Cook 2012). While the study area is primarily associated with the Pacific Marten, there is possible range overlap (especially toward the eastern edge of the RSA) and therefore potential for both species to be present (BC Conservation Data Centre 2016). Given that there was only one species of Marten (American Marten) recognized in BC between 1953 and 2012, the available data and records are all associated with the American Marten (Helgen and Reid 2016).

Breeding usually occurs between July and August, with delayed implantation of the embryos (Eder and Pattie 2001). Litters of 1 to 6 offspring are born between March and April (Eder and Pattie 2001). When the young are approximately 3 months old the female will re-enter estrus and the family disbands (Eder and Pattie 2001). The young can disperse 40 km or more away from the natal den (BC Conservation Data Centre 2016). Female American Martens have their first litter when they are between 2 and 3 years old (Eder and Pattie 2001).

4.4.2 Habitat

American Martens are opportunistic carnivores, though they will supplement their diet with seasonally available insects, eggs, berries, and vegetation (Takats 1996; Eder and Pattie 2001; BC Conservation Data Centre 2016).

American Martens will occupy deciduous or mixed upland or lowland forest habitat year round, but prefer mature, dominantly coniferous, forests (Eder and Pattie 2001; BC Conservation Data Centre 2016). Habitat selection is based on availability of cover from their predators as well as cover for their rodent prey. While American Martens do not occupy open, recently burned areas or cutblocks, they will use them for hunting subnivean prey, such as voles (Eder and Pattie 2001; BC Conservation Data Centre 2016). When inactive, American Martens will use a variety of cover such as holes in trees or stumps, conifer canopies, coarse woody debris, and rock or snow cavities (BC Conservation Data Centre 2016). Natal dens are usually in hollow trees or logs, lined with grass and leaves (Eder and Pattie 2001, BC Conservation Data Centre 2016).

4.4.3 Study Area Distribution

American Martens are widely distributed across British Columbia. They are found in every region in the province and in almost every biogeoclimatic classification (BEC) zone. The only notable exception is the open desert ecosystem of the southern interior (Hatler et al. 2008).

American Martens are well documented in BC, through harvest records and reported observations, including throughout the study area, which occurs within the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain-heather Alpine (CMA) biogeoclimatic classification (BEC) zones, all of which are associated with American Marten habitat (BC Conservation Data Centre 2016). The wildlife species inventory (WSI) database does not show any marten occurrences within the LSA, however there are large numbers of observations within the eastern portion of the RSA along the White River, Nelson, and Surprise Creek drainages.

American Martens inhabit a wide range of elevations, from sea level to high elevation alpine environments (BC Conservation Data Centre 2016)

4.4.4 Habitat Suitability

4.4.4.1 Habitat Use – Life Requisites and Seasons

Marten will use the Project area year-round but only one season is rated for the Marten: Winter-Living (Table 4-38). Life requisites for each month are outlined in Table 4-388 and are similar to those used in other Marten habitat models (Tripp 1999; EBA 2002; Jacques Whitford AXYS 2010).

Table 4-38. Monthly life requisites for Marten near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Food Security/Thermal
February	Winter	Food Security/Thermal
March	Winter	Food Security/Thermal Reproducing (birthing)
April	Spring (Growing)	Food Security Reproducing (birthing)
May	Spring (Growing)	Food Security
June	Summer (Growing)	Food Security
July	Summer (Growing)	Food Security
August	Summer (Growing)	Food Security
September	Fall (Growing)	Food Security
October	Fall (Growing)	Food Security
November	Winter	Food Security/Thermal
December	Winter	Food Security/Thermal

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Winter habitat is considered the most important life requisite for Marten (Watt et al. 1996) and Martens are adaptable to winter conditions. In areas where it is available, deep snow provides important thermal protection and cover during the winter months and where deep snow does not accumulate, other sources of cover, such as squirrel middens, may be used (Baltensperger 2009). Overall, forest structural stage is likely the main predictor of high quality habitat for winter.

4.4.4.2 Existing Habitat Models

Habitat models for Marten have been produced for other projects in northern BC. The models differ slightly in how seasonal life requisites are assigned. In the model by Rescan (2013), winter was considered the limiting time for Marten and was the only season modelled. In the model by Jacques Whitford AXYS (2010), year-round habitat is modelled. Despite this discrepancy, the models are similar since Marten use similar

habitat throughout the year (Jacques Whitford AXYS 2010). Both models give the highest ratings to closed canopy, low elevation, mature coniferous forests with high complexity and coarse woody debris. Open canopy, young, deciduous forests, or drier or wetter forests are rated lower. These models form the basis for the Marten habitat model developed for the Project.

4.4.4.3 Wildlife Habitat Ratings

A moderate amount of information on Marten habitat requirements is available, therefore a 4-class rating scheme is used (Table 4-40), similar to other models (Tripp 1999; Rescan 2013). Winter was assumed to be the limiting factor for Marten and therefore only winter habitat was rated. Winter habitat generally provides the necessary elements for two life requisites: feeding and thermal/security cover (Table 4-39).

Table 4-39. TEM attribute relationships for each winter life requisite for Marten

Life Requisite	*Habitat Attributes*
Feeding Habitat	• Elevation, slope, aspect, structural stage • Site disturbance • Canopy closure, percent cover by layer, species list by layer, coarse woody debris (CWD)
Thermal/Security Habitat	• Elevation, slope, aspect, structural stage • Site disturbance • Terrain texture • Canopy closure, percent cover by layer, species list by layer, coarse woody debris (CWD) • Individual wildlife tree characteristics (diameter at breast height [dbh], decay classes, cavity characteristics) • Snow cover

4.4.4.4 Provincial Benchmark for Marten Winter Habitat

The Engelmann Spruce Subalpine Fir dry cool (ESSFdk) subzone within the East Purcell Mountains (EPM) ecosection is considered the best winter habitat in the province. A regional benchmark for the South Boundary Ranges (SBR) has not been formally designated.

Table 4-40. Relative suitability classes to be assigned to Marten habitat polygons

Class	*Suitability*	*Attributes*
1	High	• Closed canopy, structural stage 6 or 7 coniferous forest on mesic to moist sites (CWH and MH zones)
2	Moderate	• Open canopy, structural stage 6 or 7 forest on wetter sites • Closed canopy, structural stage 4 or 5 coniferous forest on mesic to moist sites (CWH and MH zones)
3	Low	• Structural stage 4 or 5 floodplain forests
4	Nil	• BAFAunp and CMAunp zones • Structural stage 1-3 including open water and rivers

4.4.4.5 Habitat Ratings Assumptions

Table 4-41 outlines the specific mapping criteria and habitat ratings assumptions for Marten living (winter).

Table 4-41. Habitat suitability ratings assumptions for Marten Living-Winter

Class	*Rating*	*Assumptions*
1	High	• CWHwm, ICHvc,MHmm1 and 2: o structural stages 6-7 o canopy closure classes 6 to 9 (>60%)
2	Moderate	• CWHwm, ICHvc,MHmm1 and 2: o structural stages 6-7 o Canopy closure classes 5 and less (<60%)
3	Low	• CWHwm and MHmm1: o structural stages 2- 5
4	Nil	• CMAun and BAFun • All non-vegetated sites

General Habitat assumptions:

- Winter habitat is a limiting factor.
- Mature forests are high quality habitat. Forests with structural stage 6 or 7 are rated highest.
- Coarse woody debris and other ground features that provide complexity are preferred.
- Non-vegetated sites are rated Nil.
- CWH zone is rated higher than MH zone.
- CMAun is rated nil.

4.4.4.6 Habitat Ratings Adjustments

- Forests with closed canopies (>40% closure) are rated higher. Forests that are drier or wetter than normal are assumed to have reduced canopy closure and are rated lower.
- Coniferous forests are preferred and deciduous forests are reduced by one class.
- High coarse woody debris is preferred and forests with high CWD (>20%) are increased by one class.

4.4.4.7 Habitat Ratings Summary

Overall the model identified 1,157 ha (7.9%) of suitable (High and Moderate) winter habitat within the LSA for Marten (Table 4-42). Most of the winter habitat was limited to areas with mature and old-growth forests assumed to provide large coarse woody debris for Marten to access prey and thermal cover. Marten winter habitat was slightly higher in the RSA encompassing 10.5% of the RSA (21,706 ha).

Table 4-42. Habitat suitability ratings summary for Marten winter habitat

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
Living-Winter	High	10,530	5.1	573	3.9	5.4
	Moderate	11,176	5.4	584	4.0	5.2
	Low	8,592	4.4	2,567	17.5	29.8
	Nil	175,052	85.2	10,872	74.5	6.2

4.4.4.8 Habitat Model Evaluation

Field verification was conducted only in the LSA and was based on structural stage identification and presence of coarse woody debris. Structural stage was considered a surrogate measure for the abundance of coarse woody debris. The Marten winter model predictions matched 93% of the field ratings. No further adjustments were required. The same model was applied to the RSA and similar results were expected although no field verification was conducted in the RSA. The PEM model grouped structural stage 5 (young forests) in with structural stages 6 and 7 (mature and old-growth), possibly overestimating the amount of high value winter habitat for Marten.

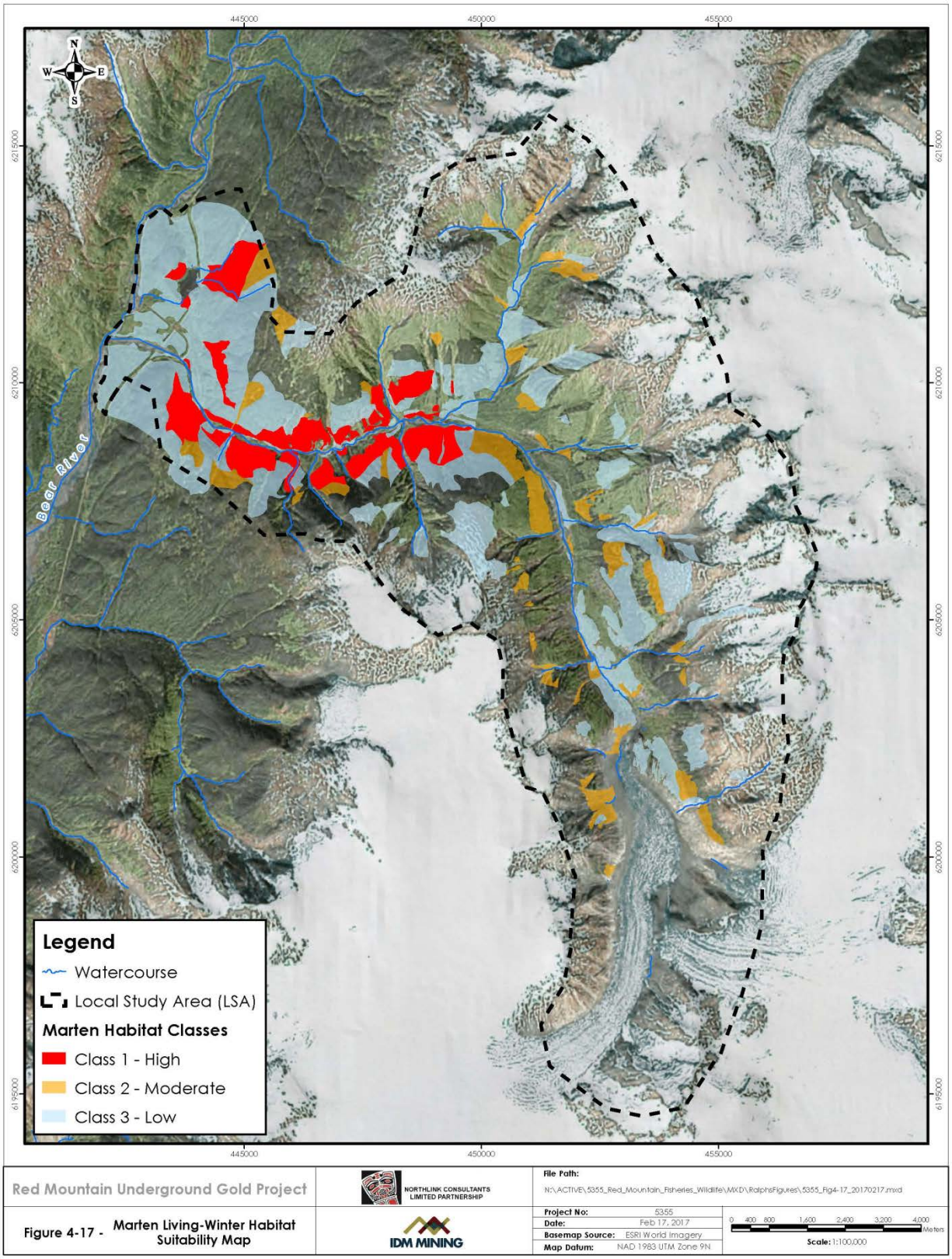
4.4.5 Field Surveys

No field surveys were conducted for American Marten and no detections were made incidentally during other surveys.

4.4.6 Conclusions

Suitable winter habitat for Marten is present throughout the forested ecosystems within the LSA.

Figure 4-17 Marten Living Winter habitat suitability map



4.5 Wolverine

4.5.1 Identification and General Ecology

Wolverines are the largest terrestrial member of the weasel family in North America. They are stocky and powerfully built which allows them to hunt and scavenge a wide variety of prey items. They have long fur which may be brown to black and a light stripe along their sides, often extending across the face and rump. Males are larger (12 to 16 kg) than females (7.5 to 11 kg; COSEWIC 2003).

Wolverines mate in the late summer and kits are normally born in February or March. Due to delayed implantation of embryos, the actual pregnancy is thought to be only 30 to 40 days (Hatler and Beal 2003). Wolverines are sexually mature at about two years. Pregnancy rate and litter size have opposite relationships with age: pregnancy rate is highest in young females, but litter size is highest in those over age 6. Combined, these factors contribute to a low overall reproductive rate (COSEWIC 2003; Persson et al. 2006).

Most large mammalian carnivores and also Golden Eagles (*Aquila chrysaetos*) feed on Wolverines, often as Wolverines attempt to scavenge food. However, almost half of mortalities are due to human causes (trapping, road mortality). Where trapping occurs, population growth may be negative, indicating the importance of recruitment from surrounding areas to maintain local population viability (COSEWIC 2003).

4.5.2 Habitat

Wolverine range and habitat are strongly related to the availability of prey species and they will be in the highest densities where their prey is abundant, although areas used by humans for recreation or resource extraction may be avoided (Krebs et al. 2007). Wolverines are opportunistic feeders and will scavenge or hunt for a wide variety of prey, from rodents to small ungulates. Large ungulates including Mountain Goat, Moose, Caribou (*Rangifer tarandus*), Elk (*Cervus elaphus*), and other species are mostly scavenged. Hoary Marmot is also commonly hunted. Cannibalism by other wolverines also occurs. Hunting is more common in the summer whereas scavenging is more common during winter. Wolverines may also cache food for winter months (COSEWIC 2003).

Aside from the presence of adequate prey, habitat is also determined by suitable reproductive denning sites. Dens are divided into two types: natal dens which are used for birth, and maternal dens which are used after birth has occurred but before kits have weaned. Natal and maternal dens may be associated spatially and may be reused in subsequent years (Magoun and Copeland 1998). Den characteristics are variable however they may be located in snow drifts, talus slopes, or deadfall (COSEWIC 2003); in general they are located at high elevations under at least 1 m of snow. Natal dens often have a single 25 to 35 cm opening (although some dens may have several) which often drops steeply at first then continues slowly descending to a

depth of up to 2.4 m under the snowpack. Dens may be between 14 and 35 m long, often with several side tunnels. Maternal dens may be located from several hundred metres to several kilometres from the natal den. Maternal dens may take advantage of natural crevices or chambers under snow formed by boulders, caves, trees, logs, or meltwater. They may form a complex of several dens hundreds of metres apart or be a single large den with many entrances. Multiple maternal dens may be used in a single season (Magoun and Copeland 1998).

4.5.3 Study Area Distribution

Globally, Wolverines have a Holarctic distribution which spans North America, Eurasia, and Scandinavia. Within North America they have been extirpated from much of their southern range, especially in the northeastern United States, although the range extends south along the Rocky Mountains into Colorado and there are isolated populations in Oregon and California. In Canada they are present across almost all of British Columbia, Yukon, Northwest Territories, and Nunavut. They are present in northern Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Labrador. Two subspecies are known to Canada: *Gulo gulo luscus*, which occurs throughout most of the range, and *G. g. vancouverensis* which occurs only on Vancouver Island (COSEWIC 2003). Wolverines are present in most of British Columbia. Historically they were present in the Lower Mainland and Sunshine Coast but have now been extirpated. There have been no recent observations of *G. g. vancouverensis* on Vancouver Island and this subspecies may be extirpated. They are not found on Haida Gwaii. In British Columbia the highest densities of Wolverines occur in the north and Rocky Mountains (COSEWIC 2003).

No specific occurrences of Wolverine are available through E-Fauna BC (BC Conservation Data Centre 2016). However the range map for Wolverine includes the Project area (COSEWIC 2014). This report will focus on *G. g. luscus* as the Project area is within the range of this subspecies. For the purpose of this report "Wolverine" will refer to the *luscus* subspecies unless otherwise specified. Wolverines are known to the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and CMA (Coastal Mountain-heather Alpine) biogeoclimatic classification (BEC) zones, which occur within the study area (BC Conservation Data Centre 2016). Wolverines are habitat generalists and will inhabit most areas where an adequate supply of food, particularly large ungulates, is present (COSEWIC 2003).

Wolverines are found at all elevations. In general, habitat use varies by season and Wolverines are more likely to occupy lower elevations during winter. Adult females occupy higher elevations (potentially to protect young). In some areas where large ungulate populations are present in mountains, Wolverines may be very abundant as they follow prey to these higher elevation summer foraging areas (COSEWIC 2003).

4.5.4 Habitat Suitability Modelling

4.5.4.1 Existing Habitat Models

Habitat suitability mapping for Wolverine is difficult due to the variety of terrain and environments it inhabits. Lofroth and Krebs (2007) developed a habitat suitability model to estimate Wolverine population in British Columbia. This model incorporates abundance of dominant prey species (Moose, Caribou, Elk, Mountain Goat, and Hoary Marmot), abundance of denning habitat, and road density to produce a five class rating scheme to predict Wolverine abundance (nil, rare, low, moderate, high). This model was the basis for Wolverine habitat suitability mapping for the Project.

4.5.4.2 Habitat Use – Life Requisites and Seasons

Following Tripp et al. (1999) two seasons were rated for the Wolverine: Growing and Winter. Life requisites for each month are outlined in Table 4-43.

Table 4-43. Monthly life requisites for Wolverine near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Feeding
February	Winter	Feeding Reproducing (birthing)
March	Winter	Feeding Reproducing (birthing)
April	Growing	Feeding Reproducing (birthing)
May	Growing	Feeding Reproducing (birthing)
June	Growing	Feeding Reproducing (birthing)
July	Growing	Feeding
August	Growing	Feeding
September	Growing	Feeding
October	Growing	Feeding
November	Winter	Feeding
December	Winter	Feeding

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.5.4.3 Wildlife Habitat Ratings

The attributes of suitable habitat for Wolverine are summarized in Table 4-44.

Table 4-44. Summary of habitat attributes for Wolverine reproduction

Habitat Use	*Attributes of Suitable Wolverine Habitat*	*Structural Stage[1]*
Living	High elevation habitat with abundant prey	1-7

Habitat Use	*Attributes of Suitable Wolverine Habitat*	*Structural Stage[1]*
Reproducing (birthing)	High elevation with deep snow pack at or just below the treeline	1-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Wildlife habitat ratings will be based on the following habitat suitability model:

HSI = Food + Den + Road

Where Food = prey availability; Den = denning and rearing habitat; and Road = road density.

4.5.4.4 Habitat Ratings Assumptions

A four-class rating scheme was used for Wolverine (Table 4-45) adapted from the five-class rating scheme by Lofroth and Krebs (2007). Habitat variables and assumptions are described in Table 4-46.

Table 4-45. Cross reference for HSI values with respect to habitat ratings classes

Overall Score	*Class*	*Interpretation*
0	Nil	Unsuitable. Habitat fails to provide minimum requirements and wolverines are not present.
1-6	Low	Wolverines are uncommon or are present but in low abundance. Normally associated with areas that have low ungulate abundance, are disturbed by human activity, and/or have unsuitable denning habitat.
7-12	Moderate	Good wolverine habitat but at least one of the variables (Food, Den, or Road) is suboptimal
12+	High	Optimal wolverine habitat with abundant prey and den sites with little human disturbance

Table 4-46. Habitat variable ratings assumptions table for Wolverine

Mapping Attribute	*Variable*	*Value*	*Score*
Food	% of area with moderate or high Moose abundance (>10/100 km^2)	0-20	1
		21-40	2
		41-60	3
		61-80	4
		81-100	5
	% of area with moderate or high Caribou abundance (>4/100 km^2)	0-5	0
		6-25	2
		26+	4
	% of area with moderate or high Elk abundance (>10/100 km^2)	0-5	0
		6-25	2
		26+	4

Mapping Attribute	*Variable*		*Value*	*Score*
	% of area with moderate or high Goat abundance (>7.7/100 km²)		0-5	0
			6-25	2
			26+	4
	# of other ungulate species in high abundance in ≥10% of the area: mule and white-tailed deer (>500/100 km²); bighorn and thinhorn sheep (>7.7/100 km²)		Tally	0-2
	Hoary Marmot abundance habitat (% of alpine tundra)		0-5	0
			6-15	0.33
			16-30	0.66
			30+	1
Den	% of alpine tundra		0-5	0
			6-15	1
			16-30	2
			30+	3
	Maximum % of:	Engelmann spruce, subalpine fir, mountain hemlock, spruce with birch in area	0-5	0
			6-15	1
			16-30	2
			30+	3
		Persistent April snow cover	Yes	1.5
Road	Road density (km/km²)		0	0
			0.1-1	0
			1.1-2	0
			2.1-3	-2
			>3	-5

Reproduced from Lofroth and Krebs (2007)

4.5.4.5 Habitat Ratings Adjustments

- Only Mountain Goat sign was observed during ground surveys of the Project area, therefore other ungulate species will be given an HSI value of 0 or 1 (as applicable).
- Hoary Marmots, White-tailed Ptarmigan, and Sooty Grouse are the only other significant prey species within the LSA.
- Aspect is not rated.
- Road Density adjustments were not made.

4.5.4.6 Habitat Ratings Summary

Suitable Wolverine habitat was spread throughout the LSA and RSA (Table 4-47) which is reflective of this species wide ranging and opportunistic nature.

Table 4-47. Habitat Suitability Ratings summary for Wolverine Living for both growing (summer) and winter seasons

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
Living-Growing	High	13,160.3	6.4	3,846	26.4	29.2
	Moderate	44,271.7	21.6	4,610	31.6	10.4
	Low	103,438.6	50.4	4,318	29.6	4.2
	Nil	44,479.4	21.7	1,820	12.5	7.9
Living-Winter	High	4,305.7	2.1	573	3.9	13.3
	Moderate	6,472.1	3.2	584	4.0	9.0
	Low	8,821.7	4.3	3,459	23.7	39.0
	Nil	185,750.6	90.5	10,806	74	5.8

4.5.4.7 Habitat Model Evaluation

The winter habitat suitability model correlated with field ratings 90% of the time and the summer habitat suitability model had a correlation of 95%. Summer was closely related to prey availability and therefore closely followed the Mountain Goat and Hoary Marmot ratings. As with the Mountain Goat model, the alpine fellfield (Map code Af) had been undervalued and the original correlation was only 60%. Adjustments were made to include map code Af as moderate summer habitat to reflect the importance to Wolverine prey species (Mountain Goat and Hoary Marmot) and as a result the correlation rose to 95% percent.

4.5.5 Field Surveys

No specific field surveys were conducted for Wolverine. One possible detection of Wolverine sign was made incidentally (9 U 454174 6201640) during one of the Mountain Goat transects (Appendix 5-4).

4.5.6 Conclusions

Wolverine summer and winter habitats are both present within the LSA. During the winter, suitable habitat is in the valley bottoms where potential prey species such as Moose may be found. During the summer, suitable habitat is available in the alpine and subalpine areas within the LSA. Within the LSA, the only prey species for Wolverine are Mountain Goat and Hoary Marmots for mammals while birds include White-tailed Ptarmigan and Sooty Grouse. Within the RSA there is much more opportunity for prey species, especially along the eastern boundary near Meziadin Lake and in the Nelson and Willoughby drainages. These areas support high Moose value habitat and likely a higher density of Moose than within the LSA.

Figure 4-18. Wolverine Living-Growing habitat suitability map

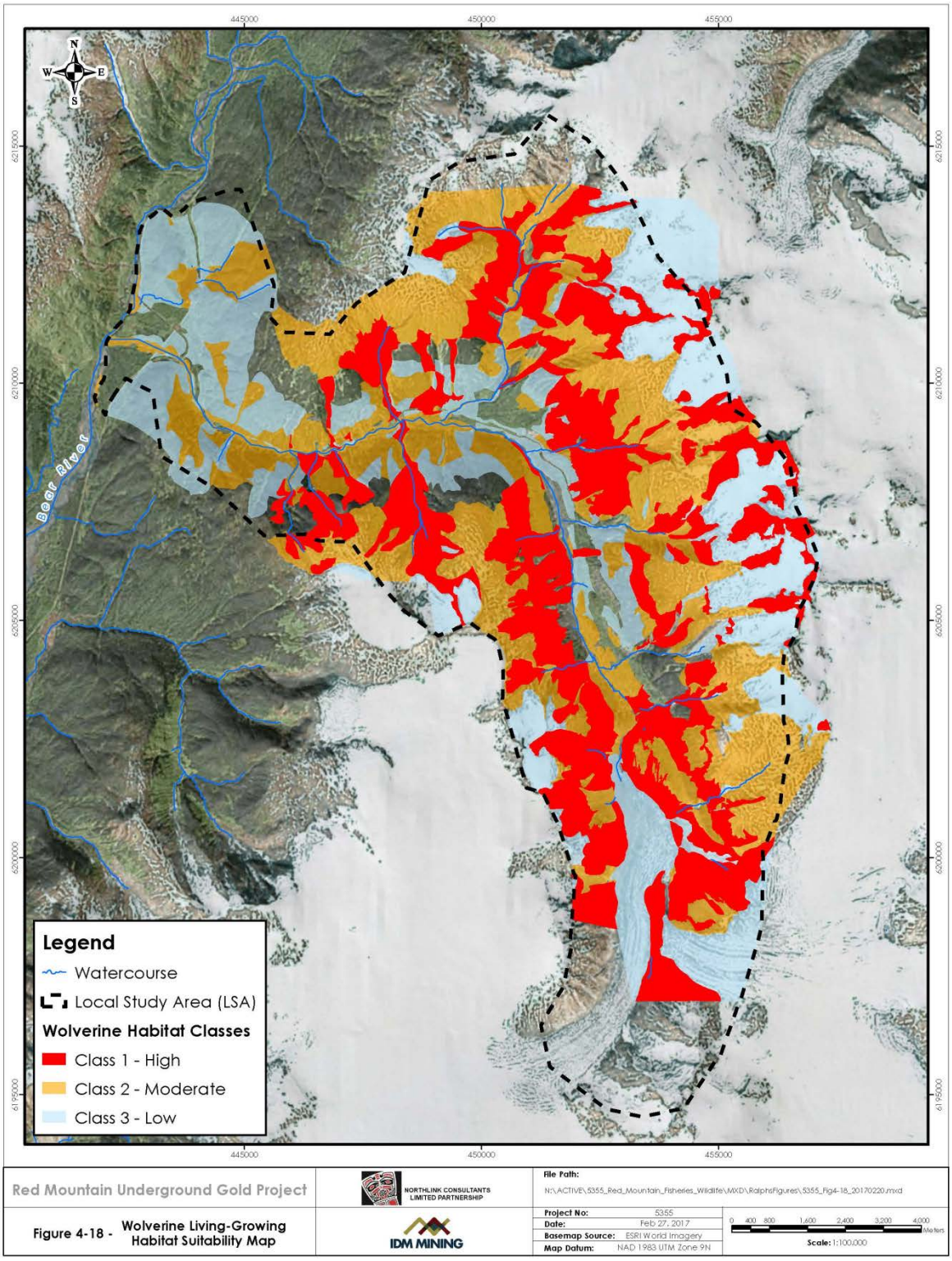
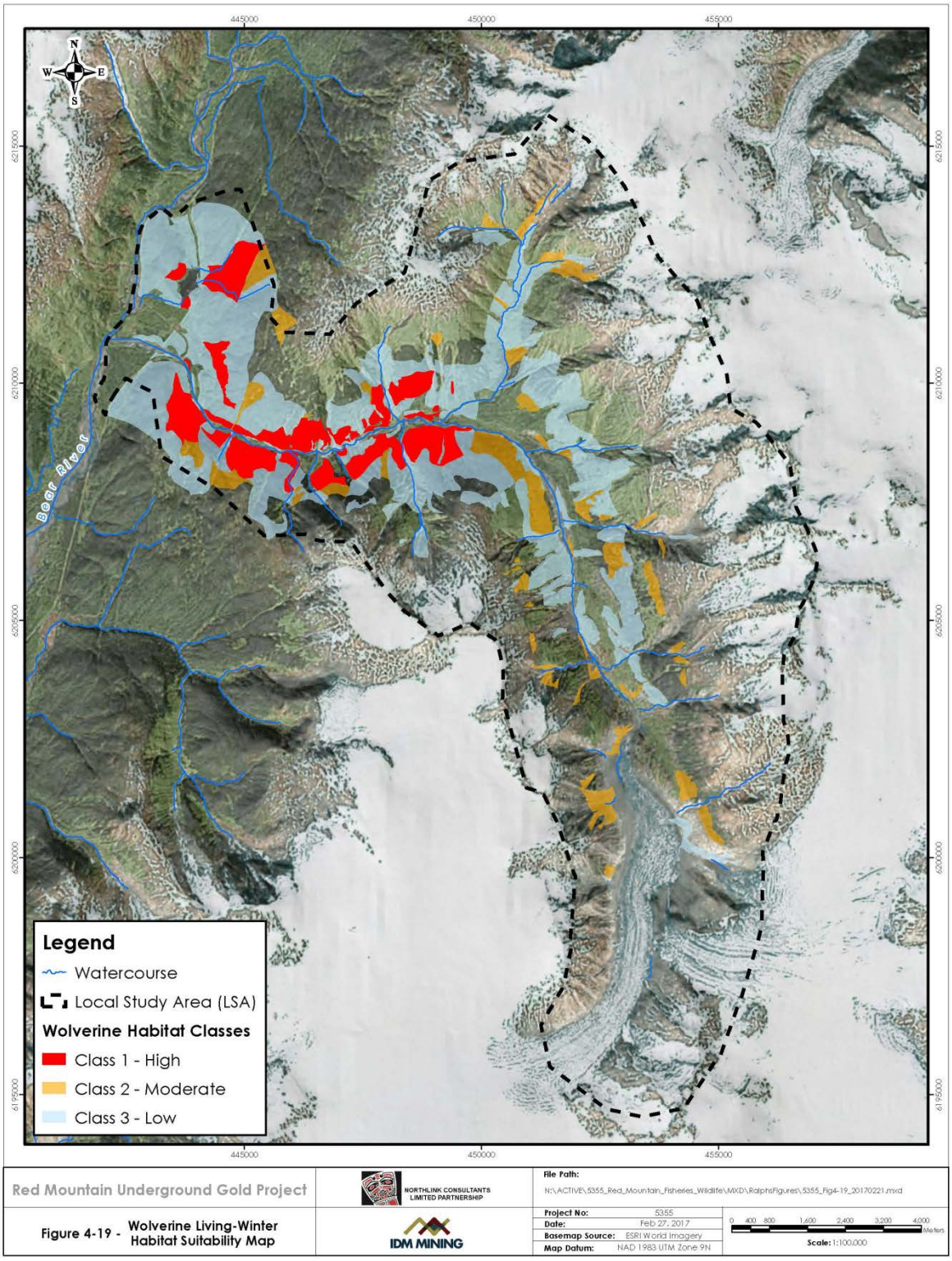


Figure 4-19. Wolverine Living-Winter habitat suitability map



4.6 Hoary Marmot

4.6.1 Identification and General Ecology

The Hoary Marmot (*Marmota caligata*) is the largest species of ground squirrel residing in British Columbia. On average, adults measure roughly 61 cm in length, and have a mass of 4.6 kg (Nagorsen 2005 and University of Alaska 2010 in Klinkenberg 2014). Five subspecies are known to occur throughout the province. Fur colour varies throughout the subspecies, however, in general the coat is usually white to grey, with a darker swath around the pale shoulder regions. It has a white nose with a white patch between the eyes on the snout. The head is blackish-brown, and the tail is short and bushy and varies in colour from pale brown to blackish-brown. It has slightly curved thick claws for digging. All-black animals are sometimes found in northern populations (Nagorsen 2005 in Klinkenberg 2014).

Breeding Ecology

Throughout its range, the *M. caligata* species is known to be both monogamous and polygamous. Adults generally breed every other year (sometimes only every 3 or 4 years), and mate in the spring after hibernation. Breeding may occur within hibernacula before emergence (Kyle et al. 2007), or shortly after emergence (Barash 1981).

The gestation period is typically 25 to 30 days, with one litter of two to four, or sometimes five young born in late May or mid-June. The young emerge from the birth den at about 3 to 4 weeks of age, at which time they are already beginning to be weaned. The young will typically stay with the colony until two years of age, at which time they will disperse, and become fully sexually mature the following year (Braun et al. 2011).

4.6.2 Habitat

The Hoary Marmot is a colonial species, living in social groups of up to 36 individuals (Braun et al. 2011). It is a diurnal species which is most active in the early morning or late afternoon (Nagorsen 2005 in Klinkenberg 2014). Individuals have relatively large home ranges (approximately 10 ha) (Blumstein 2009 in Klinkenberg 2014), and generally only travel large distances during the dispersal phase of juvenile offspring (Nagorsen 2005 in Klinkenberg 2014). The average lifespan of the species is approximately 5 years (Klinkenberg 2014). Social groups have been known to consist of one or two female adults, offspring from previous litters, and one adult male. Two-year-old offspring disperse in the spring if a new litter is born (Nagorsen 2005 in Klinkenberg 2014).

Hoary Marmots hibernate 7 to 8 months of the year, generally from September to April in British Columbia (Whitaker 1980). Hibernation typically occurs in a single burrow shared by all family members. Hibernacula are generally located near a viable spring food source (Nagorsen 2005 in Klinkenberg 2014). In addition to hibernating burrows, Hoary Marmots also construct specialized sleeping burrows, which usually contain several entrances, as well as refuge burrows, which are more simple structures. Refuge burrows are usually most numerous, and generally consist of a single hole which ranges

from 1 m to 2 m deep. Sleeping burrows and hibernacula are generally more complex than refuge burrows, may extend to a depth of approximately 3.5 m, and are often lined with plant material. A mature colony may have as many as 100 refuge burrows, 9 regular sleeping burrows, and generally 1 hibernaculum (Holmes 1984).

The diet of the Hoary Marmot includes grasses, sedges, leaves and forbs, as well as berries, roots, mosses, and lichens (Nagorsen 2005 in Klinkenberg 2014).

4.6.3 Study Area Distribution

Globally, the Hoary Marmot exists from Alaska to Yukon and Northwest Territories, south to northeastern Washington, central Idaho, and western Montana (BC Conservation Data Centre 2016).

Hoary Marmots can be found within most mountainous, high elevation areas of the British Columbia mainland, aside from lowland boreal forests of the northeast, and low elevation grasslands in the areas of the dry interior (Klinkenberg 2014).

The Hoary Marmot can be found in alpine and sub-alpine areas, within meadows, open forests of subalpine fir (*Abies lasiocarpa*) or subalpine larch *(Larix lyalii*), near rock slides, and on talus slopes or within burrows (Nagorsen 2005 in Klinkenberg 2014). It can often be found in habitats containing large boulders which are used for predator observation and basking in the sun (Banfield 1981).

Specific occurrences of Hoary Marmot within or near the Project area are not mapped, however this species is known to reside throughout all of British Columbia in the mountains and talus slopes, including that of the study area.

Elevation Range

Hoary Marmots are found at elevations ranging from 1,250 m to 2,450 m (Nagorsen 2005 in Klinkenberg 2014).

4.6.4 Habitat Suitability

4.6.4.1 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Hoary Marmot which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-48). Life Requisites include Living and Hibernating.

Living

The Hoary Marmot resides in open areas with good visibility and available vegetative food resources such as grasses and forbs. It is found in habitats with deep soil which is suitable for excavation of burrows as well as boulders and rock ledges used for perches. It feeds in and around den areas and will travel up to 100 m from dens to feed (Banfield 1981).

Hibernating

Hoary Marmot hibernates in deep burrows lined with plant material from September to April in British Columbia. During hibernation it survives on stored body fat.

Table 4-48. Life Requisites of the Hoary Marmot within the Project area (near Stewart, BC) rated by month and season

Hoary Marmot Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Winter	Hibernating
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Summer)	Living
September	Winter	Hibernating
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.6.4.2 Wildlife Habitat Ratings

The attributes for suitable Living and Hibernating Life Requisites in relation to specific ecosystem attributes are summarized in Table 4-49.

Table 4-49. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Hoary Marmot

Hoary Marmot Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: elevation, slope, aspect, structural stage • Soil/Terrain: terrain texture, deep soils • Vegetation: % cover by layer, plant species • Boulder fields, talus, rock slides
Hibernating Habitat	• Site: elevation, slope, aspect, structural stage • Soil/Terrain: terrain texture, deep soils • Vegetation: % cover by layer, plant species • Boulder fields, talus, rock slides

An intermediate level of knowledge exists on the habitat requirements for the Hoary Marmot, therefore a 4-class rating scheme will be used.

The habitat requirements for the Hoary Marmot are summarized by season and structural stage in Table 4-50. Detailed descriptions of habitat ratings assumptions for Hoary Marmot are outlined in Table 4-51.

Table 4-50. Summary of habitat requirements for Hoary Marmots by season and structural stage

Hoary Marmot Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Alpine and subalpine meadows with deep soils, talus, boulder fields	2-3
Winter	Hibernating	Alpine and subalpine meadows with deep soils, talus, boulder fields	2-3

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

4.6.4.3 Habitat Ratings Assumptions

- Alpine and subalpine meadows (structural stage 2) with deep soils and moderate warm aspects (<30% slope, 135 to 185° aspect), will be rated High (Class 1).
- Large talus and boulder fields will be rated Class 1.
- Cool aspects and shallow soils will be rated downward to Class 2.
- Wet areas will be rated downward by one class.
- Very shallow soils will rate Nil (Class 4).
- All habitat below 1,200 m will be rated Nil (Class 4).

Table 4-51. Habitat ratings assumptions for Hoary Marmot Living-Summer

Hoary Marmot Living	
Ratings	**Assumptions**
1 (High) [75-100%]	• CMAun and MHmmp: o Above 1,200 m and o Structural stage 2 and o Moderate slope (<30%); and o Warm aspect (135 - 285°) • Large blocky talus (Rt) o Moderate slopes (<30 %); and o warm aspect (135 - 285°)
2 (Moderate) [25-75%]	• CMAun and MHmmp: o Above 1,200 m and o Structural stage 1 and 3a o Moderate to steep slopes (30 -60%); and o warm aspect (135 - 285°) • Large blocky talus (Rt) o Moderate to steep slopes (30 -60%); and o warm aspect (135 - 285°)

Hoary Marmot Living	
Ratings	**Assumptions**
3 (Low) [1-25%]	• CMAun, MHmmp, and MHmm1: o Above 1,200 m and o Structural stage 3b to 7 • steep slopes (>60%); and o cool aspect (286 - 134°) • Large blocky talus (Rt) o steep slopes (>60%); and o cool aspect (286 - 134°)
4 (nil) [0%]	• All habitats below 1,200 m

4.6.4.4 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

4.6.4.5 Habitat Ratings Summary

Habitat suitability ratings modelled for Hoary Marmot Living–Growing resulted in 59.1 ha (0.7%) of high value habitat being identified (Table 4-52). Only the MHmmp and CMAun zones were modelled for Hoary Marmot based on the assumption that the CWHwm and MHmm1 zones (below 1,200m elevation) are not used by Hoary Marmot.

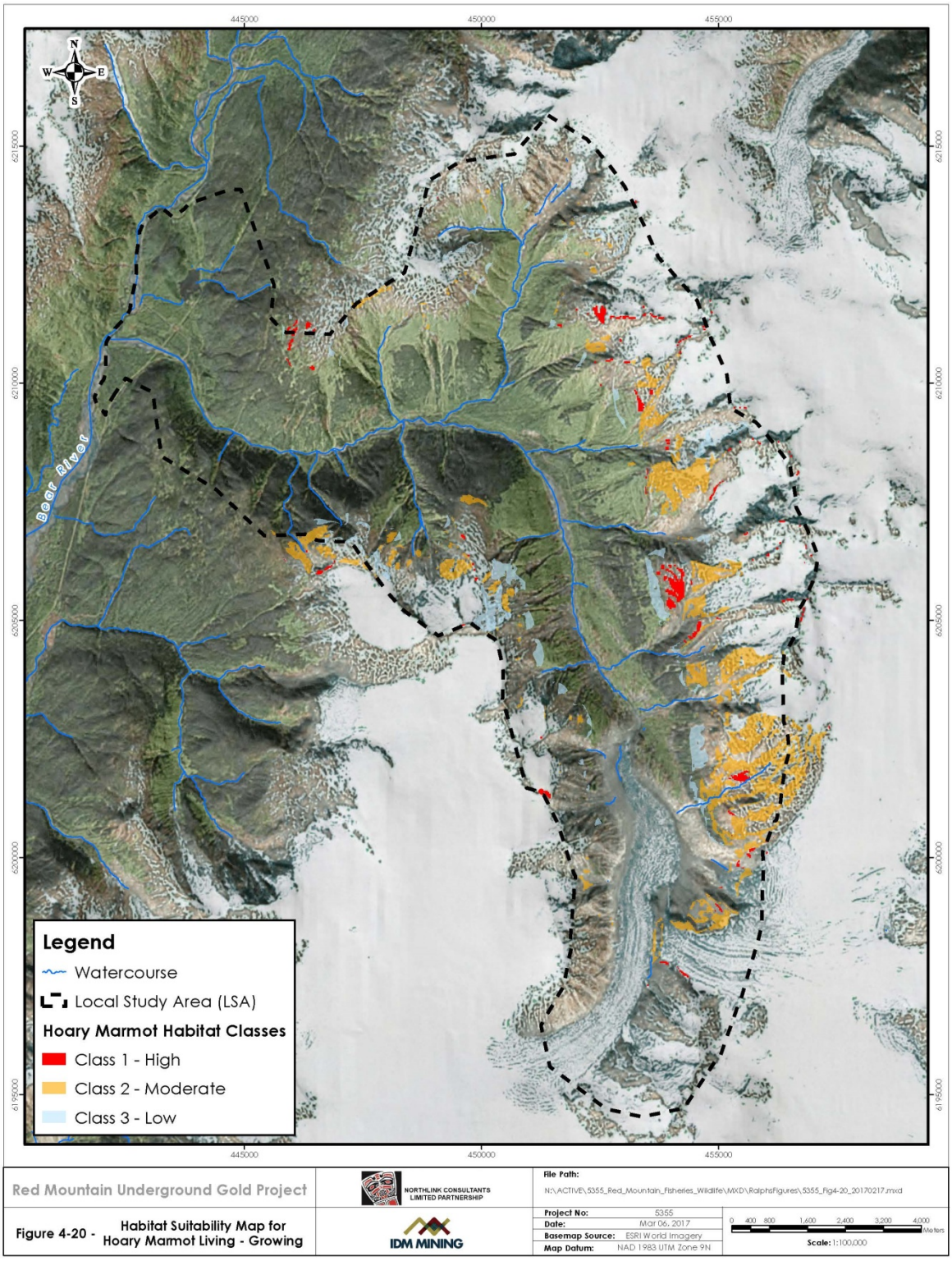
Table 4-52. Habitat suitability ratings summary for Hoary Marmot

Life Requisite	***Habitat Suitability Rating***	***LSA***	
		Area (ha)	**Area (%)**
Living-Growing	High	59.1	0.7
	Moderate	684.2	8.3
	Low	245.3	2.9
	Nil	7235	87.9

4.6.4.6 Habitat Model Evaluation

Suitable growing habitat for Hoary Marmot identified by the wildlife habitat suitability model agreed with the field ratings 95% of the time. No further model adjustments were necessary.

Figure 4-20. Habitat suitability map for Hoary Marmot



4.6.5 Field Surveys

No specific field studies were carried out for Hoary Marmot, however incidental observations were made during other surveys in both 2015 and 2016. Hoary Marmot habitat and sign (including potential burrows, scat, and tell-tale "whistling" alarm calls) were opportunistically recorded throughout the higher elevations of the LSA (Table 4-533).

Table 4-53. Incidental observations of Hoary Marmots within the LSA

Observation type	*Date*	*UTM*	*Elevation (m)*	*Structural Stage*	*Evidence of Use*
Incidental	Aug 13, 2015	9U 455757, 6201748	1500	3a (Mtn Heather)	Scat
Incidental	Aug 13, 2015	9U 456719 6201613	1512	2 Heather/lichen	Burrow
Incidental	Aug 14, 2015	9 U 454671 6203921	1410	2 Heather/lichen	Hoary Marmot
Incidental	Aug 14, 2015	9 U 454536 6203991	1360	3a (Mtn Heather)	Hoary Marmot Kill
Incidental	Aug 16, 2015	9 U 455069 6201514	1425	3a (Mtn Heather)	Hoary Marmot
Incidental	Jul 7, 2016	9 V 450208 6206864	1320	2 Heather/lichen	Burrow
Incidental	Jul 7, 2016	9 V 450208 6206864	1320	2 Heather/lichen	Hoary Marmot at burrow entrance
Incidental	Jul 7, 2016	9 V 450208 6206864	1320	2 Heather/lichen	Burrow x 3
Incidental	Jul 7, 2016	9 V 450066 6206803	1411	2 Heather/lichen	Burrow
Incidental	Jun 7, 2016	9 U 454563 6203930	1370	Blocky Talus/ Heather Meadow	Colony, multiple entrances, multiple individuals whistling

4.6.6 Wildlife Cameras

Hoary Marmots were recorded on wildlife cameras 704 times on four separate cameras between June and August 2016 (Table 4-54). All Hoary Marmot detections were made on cameras located in the alpine zone.

Table 4-54. Summary of Hoary Marmot detections on wildlife cameras

Camera	Date Range	Hours deployed	Total Marmot Detections	Total # species
TC 4	June 7 – August 31	2,060	59	5
TC 8	July 5 – August 31	1,396	38	1
TC 9	July 5 – August 31	1,388	307	6
TC 10	July 6 – August 31	1,367	300	2

Figure 4-21. Hoary Marmot taken by Wildlife Camera TC9

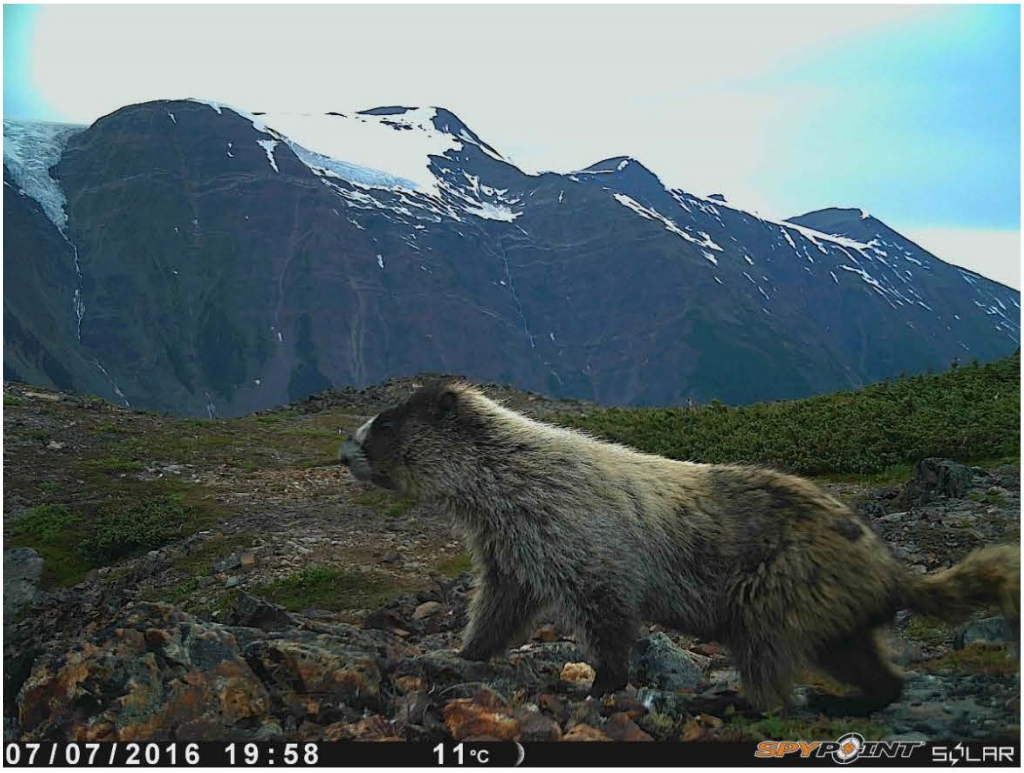


Figure 4-22. Hoary Marmot den entrance and scat near mine camp (UTM 9 U 455829 6201746)

Figure 4-23. Hoary Marmot den site in Mountain Heather near mining camp (UTM 9 U 455829 6201746)

Figure 4-24. Large blocky talus surrounded by Mountain Heather and herbaceous alpine meadow represents class 1 (high) suitability habitat for Hoary Marmots (UTM 9 U 454563 6203930)

Figure 4-25. Hoary Marmot remains likely preyed upon by a large raptor. These remains were also investigated by Black Bear (based on fresh scat pile close by UTM9 U 454536 6203991).

4.6.7 Conclusions

As expected, the wildlife habitat suitability model predicted Hoary Marmot summer habitat throughout the alpine zone within the LSA. A total of 59 ha of highly suitable habitat was identified and all areas where Hoary Marmots were recorded during incidental observations corresponded with these high habitat ratings. A significant colony exists in the Goldslide Creek basin in the alpine heath meadows above the existing mine camp. Other colonies occur throughout the LSA where suitable talus slopes are found in close proximity to forage.

4.7 Bats

4.7.1 Little Brown Bat

4.7.1.1 Identification and General Ecology

Little Brown Bat (*Myotis lucifugus*) is a medium-sized bat species, with an average length of 86 mm, wingspan of 248 mm, and an average weight of 6.2 grams. Fur colour is variable throughout the species, with back fur ranging in colour from yellow or olive (common in individuals within the dry interior) to blackish (coastal populations). Hair on the back has long, glossy tips. The fur on the underside is generally lighter, ranging from light brown to tan. The wing membranes and ears are dark brown. When pushed forward, the ears reach the nostrils. The skull is gradually sloped (Nagorsen and Brigham 1993 in Klinkenberg 2014).

Breeding Ecology

Mating usually occurs in late summer and early autumn, generally in September and October (BC Conservation Data Centre 2016), before entering hibernation. Fertilization occurs after hibernation in the spring. Males do not breed in their first autumn (Nagorsen and Brigham 1993 in Klinkenberg 2014), and in British Columbia females generally do not produce young until their second year (Herd and Fenton 1983). During wet years, individuals may delay or may not reproduce (Grindal et al. 1992).

Annually, reproductive females give birth to one litter containing one young in late spring or early summer. Gestation typically lasts 50 to 60 days (Herd and Fenton 1983; Nagorsen and Brigham 1993 in Klinkenberg 2014). In the southern Okanagan, females are known to give birth between mid-June and mid-July, however birth dates likely occur a little later in coastal areas of higher elevation and latitude (Nagorsen and Brigham 1993 in Klinkenberg 2014). The Little Brown Myotis is thought to have a long lifespan, with some individuals living between 20 and 30 years. Females may remain reproductive up until 12 years of age (Hall et al. 1957; Keen and Hitchcock 1908). Newborn young weigh between 1.0 and 1.5 grams, and are capable of flying and eating solid food by three weeks of age (Nagorsen and Brigham 1993 in Klinkenberg 2014).

4.7.1.2 Habitat

The Little Brown Myotis can be found in various habitats ranging from dry open forests and riparian areas at low elevations to several higher elevation habitats including forested and riparian areas, and caves and abandoned mines while hibernating. Summer roosts occur in tree cavities, rock crevices, caves, under the bark of trees, and within man-made structures. During the summer, males and females live separately. Females assemble in nursery colonies located in sites with hot (30 to 55°C) temperatures, generally in buildings, or infrequently within hollow trees (BC Conservation Data Centre 2016). Males can be found in the summer roosting alone, or in small sites which are generally cooler that nurseries (Nagorsen and Brigham 1993 in Klinkenberg 2014).

During the winter, the bat hibernates in caves, tunnels, in old abandoned mines, or similar sites (BC Conservation Data Centre 2016), but is not known to hibernate in buildings (Nagorsen and Brigham 1993 in Klinkenberg 2014). Hibernacula usually have stable temperatures that range from 2 to 12°C. In the northeast the Little Brown Myotis may migrate hundreds of kilometres between summer and winter ranges, however in the west, the species is thought to hibernate near their summer range (Schmidly 1991). In late summer or early autumn, adults and young-of-the-year may make nocturnal flights through caves and mines looking for potential hibernacula. This generally occurs in July as the nursery colonies disband and continues until hibernation begins in September or October depending on local climate conditions. The bats select areas within the hibernaculum which contain high humidity (70 to 95%), and where the temperature remains above freezing (1 to 5°C). Within the interior, hibernation may last until April or early May, but bats may arise as early as mid-March in warmer coastal areas (Nagorsen and Brigham 1993 in Klinkenberg 2014).

4.7.1.3 Study Area Distribution

Globally, the Little Brown Myotis exists within North America. The wide range of the species includes from the Alaska-Canada boreal forest south through most of the United States. The southwestern boundary of the range is southern California (excluding the extreme southeast) to Nevada, northern Utah and Colorado, and may include parts of northeastern New Mexico. The heart of the range is thought to be the northeastern United States and boreal Canada, with smaller populations occurring in the southern and western United States (BC Conservation Data Centre 2016).

The Little Brown Myotis occurs throughout a various range of habitats, including arid grassland and Ponderosa Pine ecosystems to humid coastal and northern forest ecosystems. The bat's range is thought to extend as far north as the treeline, and can be found throughout the mainland of British Columbia, as well as on several islands, including Vancouver Island and Haida Gwaii (Nagorsen and Brigham 1993 in Klinkenberg 2014).

Three subspecies of *M. lucifugus* are known to occur within the province. *M. lucifugus alascensis* is a dark subspecies which ranges from Alaska to California, and is found throughout most of British Columbia. *M. lucifugus carissima* is thought to exist in British Columbia in the dry southern interior, and *M. lucifugus* is a widespread subspecies which is found across eastern and central North America, however it is thought to occur provincially only in the extreme northern region of British Columbia (Nagorsen and Brigham 1993 in Klinkenberg 2014).

Specific occurrences of the Little Brown Myotis within close proximity to the Project area are not mapped, however this species is known to reside throughout most of British Columbia, including within BEC zones located within the study area. Additionally, presence has been confirmed through field observation within the study area.

The bat has been recorded as occurring from sea level on the coast up to 2,288 m in the Rocky Mountains, and is thought to have the greatest altitudinal range of all of the bat species within British Columbia. Males may be more abundant than females at higher elevations (Nagorsen and Brigham 1993 in Klinkenberg 2014).

4.7.1.4 Habitat Suitability Modelling

Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Little Brown Myotis which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-55). Life Requisites include Living and Hibernating.

Living

The Little Brown Myotis is found in various habitats including dry open forests, wet riparian areas, as well as mesic and wetter forests and riparian areas at higher elevations. They often forage near bodies of water, consuming insects, and are able to adjust their summer habitats based on insect abundance. Little Brown Myotis has also been found to frequently forage in the forest within close range of its roost. During the growing season, reproductive females and young will reside in nursery colonies within structures where temperatures are hot. Males will roost alone or in small colonies in roosts where the temperatures are cooler.

Hibernating

The species hibernates in caves, tunnels, abandoned mines, or similar structures, surviving off of stored body fat, from October to March on average in British Columbia.

Table 4-55. Life Requisites of the Little Brown Myotis within the Project area rated by month and season

Little Brown Myotis Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Living
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Late Summer)	Living
September	Growing (Fall)	Living
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Wildlife Habitat Ratings

The attributes for suitable Living Life Requisites in relation to specific ecosystem attributes are summarized in Table 4-56. Hibernating habitat of the Little Brown Myotis is difficult to fit into the parameters set out by TEM and therefore only Living for the growing season will be rated.

Table 4-56. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Little Brown Myotis

Little Brown Myotis Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: site disturbance, elevation, slope, structural stage • Vegetation: % cover by layer • Mensuration: tree species, wildlife characteristics • Cliffs, caves

A low to intermediate level of knowledge exists on the habitat requirements for the Little Brown Myotis, therefore a two-class rating scheme will be used.

The habitat requirements for the Little Brown Myotis are listed in Table 4-57 and the detailed habitat ratings assumptions are outlined in Table 4-58.

Table 4-57. Summary of habitat requirements for Little Brown Myotis by season and structural stage

Little Brown Myotis Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Mature to old Forests, near cliffs, lakes and rivers	2-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Habitat Ratings Assumptions

- Wet forests will be rated High (Class 1) due to the likelihood of high insect concentration.
- Open water, ponds, and wetlands will rate High (Class 1).
- Areas with cliffs and old-growth stands with large snags will rate High (Class 1).

Table 4-58. Habitat ratings assumptions for Little Brown Myotis – Living

Little Brown Myotis - Living	
Ratings	**Assumptions**
1 (Useable) [6-100%]	• Wet forest units in structural stages 2/3 or 6/7: o CWHwm 04, 08 & 09; and o Below 1,200 m • Low to mid elevation wetlands, lakes and rivers (<1,200 m) • Low to mid elevation (0 to 1,200 m) riparian flood plains o CWHwm and MHmm1: 05, 06, & 07 • Cliffs below 1,200 m elevation
2 (Likely No Value) [<5%]	• All other habitats not listed above

Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

Habitat Ratings Summary

Habitat suitability was rated only for the ecosystem units within the LSA (Table 4-59). No ratings are given for the RSA. Overall the habitat model identified approximately 20% of the LSA as useable habitat for Little Brown Myotis during the summer growing season.

Table 4-59. Habitat Suitability for Little Brown Myotis within the LSA only

Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
Living-Growing	Useable	NC	NC	2,893	20%	NC
	Likely No Value	NC	NC	11,702	80%	NC

NC = Not Calculated

4.7.2 Keen's Myotis

4.7.2.1 Identification and General Ecology

Keen's Myotis (*Myotis keenii*) is a small, long-eared, dark brown bat with light brown or buff ventral fur, and dark shoulder patches (Eder and Pattie 2001; COSEWIC 2003). Visually, it is very similar to the Long-eared Myotis (*Myotis evotis*), which, given their over-lapping range in southwestern British Columbia, can make identification difficult and often unreliable based on external traits (COSEWIC 2003). Accurate identification requires dental and cranial analysis of collected specimens in a lab (COWSEIC 2003). However, the range of the Long-eared Myotis is not documented extending as far north as the study area. Home ranges of Keen's Myotis are typically small, with individuals

documented only travelling a maximum of 1 km away from their capture site (CDC 2016).

It is assumed that, like other Myotis species, mating occurs in the autumn, before or during the hibernation period and that after mating females store the sperm until ovulation and subsequent fertilization in the spring (COSEWIC 2003). Pregnant females will leave their hibernacula to move to traditional maternity roosts between April and May to give birth to a single offspring after a 40 to 60 day gestation period (COSEWIC 2003). The young are often capable of flight within 3 weeks of birth, but will continue to nurse until they are approximately 5 weeks old (COSEWIC 2003). It is likely that juveniles won't be ready to reproduce until their second year (COSEWIC 2003). It is assumed that Keen's Myotis is capable of using torpor to survive periods of inclement weather and hibernation during the winter months.

4.7.2.2 Habitat

Keen's Myotis is a nocturnal insectivore. It is a slow but maneuverable flyer which catches and consumes flying insects from forests, often near water but seldom over open water (COSEWIC 2003). It is also able to glean insects from surfaces, allowing it to survive periods of inclement weather when insect flight and echolocation are limited (COSEWIC 2003; CDC 2016). Keen's Myotis will usually leave its roost approximately 30 minutes after sunset and forage for insects until about 2 hours before sunrise, when it returns to its roost (COSEWIC 2016). Insects consumed primarily consist of lepidopterans, arachnids, dipterans, and neuropterans (COSEWIC 2003; CDC 2016). While there is little information available on Keen's Myotis habitat use, it appears to occur in mature/old-growth, primarily coniferous, forests where its short broad wings and sensitive hearing allow it to forage for insects in spatially complex habitat (COSEWIC 2003).

During the day, Keen's Myotis roosts in a variety of natural habitats, including caves, tree cavities, bark crevices, and rock crevices, but will also make use of anthropogenic structures, such as houses and bridges (COSEWIC 2003; CDC 2016). These roosts are used by non-reproductive females and males in the spring, while reproducing females use and re-use established maternity roosts (COSEWIC 2003). In British Columbia, only two maternity roosts are documented, both on Haida Gwaii and adjacent to hot springs in geothermally heated rock crevices (COSEWIC 2003). Non-reproductive individuals may use maternity roosts later in the summer, once offspring have become independent (COSEWIC 2003).

While there are currently no data on hibernacula on the mainland, on Vancouver Island and Haida Gwaii Keen's Myotis hibernates during winter deep within (approximately 100 m) mid-elevation caves at 550 to 945 m above sea level (COSEWIC 2003; CDC 2016). These caves remain at a stable temperature between 2.4 and 4.0°C (COSWIC 2003). Keen's Myotis will swarm around the hibernacula around August and September to breed and to build up hibernating populations (COSEWIC 2003; CDC 2016).

4.7.2.3 Study Area Distribution

Globally, Keen's Myotis exists only within North America and is restricted to the Pacific coast, specifically to southeastern Alaska, western British Columbia, and northwestern Washington State (COSEWIC 2003). In British Columbia, Keen's Myotis is limited to the temperate coastal rainforests, west of the Coast Mountains, including Haida Gwaii and Vancouver Island (COSEWIC 2003).

There are no mapped occurrences of Keen's Myotis in close proximity to the study area, the nearest mapped occurrence being around Hazelton, BC (MOE 2008). This species is known to occupy the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) Biogeoclimatic (BEC) zones, both of which occur within the study area (CDC 2016). Keen's Myotis has been recorded as occurring in caves between 4 m to 945 m above sea level, with the higher elevation caves being used as hibernacula (COSEWIC 2003).

4.7.2.4 Habitat Suitability Modelling

Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of Keen's Myotis which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-60). Life Requisites include Living and Hibernating.

Living

Keen's Myotis is found in mature/old-growth coastal rainforests. It forages within forests, consuming insects. During the growing season, reproductive females and young will reside in maternity roosts within structures where temperatures are consistently warm. Males and non-reproductive females will roost alone or in small colonies in roosts outside of the maternity roost until later in the summer, when they may join the maternity colony.

Hibernating

The species hibernates in mid-elevation caves, surviving off of stored body fat from October to May in British Columbia.

Table 4-60. Life Requisites of Keen's Myotis rated by month and season

Keen's Myotis Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Living
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Late Summer)	Living

Keen's Myotis Life Requisites		
Month	***Season****	***Life Requisites***
September	Growing (Fall)	Living
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Wildlife Habitat Ratings

The attributes for suitable Living Life Requisites in relation to specific ecosystem attributes are summarized in Table 4-61. Hibernating habitat of Keen's Myotis is difficult to fit into the parameters set out by TEM and therefore only Living for the growing season will be rated.

Table 4-61. Terrestrial Ecosystem Mapping (TEM) relationships for Living Life Requisite of the Keen's Myotis

Keen's Myotis Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: elevation, slope, structural stage • Vegetation: % cover by layer • Mensuration: tree species, wildlife characteristics • Cliffs, caves • Water body features

A limited level of knowledge exists on the habitat requirements for Keen's Myotis, with many inferences on its ecology based on the similar Long-eared Myotis species; therefore a two-class rating scheme will be used.

The habitat requirements for the Keen's Myotis are listed in Table 4-62 and detailed habitat ratings assumptions are outlined in Table 4-63.

Table 4-62. Summary of habitat requirements for Keen's Myotis by season and structural stage

Keen's Myotis Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Old-growth coniferous forests, near cliffs, lakes and rivers	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Habitat Ratings Assumptions

- Wet forests will be rated High (Class 1) due to the likelihood of high insect concentration.
- Open water, ponds, and wetlands will rate High (Class 1).
- Areas with cliffs and old-growth stands with large snags will rate High (Class 1).

Table 4-63. Habitat ratings assumptions for Keen's Myotis

Keen's Myotis Living		
Ratings	**Code**	**Assumptions**
1 (Useable) [6-100%]	U	• Wet forest units in structural stages 2/3 or 6/7: o CWHwm 04, 08 & 09; and o Below 600 m • Low elevation wetlands, and lakes (<600 m) • Cliffs below 600 m elevation
2 (Likely No Value) [<5%]	X	• All other habitats not listed above

Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape, proximity to open areas (burns, clearcuts), and proximity to structures.

Habitat Ratings Summary

Habitat suitability was rated only for the ecosystem units within the LSA. No ratings are given for the RSA. Overall the habitat model identified approximately 20% of the LSA as useable habitat for Keen's Myotis during the summer growing season (Table 4-64).

Table 4-64. Habitat Suitability summary for Keen's Myotis within the LSA only

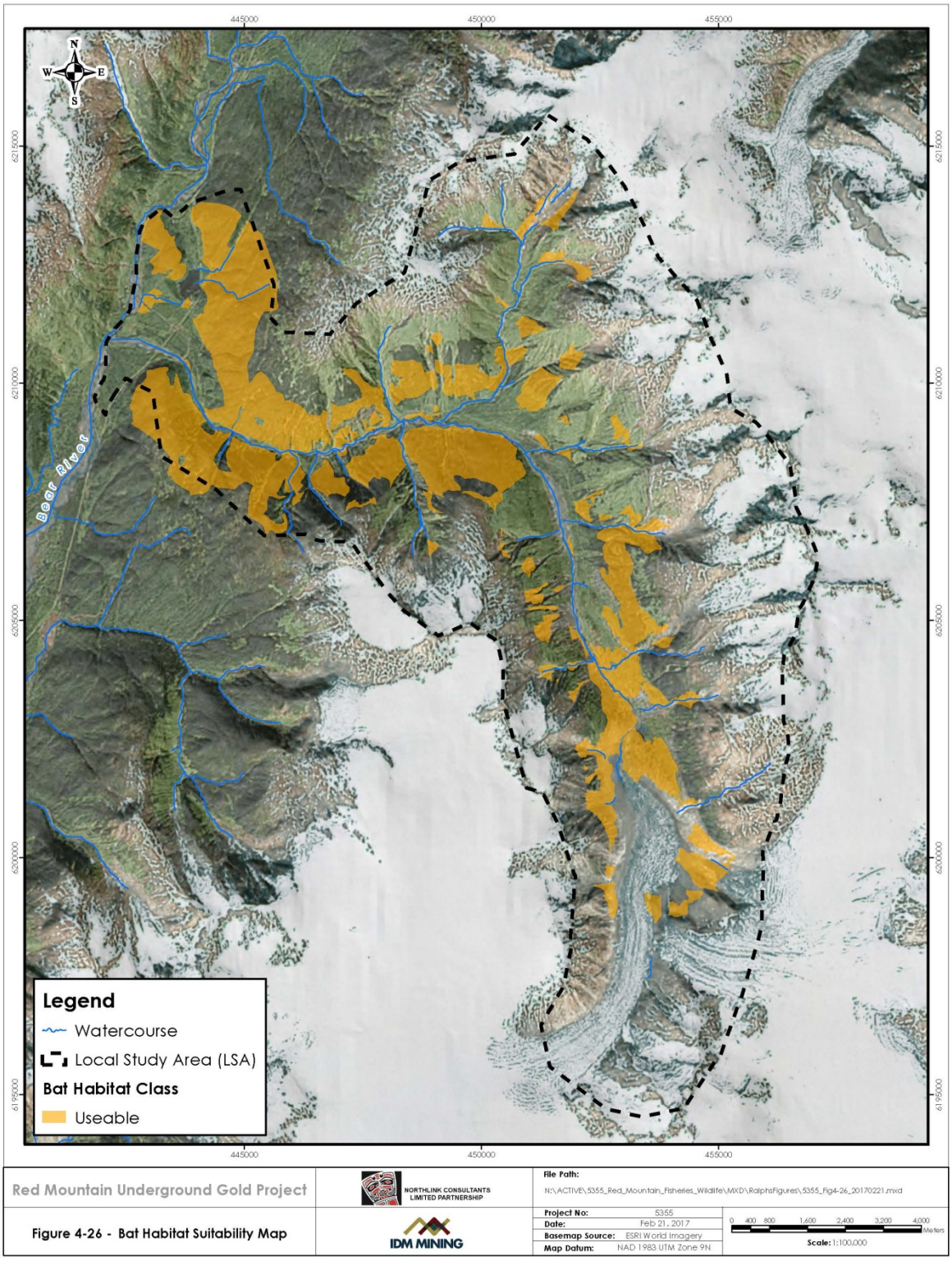
Life Requisite	*Habitat Suitability Rating*	*RSA*		*LSA*		*Proportion of Habitat in the LSA relative to the RSA (%)*
		Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**	
Living-Growing	Useable	NC	NC	2,893	20%	NC
	Likely No Value	NC	NC	11,702	80%	NC

NC = Not calculated

4.7.2.5 Habitat Model Evaluation

Overall, the suitability model predicted useable habitat fairly well. All areas identified as potential bat habitat during the 2015 and 2016 field visits were classified as useable by the model. This included the three locations where bat detectors were deployed.

Figure 4-26. Bat Living-Growing season habitat suitability map



4.7.3 Field Surveys

SM3BAT detectors from Wildlife Accoustics were deployed at three potential sites within the LSA from June 8 to August 31, 2016. SM3BAT detectors were used because of their ability to simultaneously record both ultrasonic sound that bats produce and audio sound that birds produce. The detectors were set to record from 1 hour before sunset to 1 hour after sunrise, allowing for maximum detection of a wide range of species. Ultrasonic and audio data were downloaded at the end of the 2016 field season and analyzed using Kaleidoscope Pro software (Version 4.0.0) from Wildlife Accoustics (2016). A total of 8,014 detections were made, from a total of 243 hours of recording during July 2016 (Table 4-65).

Table 4-65. Summary of deployment effort and detections

Detector Station	*UTM*	*Date Range*	*Hours deployed*	*Total Detections*	*Total Possible Bat detections*	*# of potential species*
Bat 1	9 V 444993 6208932	July 5 – July 7	22	12		2 (MYLU & MYVO)
Bat 2	9 V 445647 6208665	July 5 – July 6*	12	---	---	---
Bat 3	9 V 443967 6212021	July 9 – July 28	209	8,002	4,412	6 (LANO MYCA MYEV MYLU MYVO MYYU)

*Bat Detector stopped working for unknown reason

[1]MYLU = Little Brown Myotis (*Myotis lucifugus*), MYCA = California Myotis (*Myotis californicus*), MYEV = Long-eared Myotis (*Myotis evotis*), MYVO = Long-legged Myotis (*Myotis volans*), LACI = Hoary Bat (*Lasiurus cinereus*), MYYU = Yuma Myotis (*Myotis yumanensis)*, MYTH = Fringed Myotis (*Myotis thysanoides*), LANO = Silver-haired Bat (*Lasionycteris noctavigans*), EFU = Big Brown Bat (*Epituscus fuscus*).

4,412 of those detections were identified as possible bat echolocation pulses. Detections that did not match the patterns known for bat species were classified as "noise" by Kaleidoscope and sounds with insufficient diagnostic characteristics were labelled "No ID". A summary of detections is presented in Table 4-66.

Table 4-66. Summary of detections from July 5 – July 28, 2016

Possible Bat Echolocation Pulses	*Noise*	*No ID*	*Total*
4,412	2,233	1,357	8,002

Kaleidoscope software's Auto ID function identified a total of 6 possible bat species detected from July 5 to July 28, 2016 (Table 4-67). Out of the total 4,412 detections, 1,137 detections (26%) had pulses with a one to one match ratio for the species identified. 3,275 detections had pulses or portions of pulses detected that were characteristic of other species. The other species are listed as possible alternative identifications and represent the possible overlap of pulse characteristics (frequency, amplitude, and duration) between species. The total number of matches were greatest in species identified by the Auto ID as Long-legged Bat *(Myotis volans*). However this species also had the greatest overlap with the call characteristics of other Myotis species, especially Little Brown Bat (*Myotis lucifugus*). It is very likely that some of the Long-legged Bat identifications are actually Little Brown Bat calls.

Table 4-67. Summary of Kaleidoscope's Auto ID results for bat detections between July 5 and July 28, 2016

Possible Bat Species	*Total Detections*	*Possible False Positive Identification*	*Possible Alternative Identification[1]*	*Total Matches*
LANO	28	8	MYEV; MYVO; LACI; MYCA	20
MYCA	281	227	MYLU; MYVO; MYYU	54
MYEV	26	19	LANO; MYLU; MYVO; MYCA	7
MYLU	1,814	1,744	MYCA; MYEV; MYYU; MYVO	70
MYVO	2,261	1,275	EPFU; MYCA; MYVO; MYTH; MYLU	986
MYYU	2	2	MYCA; MYLU; MYVO	0
Grand Total	**4,412**	**3,275**		**1,137**

[1]MYLU = Little Brown Myotis (*Myotis lucifugus*), MYCA = California Myotis (*Myotis californicus*), MYEV = Long-eared Myotis (*Myotis evotis*), MYVO = Long-legged Myotis (*Myotis volans*), LACI = Hoary Bat (*Lasiurus cinereus*), MYYU = Yuma Myotis (*Myotis yumanensis)*, MYTH = Fringed Myotis (*Myotis thysanoides*), LANO = Silver-haired Bat (*Lasionycteris noctavigans*), EFU = Big Brown Bat (*Epituscus fuscus*).

Figures 4-27 through 4-31 are examples of sonographs of each potential species detected, showing the echolocation pulses. The blue shapes overlain on top of the echolocation pulses show the correlation with the calls in the species reference library.

Figure 4-27. MYLU Sonograph

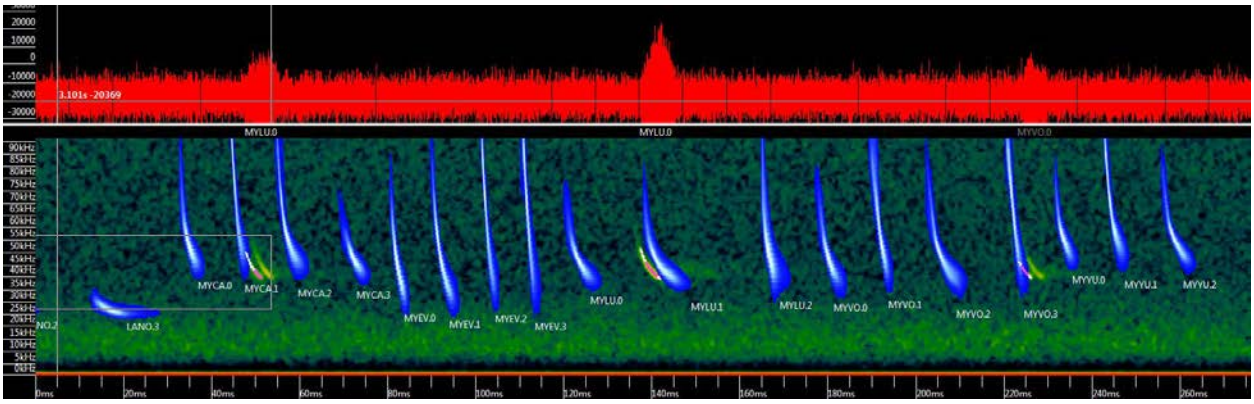


Figure 4-28. MYEV Sonograph

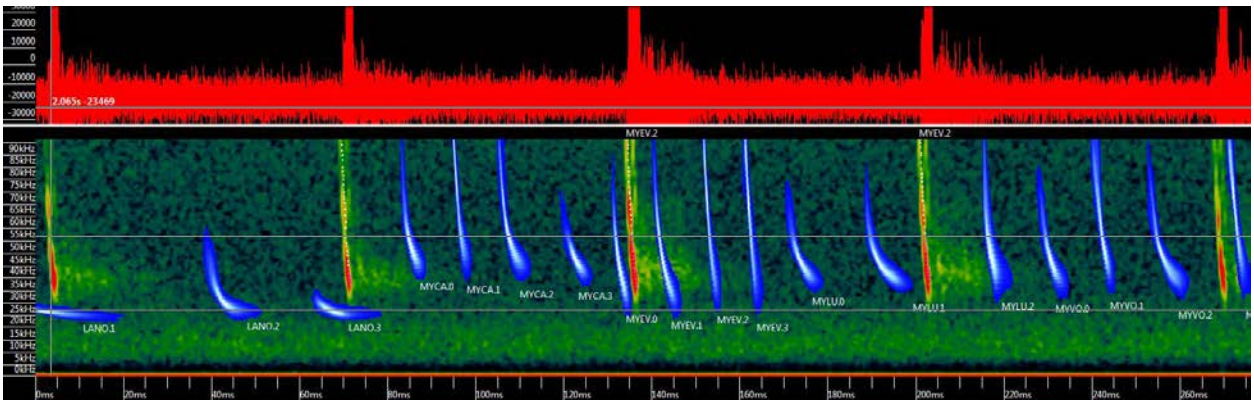


Figure 4-29. MYVO Sonograph

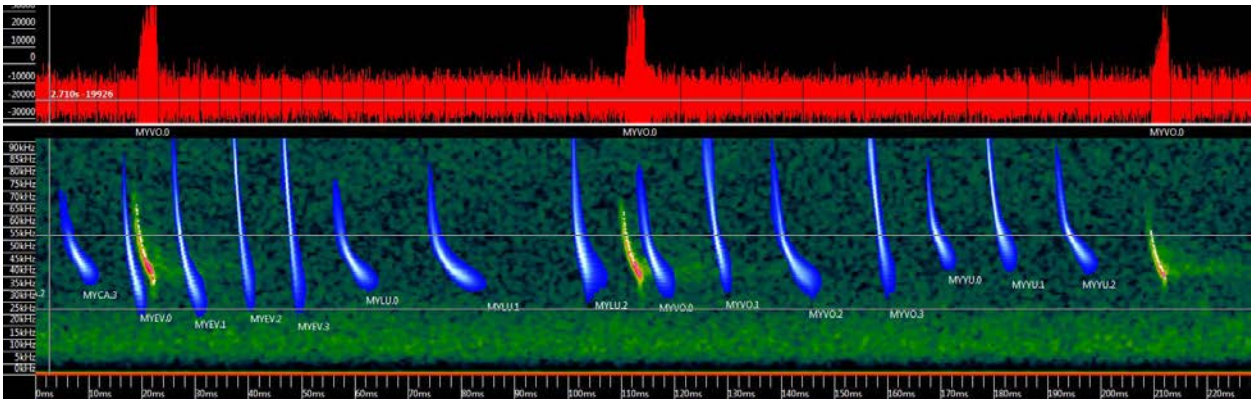


Figure 4-30. LANO Sonograph

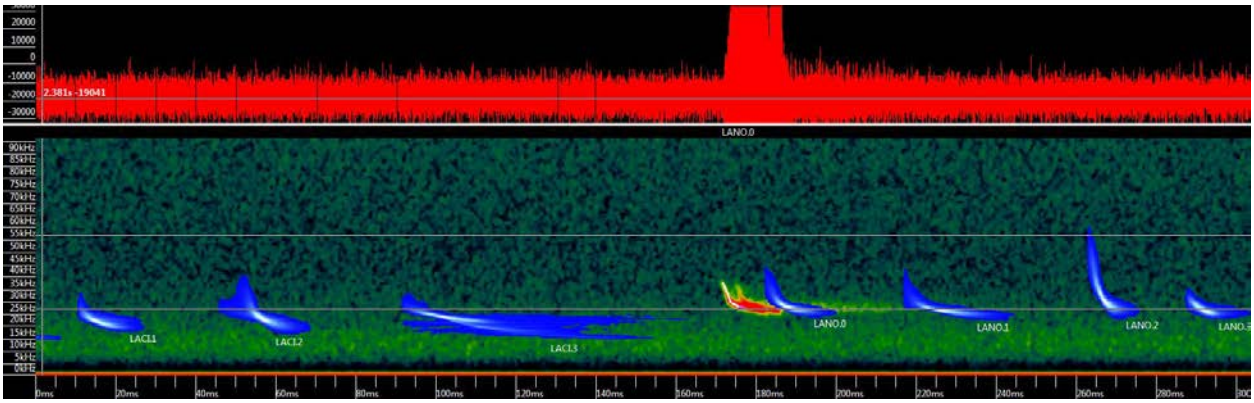
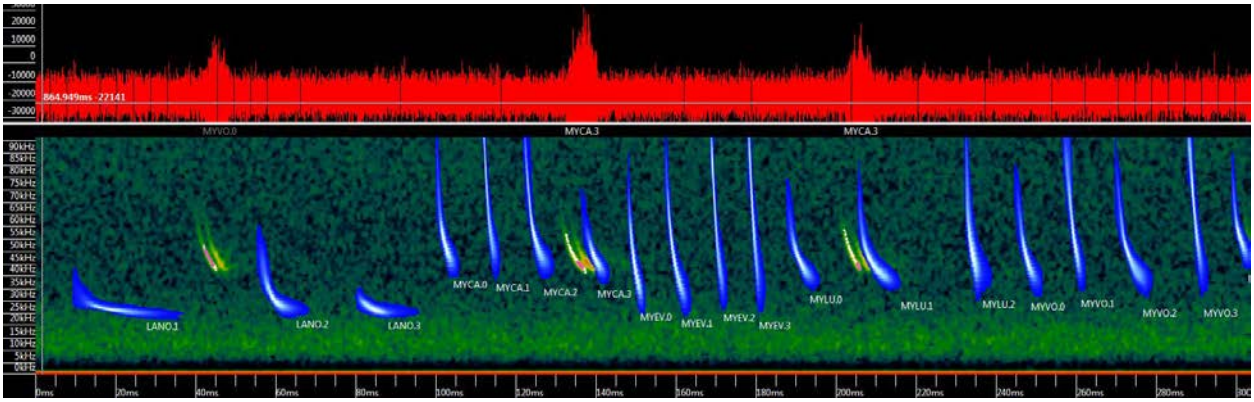


Figure 4-31. MYCA Sonograph



4.7.4 Conclusions

Overall, habitat suitability modelling identified 2,893 ha (20%) of the LSA as potentially useable habitat for Myotis bat species. Most of the area identified was associated with mature and old-growth forest, providing roosting habitat. Rock outcrops and cliffs were also identified as useable habitat. Passive acoustic bat monitoring identified six possible bat species using the lower reaches of Bitter Creek and the area around Clements Lake. Little Brown Myotis and Long-legged Myotis were the two most commonly detected bat species, however due to significant overlap in call characteristics, definitive identification was not possible. Neither Northern Myotis nor Keen's Myotis were identified as possible alternate detections although this does not preclude their absence in the LSA. Although positive identification remained inconclusive, passive acoustic monitoring has provided evidence that Myotis bat species are using the lower reaches of Bitter Creek and the area around Clements Lake. BAT 1, 2 and 3 locations were identified as the locations with the highest probability of bat use. Due to equipment and timing constraints survey effort for bats was limited to surveying the most probable areas only. Additional monitoring at other locations throughout the LSA would be required to obtain a comprehensive idea regarding the full distribution of

bats within the watershed. It is likely that at least Little Brown Myotis distribution extends further up the Bitter Creek valley.

4.8 Breeding Birds

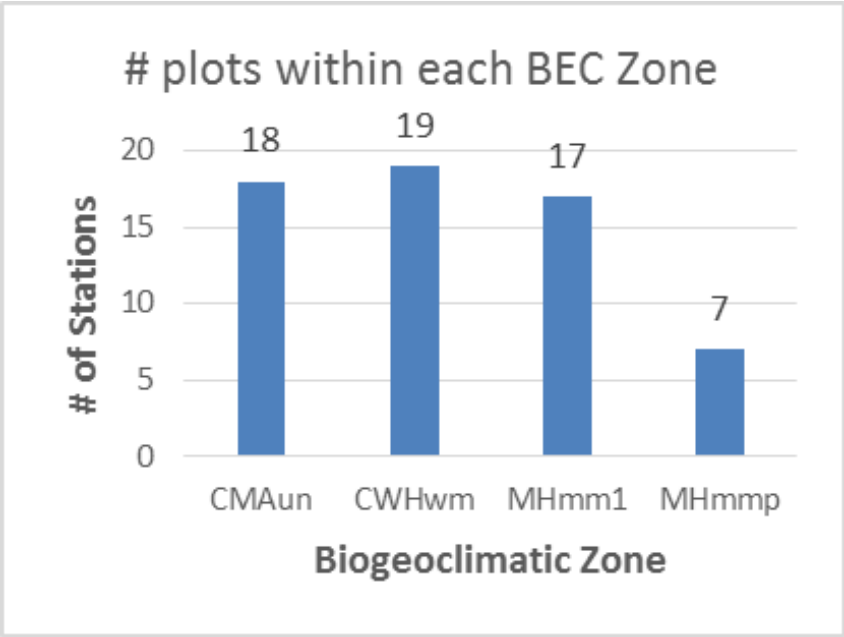
The LSA and the RSA lie entirely within the Northern Pacific Rainforest Bird Conservation Region 5. This region lists a 139 priority species (Environment Canada 2013) some of which have been confirmed to be present within the LSA. For the majority of the priority species (63%), the primary strategy is to assess the population status and maintain current population levels. The BC Breeding Bird Atlas (Davidson et al 2015) has identified 37 species with confirmed breeding within survey squares in and adjacent to the LSA. Several other recent studies included breeding bird surveys near the RSA. The Kitsault mine project assessment carried out breeding bird surveys in 2009 and 2010 (AMEC 2011). Bird surveys for the Kitsault project identified 42 species including two species of conservation concern (Sooty Grouse and Olive-sided Flycatcher). The Brucejack mine project north of the RSA also surveyed for breeding birds in 2011 and 2012 (Rescan 2013). This study identified 55 species and also identified both Sooty Grouse and Olive-sided Flycatchers.

4.8.1 Field Surveys

4.8.1.1 Point Count Distribution

A total of 61 point count stations were surveyed between June 4 and July 10, 2016. These 61 point count stations were distributed throughout the LSA to sample representative portions of the habitat types available within each Biogeoclimatic Ecosystem Classification (BEC) zone, sub-zone, and variants (Figure 4-32, Table 4-68). Point count stations were distributed fairly evenly with 29.5% of plots in the CMAun zone, 31% of plots in the CWHwm zone and 27.8% of plots in the MHmm1 zone. The MHmmp zone was slightly under-represented at 11.5% due mainly to the inaccessibility of this zone either by foot or helicopter.

Figure 4-32. Point count distribution by BEC Zone

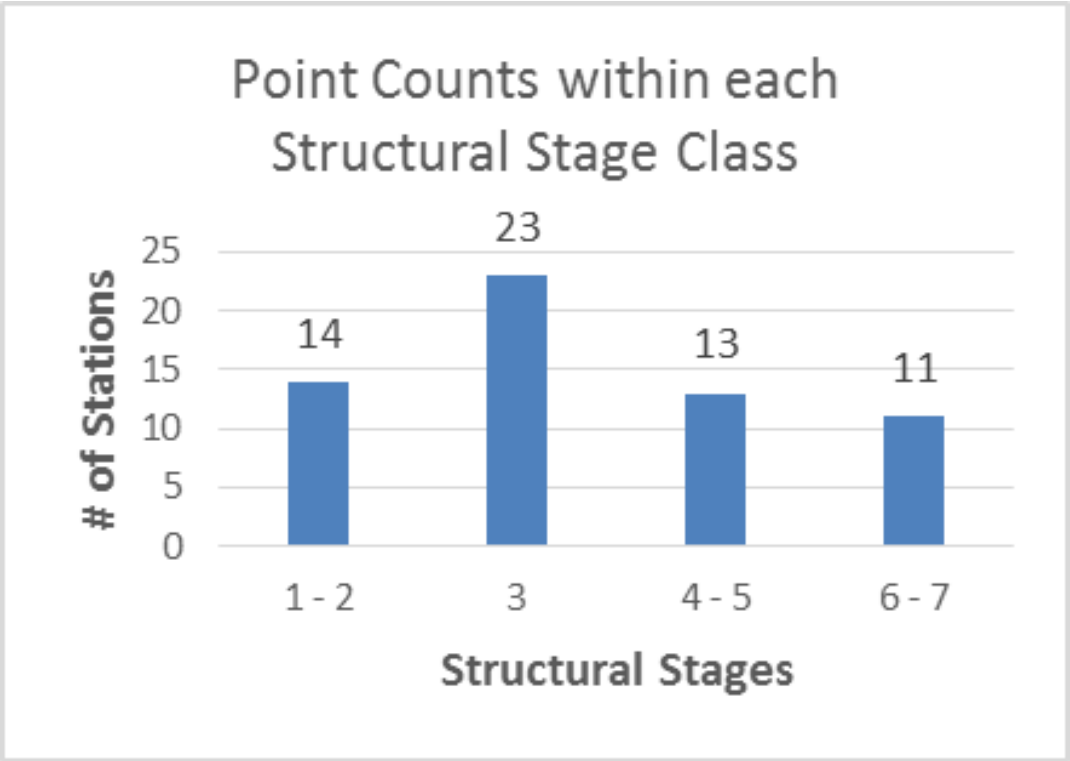


Field sampling design attempted to distribute point count stations evenly throughout the structural stages present within each BEC zone (Figure 4-33). Structural stages were lumped into the following specific groups:

- Structural stages 1 and 2 (sparsely vegetated to herb dominated ecosystems);
- Structural stage 3 (including both tall shrubs 2 to 10 m height and Low Shrubs <2 m height);
- Structural stages 4 and 5 (including pole/sapling and young forests); and
- Structural Stages 6 and 7 (mature and old-growth forest).

Detailed breakdown of habitat associations and nesting strata in relation to BEC zones and structural stages is presented in section 4.8.1.5 below. A full species list and associated habitat associations are presented in Appendix 1.

Figure 4-33. Point count distribution by structural stage



Overall, 37.7% of all point count stations were located in structural stage 3 habitat, followed by 22.9% in structural stages 1 and 2. Table 4-62 compares the percentage of songbird point count stations within each BEC zone and structural stage to the amount available in the LSA.

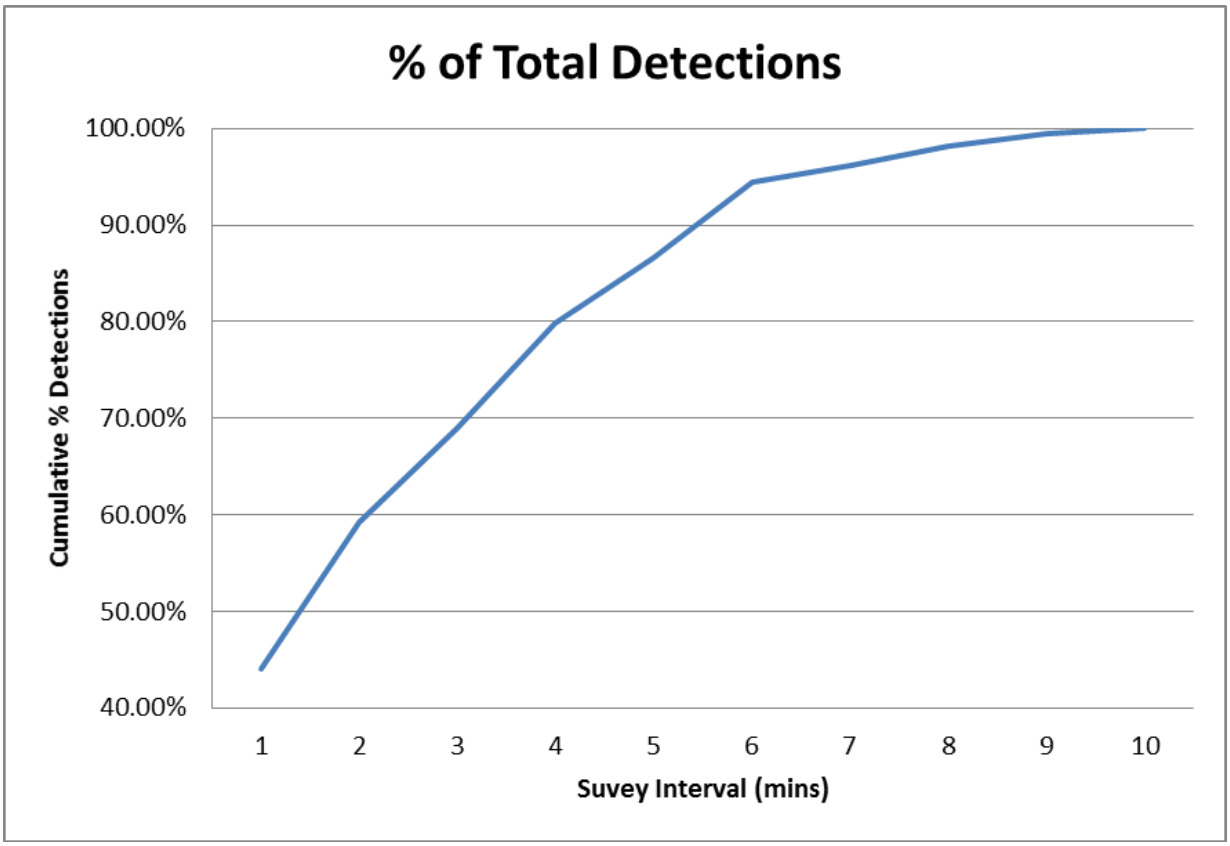
Table 4-68. Comparison of structural stages sampled within each BEC zone relative to the total available

BEC Zone	*Structural Stages*	*Total Area within the LSA (%)*	*Songbird Point Count (%)*
CWHwm	Sparse to short vegetation (Stages 1-2)	0.1	0.0
	Short and tall shrubs stages (3a and 3b)	8.9	8.2
	Young forests stages (4 – 5)	26.7	16.4
	Mature and Old forests (Stages 6 -7)	52.4	6.6
MHmm1	Sparse to short vegetation (Stages 1-2)	0.6	1.6
	Short and tall shrubs stages (3a and 3b)	33.8	9.4
	Young forests stages (4 – 5)	16.4	4.9
	Mature and Old forests (Stages 6 -7)	43.1	11.5
MHmmp	Sparse to short vegetation (Stages 1-2)	9.0	0.0
	Short and tall shrubs stages (3a and 3b)	39.2	11.5
	Young forests stages (4 – 5)	3.1	0.0
	Mature and Old forests (Stages 6 -7)	14.5	0.0
CMAun	Sparse to short vegetation (Stages 1-2)	31.9	21.3
	Short and tall shrubs stages (3a and 3b)	2.4	8.2

4.8.1.2 Point Count Intervals

Most birds were detected during the first minute of the survey, with the number of new detections decreasing substantially in the last minute of the survey. Figure 4-34 provides a graphical representation of the cumulative percentage of total bird detections for each 1-minute survey interval (ten minutes total). This graph supports previous findings that the majority of new species detections generally occurs within the first five minutes of a point count survey (Ralph et al. 1995; RIC 1999b), making this an efficient survey length when repeated over an adequate number of point count stations. Additionally, as the slope of the cumulative detections graph decreases significantly between 80 and 90%, it is safe to assume that at least 80% of the species present in the study were detected during the surveys. Over the 10 minute survey period used during our study, approximately 90% of all detections were made within the first 6 minutes of each survey.

Figure 4-34. Cumulative percent of total bird detections per survey interval



4.8.1.3 Point Count Detections

A total of 391 detections of 37 species were made during the 2016 surveys (Figure 4-35). The most frequently detected species were Varied Thrush (18.1%), Swainson's Thrush (12.8%), and American Robin (6.1%). Relative abundance was highest in the CWHwm zone with a total of 159 individuals from 28 species detected (Figure 4-36).

Figure 4-35. Total bird detections within the LSA

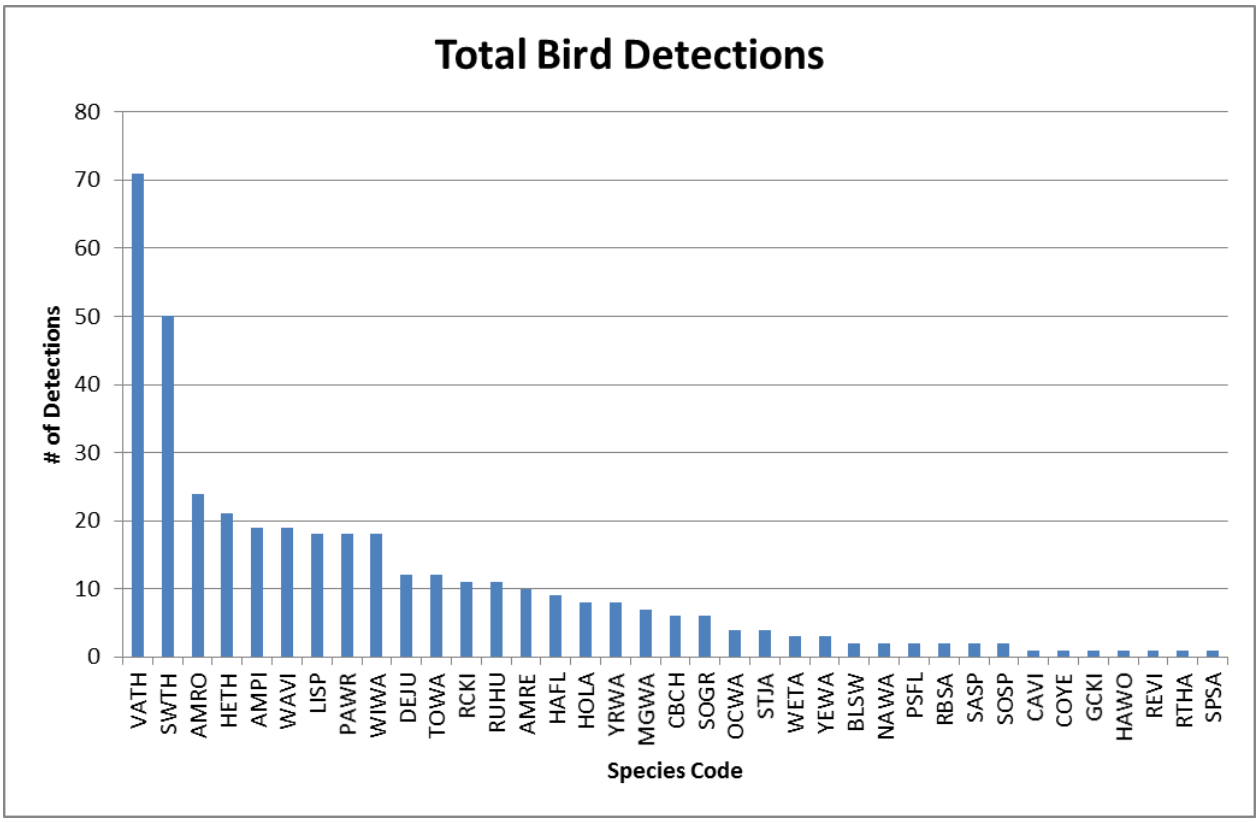
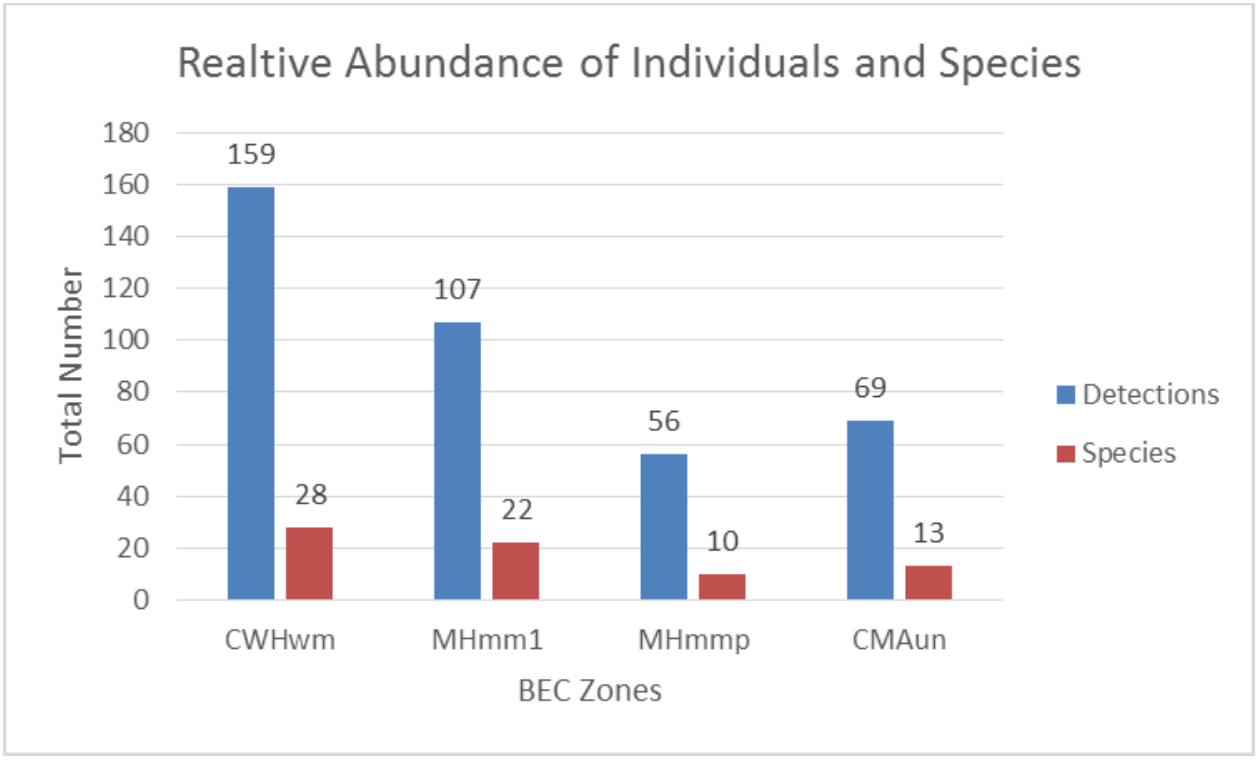


Figure 4-36. Relative abundance of individuals and species within each BEC zone



4.8.1.4 Species Richness

Species richness and species diversity were also calculated. Total species richness was determined as the total number of species detected (37 species). A slightly higher species diversity and species richness were observed in the CWHwm zone than elsewhere in the LSA (Figure 4-37, Table 4-69).

Species diversity was calculated using the Simpson Index (D):

$D = \sum (n/N)^2$

Where n = the total number of individuals detected of each species
N = the total number of individuals detected of all species

With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity. To present this in a more logical way we subtracted the Simpson's Diversity from 1 to obtain the Simpson's Index of Diversity:

Simpson's Index of Diversity = 1 – D

The value of this index ranges between 0 and 1, and the greater the value, the greater the sample diversity. The index represents the probability that two individuals randomly selected from a sample will belong to different species.

Figure 4-37. Comparison of Simpson's Index of Diversity between BEC zones

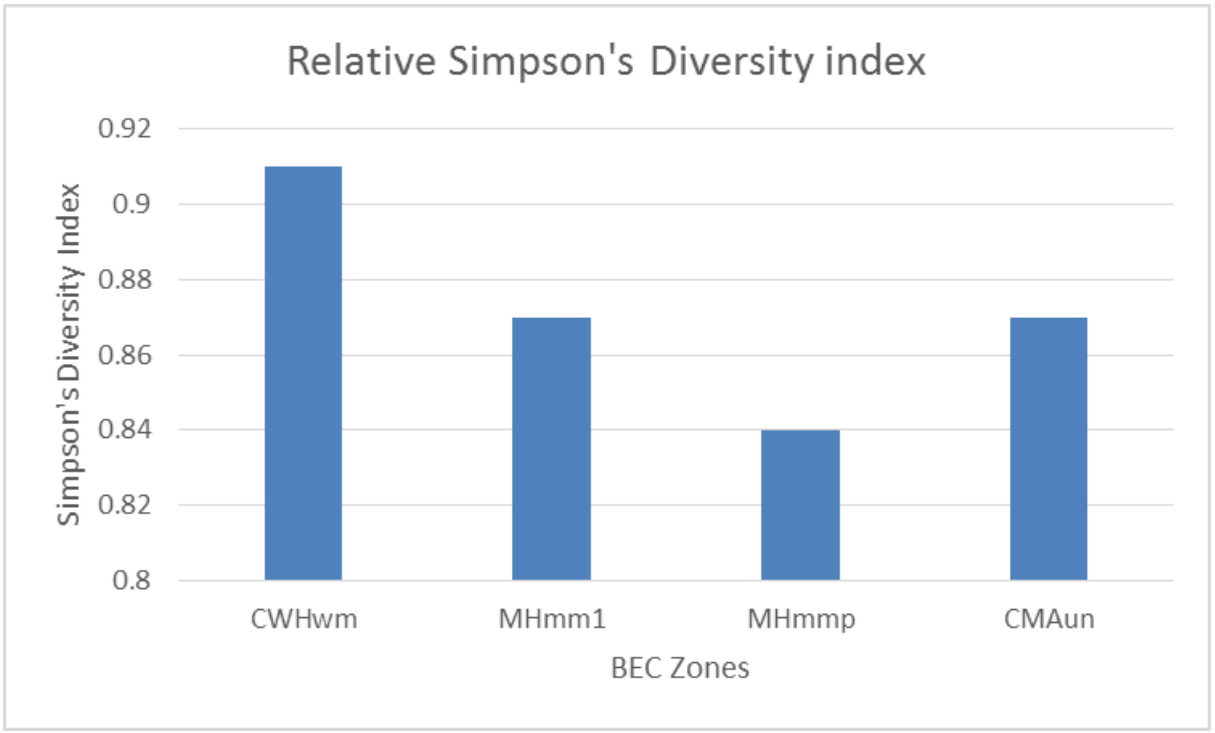


Table 4-69. Comparison of bird detections and diversity by BEC zone

Zone	*# Point Counts*	*# Detections*	*# Species Detected*	*Most Detected Species[1]*	*Simpson's Index of Diversity*
CWHwm	19	159	28	SWTH, VATH, AMRO	0.91
MHmm1	17	107	22	VATH, SWTH, PAWR	0.87
MHmmp	7	56	10	HETH, LISP, VATH	0.84
CMAun	18	69	13	AMPI, HOLA, LISP	0.87
Total	**61**	**391**	**37**		**0.93**

[1]Species are listed in decreasing order with the most detected species listed first. See Appendix 1 for full species list and associated four letter codes.

4.8.1.5 Habitat Associations

Birds detected during the point count surveys were divided into two different groups for analysis. Birds were grouped into habitat associations ("guilds") and nesting strata associations based on nesting preference. Habitat associations were defined using the TEM data by identifying structural stages and specific map codes for individual habitat types. Nesting strata preferences were determined from literature and professional knowledge (Ehrlich et al. 1988; Birds of North America 2017). Eleven habitat associations (Table 4-70) and 13 nesting strata (Table 4-71) were defined for the species detected. The nesting strata were grouped into five major classes that corresponded to habitat definitions within the TEM model. The majority of bird species detected (60.9%) were associated with forested habitat corresponding to 54.2% using some type of tree structure for nesting within the forested ecosystems of the CWHwm and MHmm1 zones.

Table 4-70. Summary of point count detections by habitat association

BEC Zone	*Habitat Association*	*Detections*	*%*	*% Habitat Available*
CWH	Alpine	0	0.0	0
	Generalist	23	14.5	100
	Herb/Grass	0	0.0	0.1
	Low Shrub	2	1.3	2.3
	Mature Coniferous Forest	61	38.4	52.4
	Mature Deciduous Forest	2	1.3	
	Mature Mixed Forest	48	30.2	
	Riparian	14	8.8	7.9
	Riverine	0	0.0	6.2
	Tall Shrub	8	5.0	6.6
	Wetland	1	0.6	1.8
MHmm1	Alpine	0	0.0	0.0
	Generalist	6	5.6	100
	Herb/Grass	0	0.0	0.6
	Low Shrub	3	2.8	18.6

BEC Zone	Habitat Association	Detections	%	% Habitat Available
	Mature Coniferous Forest	50	46.7	43.1
	Mature Deciduous Forest	0	0.0	
	Mature Mixed Forest	28	26.2	
	Riparian	4	3.7	2.5
	Riverine	1	0.9	2.5
	Tall Shrub	15	14.0	15.2
	Wetland	0	0.0	0
MHmmp	Alpine	0	0.0	6.2
	Generalist	7	12.5	100
	Herb/Grass	0	0.0	8.0
	Low Shrub	11	19.6	26.7
	Mature Coniferous Forest	15	26.8	14.5
	Mature Deciduous Forest	0	0.0	
	Mature Mixed Forest	15	26.8	
	Riparian	0	0.0	0.8
	Riverine	0	0.0	0.8
	Tall Shrub	8	14.3	12.6
	Wetland	0	0.0	0.0
CMAun	Alpine	27	39.1	31.9
	Generalist	11	15.9	100
	Herb/Grass	2	2.9	11.1
	Low Shrub	10	14.5	2.2
	Mature Coniferous Forest	14	20.3	0.0
	Mature Deciduous Forest	0	0.0	
	Mature Mixed Forest	5	7.2	
	Riparian	0	0.0	0.0
	Riverine	0	0.0	0.0
	Tall Shrub	0	0.0	0.3
	Wetland	0	0.0	0.0
Overall	Alpine	27	6.9	26.1
	Generalist	47	12.0	100
	Herb/Grass	2	0.5	8.2
	Low Shrub	26	6.7	10.6
	Mature Coniferous Forest	132	33.8	17.1
	Mature Deciduous Forest	2	0.5	
	Mature Mixed Forest	104	26.6	
	Riparian	18	4.6	16.5
	Riverine	1	0.3	14.0
	Tall Shrub	31	7.9	6.3
	Wetland	1	0.3	0.3

Table 4-71. Summary of point count detections by nesting strata

Nesting Strata	*# of Detections*	*Percent (%)*	*Nesting Strata[1]*	*# of Detections[2]*	*% of Strata Available[3]*
Generalist	24	6.1	Generalist	24 (6.1)	100
Cliff/Cavity	2	0.5	Cliff	4 (1.0)	5.7
tree or Cliff	2	0.5			
Cavity	9	2.3	Tree	231 (59.1)	24.0
Conifer	132	33.8			
Deciduous tree	51	13.0			
Tree	19	4.9			
Tree or Shrub	12	3.1			
Roots or cavities	18	4.6			
Ground	46	11.8	Ground	80 (20.5)	20.5
Shrub/Ground	34	8.7			
Low Shrub	2	0.5	Shrub	76 (19.4)	10.7
Shrub	40	10.2			

[1]Original nesting strata was combined from 13 groups to six based on vegetation structural similarity and nesting heights.

[2]The number in brackets is the percent of total detections (n= 391)

[3]Indicates the percentage of this strata type available within the LSA

4.8.1.6 Bird Density Calculations

Results of bird density calculations are provided in Table 4-72 for each species encountered within its effective assessment area. These calculations exclude fly-by's, as in the case of all Rufous Hummingbird observations. Overall bird density was in the range of 0.01 to 0.52 birds/ha. Maximum density was 0.52 was found in the CWHwm zone.

Table 4-72 Bird densities (birds/ha) by BEC zone

Species	*Effective Detection Distance (m)*	*Bird Density (Birds/ha)*			
		CMAun	**CWHwm**	**MHmm1**	**MHmmp**
AMPI	90	0.33	---	---	---
AMRE	70	---	0.24	0.16	---
AMRO	100	0.7	0.17	0.05	0.09
BLSW*	---	---	---	---	---
CAVI	100	---	0.02	---	---
CBCH	100	---	0.07	0.10	---
COYE	100	---	0.02	---	---
DEJU	70	0.18	0.05	0.04	0.28

Species	Effective Detection Distance (m)	Bird Density (Birds/ha)			
		CMAun	CWHwm	MHmm1	MHmmp
GCKI	60	---	---	0.05	---
HAFL	90	---	0.17	0.02	---
HAWO	120	---	0.01	---	----
HETH	150	0.04	---	0.01	0.47
HOLA	60	0.29	---	---	---
LISP	100	0.06	---	---	0.45
MACW	70	---	---	0.27	---
NAWA	60	---	0.09	---	---
OCWA	70	---	---	0.04	0.28
PAWR	100	---	0.15	0.21	---
PSFL	50	---	0.13	---	---
RBSA	70	---	0.07	---	---
RCKI	120	0.06	0.03	0.02	0.18
REVI	60	---	0.05	---	---
RTHA*	---	---	---	---	---
RUHU*	---	---	---	---	---
SASP	100	0.04	---	---	---
SOGR	100	0.02	0.01	0.09	0.06
SOSP	90	0.02	0.02	---	---
SPSA	50	---	---	0.05	---
STJA	100	---	0.05	---	0.05
SWTH	120	---	0.34	0.27	---
TOWA	100	0.04	0.10	0.16	---
VATH	150	0.06	0.30	0.52	0.45
WAVI	70	---	0.48	0.12	---
WETA	70	---	0.10	0.04	---
WIWA	80	---	0.16	0.16	0.23
YEWA	80	---	0.05	0.04	---
YRWA	100	---	0.12	0.04	---

*Only detected as fly-by

4.8.1.7 Breeding Evidence

Breeding-related behaviour was observed in 28 of the 37 species encountered during point count surveys (Table 4-73). This included singing in males of all species, as well as drumming/hooting in woodpeckers and grouse. Both of these behaviours are typical territorial and/or mating behaviour during the breeding season. No visual observations were made of mating, protecting young, or carrying nest material during point count surveys. The majority of breeding individuals detected were Varied Thrush, Swainson's Thrush, American Robin, and Warbling Vireo. Breeding evidence was observed incidentally along the mature coniferous riparian area in the lower Bitter Creek valley. A

Red-breasted Sapsucker was observed carrying food back to the cavity in an old 65 cm diameter cottonwood. The cavity was located at a height of approximately 8 m.

Table 4-73. Number of territorial males of each species detected during point count surveys

Species Code	*# Singing Males (Includes drumming male woodpeckers and hooting grouse)*
VATH	67
SWTH	39
AMRO	19
WAVI	19
PAWR	18
WIWA	18
HETH	17
LISP	14
RCKI	10
TOWA	10
AMRE	9
HAFL	9
DEJU	7
MGWA	7
YRWA	7
SOGR	5
AMPI	4
OCWA	4
WETA	3
HOLA	2
PSFL	2
SOSP	2
YEWA	2
CAVI	1
COYE	1
GCKI	1
HAWO	1
REVI	1

4.8.2 Conclusions

The majority of bird species detected (60.9%) were associated with forested habitat corresponding to 54.2% using some type of tree structure for nesting within the forested ecosystems of the CWHwm and MHmm1 zones. Moving up in elevation, the bird community shifted to a predominantly shrub-dependent community in the MHmmp

zone where 39.3% of species detected belonged to either tall shrub or low shrub association. Tree association decreased significantly in the MHmmp zone as well with only 14.5% of detections. Species diversity was the highest in the CWHwm zone. This zone also had the highest density of breeding birds with three species (Varied Thrush, Swainson's Thrush, and Warbling Vireo) at 0.30 to 0.48 birds per hectare. The majority of breeding individuals detected throughout all BEC zones were Varied Thrush, Swainson's Thrush, American Robin, and Warbling Vireo.

4.9 Common Nighthawk

4.9.1 Identification and General Ecology

The Common Nighthawk is a medium-sized bird (21 to 25 cm long, 65 to 98 g) and is characterized by long, slender, pointed wings and a long, slightly notched tail (COSEWIC 2007). It has a large flattened head, large eyes, a small bill, and a large mouth. Common Nighthawks have cryptic colouration, generally dark brown, with black, white, and buff mottling on the wings and upper parts and fine buff bars on the under parts. In flight, adults have a pronounced white patch at the base of the primaries, which are dark brown.

The nesting season from egg-laying to fledging is short and is usually completed within 40 days. Peak egg laying occurs from late June through mid-August. The full breeding period in BC extends from May 22 to September 21 (Campbell et al. 2006).

The Common Nighthawk has one of the longest north-south migration distances of any species in North America (Pouline et al. 1996). It arrives in Canada from early May to the beginning of June and migration to South America occurs from mid-August to mid-September. These autumnal migratory flights are often associated with the emergence of flying ants (Hymenoptera) in August and involve flocks ranging from 10 to an estimated 16,000 individuals.

4.9.2 Habitat

No nest is constructed, but nest scrapes are found in soft substrates. Eggs have been found in two distinct habitat types: on the ground in open country and on flat roofs (typically gravel) in cities. Eggs are laid on gravel, soil, sand, bare rock, lichen, fallen logs, moss, grass, dried cow manure, live dandelions rosettes, crushed rock, sawdust, wood chips, deciduous leaves, conifer needles, debris of rotten stumps, old Bracken Fern (*Pteridium aquilinum*) fronds, pebbles, and gravel and tar roofs of buildings (Campbell et al. 2006). Incubation is provided by the female alone, who broods the chicks for up to 15 days after hatching (Campbell et al. 2006).

Males use communal roost sites, three of which are identified in BC and are all in small patches of individually spaced Ponderosa Pine trees (Pinus ponderosa) bordering rivers (Campbell et al. 2006).

The diet of the Common Nighthawk includes a wide variety of insects. It is an aerial insectivore that feeds primarily at dusk and dawn (Pouline et al. 1996) at heights varying from 1 m to more than 80 m (COSEWIC 2007). The Common Nighthawk visually detects its prey, aided by a highly developed tapetum lucidum (biological reflector system) in the eye which improves its vision in low-light environments (Pouline et al. 1996). The majority of foraging occurs in a period of 45 to 60 minutes around dusk, and 30 to 60 minutes around dawn. Foraging at night can occur and is usually associated with anthropogenic sources of illumination (Campbell et al. 2006).

4.9.3 Study Area Distribution

The Common Nighthawk can be found throughout British Columbia including Vancouver Island, but is absent from the Coast Mountains and from Haida Gwaii (Campbell et al. 2006). The species breeds in the southern part of the Yukon up to the Dawson region (COSEWIC 2007). The highest probability of observation is in the valley systems of BC's Southern Interior, Central Interior, and Southern Interior Mountains Ecoprovinces. In the southern interior the highest abundance overlaps with the Interior Douglas-fir (IDF), Ponderosa Pine (PP), and Bunchgrass (BG) biogeoclimatic zones, principally between 400 and 1,000 m elevation (Boyd 2015). The species becomes less common, and more local, northward through the interior, and numbers decrease as elevation increases. On the south coast, it is an uncommon to common migrant, summer resident, and breeder. Along the central and northern mainland coast, it is rare and most often recorded at the head of long inlets (Campbell et al. 2006).

In most Canadian provinces, including British Columbia, the Common Nighthawk is not at risk and therefore is not monitored by Conservation Data Centres. Common Nighthawk is listed as threatened under SARA and is also listed as a priority species in the Northern Pacific Rainforest Bird Conservation Region 5 strategy.

Common Nighthawk habitat may be present within the Project boundaries as it is distributed widely throughout most of British Columbia and most often recorded at the head of long inlets. Migration, foraging, and roosting habitats occur from sea level to at least 2,067 m (Campbell et al. 2006.). This elevation range would encompass most of the Project Area. It can be found in almost any open or semi-open habitat where flying insects are common such as cultivated fields, rangeland, marshes, sloughs, estuaries, subalpine, and alpine (Campbell et al. 2006.). The Project Area would include some of these habitats, however it is unlikely that the Common Nighthawk breeds in the Project Area as coastal breeding grounds are limited to Vancouver Island, the Gulf Islands, adjacent mainland coast north to Powell River, and in the lower Fraser River valley to Hope (Campbell et al. 2006).

Common Nighthawk nest sites can be found from sea level up to 1,250 m (Campbell et al. 1990) with the abundance between 400 and 1,000 m elevation (Boyd 2015).

4.9.4 Habitat Suitability Modelling

Two life requisites are listed for the Common Nighthawk in the Project area (Table 4-74): Reproducing and Growing. Only the Reproducing life requisite is modelled for the Project.

Table 4-74. Life Requisites of the Common Nighthawk within the Project area rated by month and season

Month	*Season**	*Life Requisites*	*Specific Time Period*
January	Winter	n/a	
February	Winter	n/a	
March	Winter	n/a	
April	Growing (Spring)	Living	
May	Growing (Spring)	Reproducing	Nesting late May
June	Growing (Summer)	Reproducing	Nesting
July	Growing (Summer)	Reproducing	Nesting
August	Growing (Summer)	Living	Nesting
September	Growing (Fall)	Living	
October	Growing (Fall)	Living	
November	Winter	n/a	
December	Winter	n/a	

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.9.4.1 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for Common Nighthawk are summarized in Table 4-75. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the 4-class rating scheme (Table 4-76). Detailed habitat ratings assumptions are found in Table 4-77.

Table 4-75. Summary of habitat attributes for Common Nighthawk

Habitat Use	*Attributes of Suitable Common Nighthawk Habitat*	*Structural Stage[1]*
Reproducing (eggs)	Open habitat with bare surfaces or gravel roofs	1-3
Living (growing)	Open habitat	1-5

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Table 4-76. Relative suitability classes to be assigned to Common Nighthawk habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

4.9.4.2 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Open habitat with bare surfaces, gravel roofs for nesting is rated Class 1.
- Habitat of structural stage 1 and 2 is rated Class 1 for nesting.
- Open habitat in structural stage 3a is rated Class 2.
- Structural stage 3b with large openings is rated Class 3.
- Structural stage 4 or greater is rated Class 4.
- Suitable habitat located below 600 m is rated Class 1; habitat above 1,300 m is rated Class 4.

Table 4-77. Habitat ratings assumptions for Common Nighthawk Reproducing-Eggs-Growing

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Dry open forest habitat with bare ground, rocky outcrops, gravel or sand.
	Key Habitat Requirements	
	• Bare ground for nesting • Open areas for foraging, usually over large insect producing areas such as wetlands but will also use open forested areas.	
	Ratings	**Assumptions**
	1 (high) [76-100%]	CWHwm • Drier forested sites with: o SS 1 – 2; or o Open forests canopy closure classes 0 – 3 o Below 600 m • Non Forested sites: o Openings including cutblocks, roads, natural openings and burnt areas o Below 600 m
	2 (moderate) [26-75%]	CWHwm and MHmm1 • forested Site series with:

		o SS 1- 2 or 3a; or o canopy closure classes 1 -3 and warm aspects between 600 to 1,300 m • Non-forested sites with: o Open areas including cutblocks, roads, natural openings and burnt areas; or o Wetlands, bogs, marshes, swamps; or o Rock outcrops, talus slopes o 600 – 1,300 m
	3 (low) [1-25%]	• MHmm1 and mmp o SS 1 – 2 and 3a; or o Forested area with structural stages 1- 3a; or o Canopy closure classes 4 – 5; or o Cool aspects up to 1,300 m.
	4 (nil) [0%]	• MHmm1 and mmp SS 3- 7 • All areas with canopy closure classes 6-9 (56 – 100%) • All areas with SS 4 – 7 • All areas above 1,300 m

4.9.4.3 Habitat Ratings Summary

Overall suitability of Reproducing-Eggs-Growing (nesting) habitat within the LSA is relatively low. High quality (class 1) habitat is found in very small patches sporadically throughout the lower elevations in the CWHwm zone (Figure 4-38). In total, 80 ha of class 1 habitat were identified and 507 ha of class 2 within the LSA (Table 4-78).

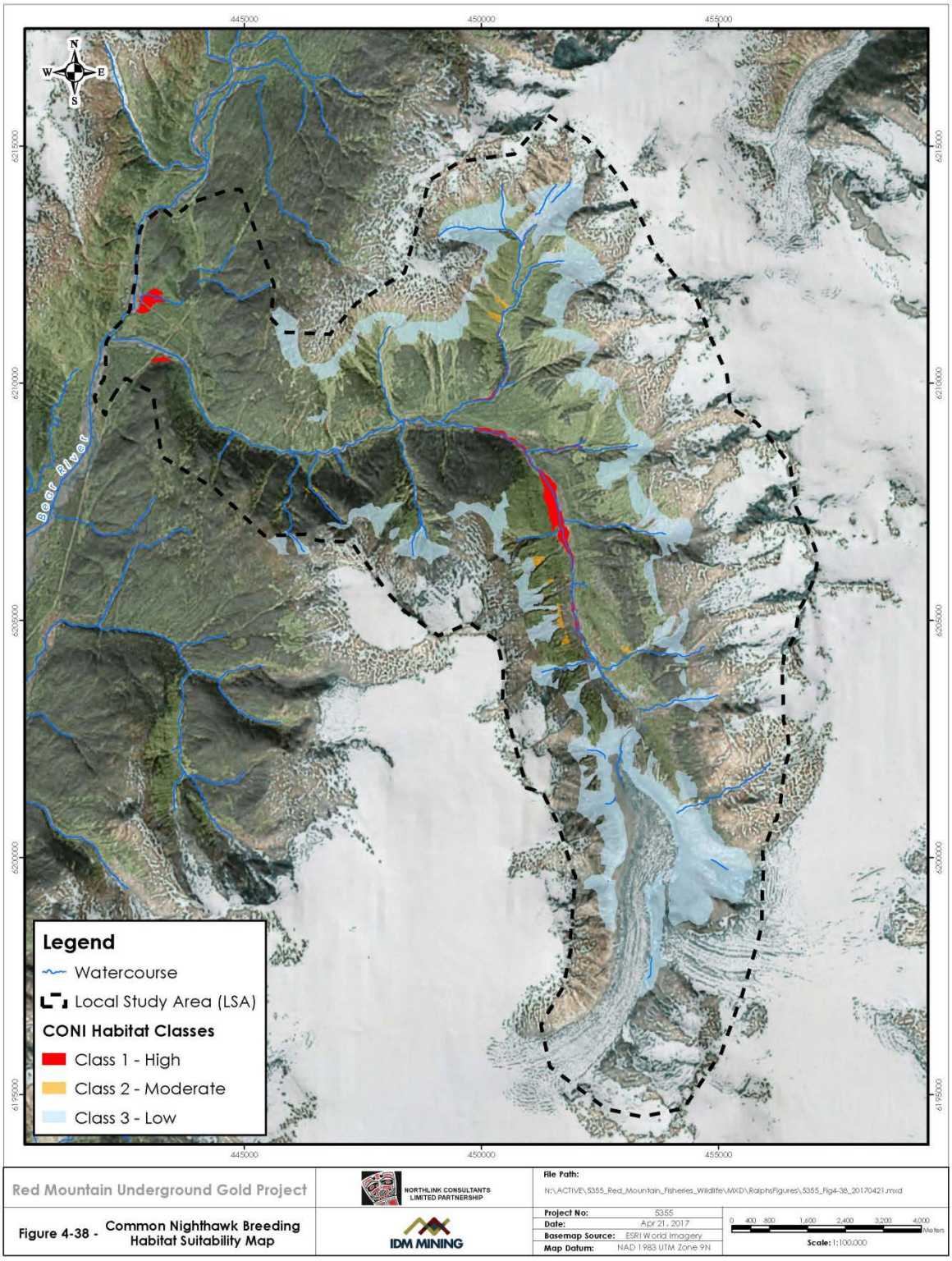
Table 4-78. Habitat Suitability ratings summary for Common Nighthawk within the LSA only

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High (Class 1)	80	0.6
	Moderate (Class 2)	21	0.1
	Low (Class 3)	1868	12.8
	Nil (Class 4)	12,626	86.5

4.9.4.4 Habitat Model Evaluation

Habitat suitability ratings identified by the model agreed with field ratings 95% of the time. No further adjustments were necessary. Habitat within the LSA was found to be very limited and located in small fragmented patches. Surveys conducted in areas that were identified as high or moderate habitat within the LSA did not detect any Common Nighthawks. Two Common Nighthawk detections were made outside of the LSA approximately 5 km west along the Bear River.

Figure 4-38. Common Nighthawk habitat suitability map



4.9.5 Field Surveys

Two rounds of field surveys were conducted to inventory Common Nighthawk within the LSA (Figure 4-39). Silent listening and call-playback surveys were conducted on June 5 to June 7, 2016 and again on July 4, 2016. A total of 18 survey stations were visited between 0.5 hours before sunset and 1.5 hours after sunset during the peak (crepuscular) activity times for Common Nighthawk. The June 5, 2016 survey was cut short due to deteriorating weather and only six stations were surveyed. The survey was repeated on June 7, 2016 with more favourable weather conditions. Each station was started with 2 minutes of silent listening (for spontaneous calling), followed by four 30-second calling bouts in four cardinal directions. Each calling bout was followed by a single "boom" presumed to be made by breeding males (RIC 1998; Poulin et al. 1996). Call-playback was conducted using a FOXPRO Spitfire digital game caller with pre-loaded sound files. A total of 6 minutes of calling and listening was conducted at each station.

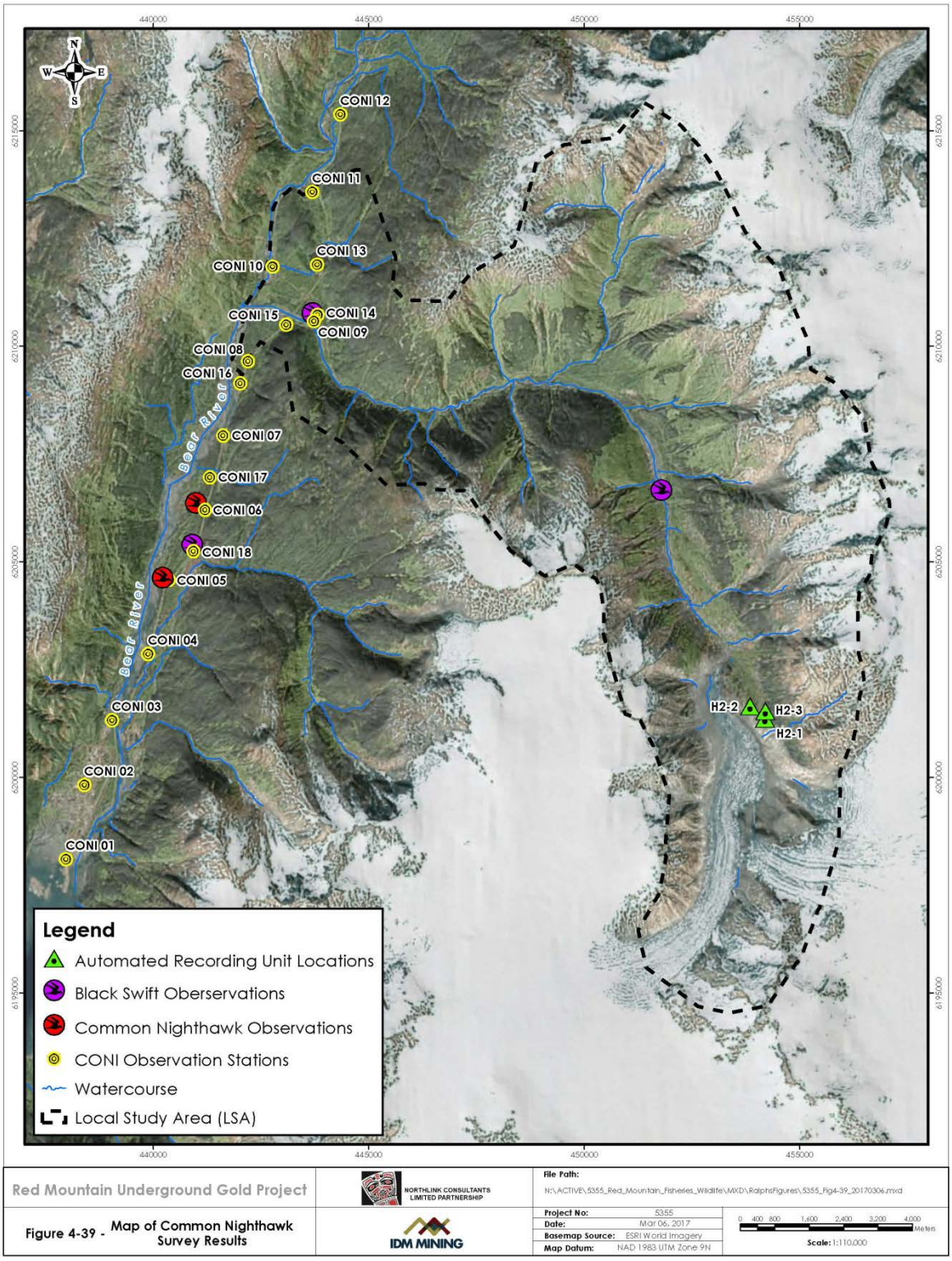
Two Common Nighthawks were detected at one station on June 7, 2016 and again at an adjacent station on July 4, 2016 (Table 4-79). None of the ARUs detected any Common Nighthawk activity at the helicopter access sites. During the roadside Common Nighthawk surveys numerous Black Swifts (*Cypseloides niger*) were observed and recorded as well (Table 4-79).

Table 4-79. Summary of Common Nighthawk observations within the LSA and portions of the RSA immediately adjacent to the LSA

Date	*Station*	*UTM*	*Number Observed*
Common Nighthawk Observations			
June 7, 2016	CONI-5	9 U 440363 6204599	2 CONI*
July 4, 2016	CONI-6	9 U 441198 6206218	1 CONI
Black Swift Observations			
June 5, 2016	CONI-14	9 V 443802 6210750	10 BLSW**
June 5, 2016	CONI-18	9 U 440932 6205259	1 BLSW
July 4, 2016	CONI-14	9 V 443802 6210750	2 BLSW

*CONI = Common Nighthawk; **BLSW = Black Swift

Figure 4-39. Map of Common Nighthawk survey results



4.9.6 Conclusions

Habitat within the LSA was found to be very limited and located in small fragmented patches. Surveys conducted in areas that were identified as high or moderate habitat within the LSA did not detect any Common Nighthawks. Two Common Nighthawk detections were made outside of the LSA approximately 5 km west along the Bear River. Of particular note is that during the roadside surveys for Common Nighthawk, Black Swifts were recorded at two different stations: one within the LSA close to the highway bridge crossing the Lower Bitter Creek and the other approximately 5 km west within the RSA. One other observation of two Black Swifts was made during the breeding bird point count surveys along the middle reaches of Bitter Creek.

4.10 Olive-sided Flycatcher

4.10.1 Identification and General Ecology

The Olive-sided Flycatcher is a medium-sized (approximately 18 to 20 cm) songbird. Individuals are deep olive green or brown with a white breast and belly. Males have slightly longer wings than females, but both sexes have relatively long wings. It is known for its tendency to perch on the tallest tree tips or snags. This location gives it the best view for detecting flying insects, which are its primary prey. Its song is loud and distinctive; the three-note whistle is commonly described as sounding like 'Quick, THREE BEERS!' (Campbell et al. 1997; COSEWIC 2007).

Olive-sided Flycatchers are Neotropical migrants. Their primary overwintering habitat is located in Panama and in the Andes from Venezuela to Peru, but they can be found in other areas of Central and South America. A large portion of their breeding habitat is located in Canada, with most being west of the Rocky Mountains. Breeding has been reported in coastal BC from the end of May until early August, although the presence of breeding individuals in the province is thought to range from late April until early September (Campbell et al. 1997).

Males arrive at the breeding ground and select territories, and pair bonds form when females arrive. Nests are created by weaving twigs, sticks, and roots together and are lined with beard lichens, grass, and other vegetation. The number of eggs per nest ranges from 1 to 4 for an average clutch size of 3 (Campbell et al. 1997; COSEWIC 2007). Both parents incubate the eggs for 10 to 17 days and the chicks remain in the nest for 21 to 23 days after hatching (Campbell et al. 1997). Their nesting period is the longest of any passerine in North America (Robertson and Hutto 2007).

4.10.2 Habitat

Breeding habitat is seen in a wide variety of forest types and structural stages, from old-growth to young stands (Campbell et al. 1997). Preference is seen for mature forest habitat adjacent to water. Most nests are found in intact forest, although both natural and man-made edge habitat provides the open area favoured by this species (Campbell et al. 1997). Engelmann Spruce (*Picea engelmannii*) and Subalpine Fir (*Abies*

lasiocarpa var. *lasiocarpa*) are preferred nesting trees, likely due to their structural characteristics being suitable for the bulky nature of Olive-sided Flycatcher nests (Robertson and Hutto 2007). Nesting is also observed in other conifers including Douglas fir (*Pseudotsuga menziesii*), Ponderosa Pine (*Pinus ponderosa*), White Spruce (*Picea glauca*), and occasionally in deciduous tree species and shrubs (Campbell et al. 1997; Robertson and Hutto 2007).

There appears to be a relationship between fire-affected forest and occurrence of Olive-sided Flycatcher (Hutto 1995; Hutto and Young 1999; Robertson and Hutto 2007). Hutto (1995) found this species to be most commonly detected in post-fire forest stands than any other cover type in the northern Rocky Mountains. Burned forests typically contain an abundance of standing dead trees that Flycatchers use as lookouts for prey. Robertson and Hutto (2007) investigated the preference of burned forest versus selectively harvested forest; they showed that Olive-sided Flycatcher was observed in higher densities in selectively harvested forests than in burned plots. However nest success was higher in burned plots even though nest provisioning was higher in harvested plots, suggesting that natural regenerating burned forests offer higher quality habitat than selectively harvested forests that were apparently preferred (Robertson and Hutto 2007). In contrast, Meehan and George (2003) found a negative effect of fire on reproduction of Olive-sided Flycatcher; they found reduced food availability, foraging rates, and nest success in burned areas as compared to adjacent unburned habitat.

4.10.3 Study Area Distribution

Globally, Olive-sided Flycatchers are found across North and South America. In North America, breeding occurs across most of Canada, the northern United States, and the Rocky Mountains. In South America breeding occurs primarily in Bolivia, Peru, Columbia, and Venezuela. Wintering occurs in Central America (Campbell et al 1997).

The breeding range of Olive-sided Flycatcher is widely distributed throughout BC. This migrant songbird can be found in all forested areas of the province except for Haida Gwaii and all biogeoclimatic zones except for the Alpine Tundra and Bunchgrass zones (BC Conservation Data Centre 2013). Highest concentrations of Olive-sided Flycatcher are found on southeast Vancouver Island, the Georgia Depression Ecoprovince, and in the southwest portion of the Sub-boreal Interior Ecoprovince (Campbell et al. 1997). Despite its wide distribution, this species has experienced severe population declines in the last half-century; it is estimated that the breeding population has declined by 29% from 1996 to 2006 and by 79% from 1966 to 2006 (COSEWIC 2007).

Specific occurrences of Olive-sided Flycatcher within or near the Project area are not mapped. The closest mapped observation indicated on distribution mapping compiled by E-Fauna BC for this species is approximately 100 km to the south-southeast, however known breeding range covers all of British Columbia (Altman and Sallabanks 2012). The Breeding Bird Atlas of BC list the Olive-sided Flycatcher's breeding evidence as possible within survey squares within and adjacent to the LSA (Davidson et al 2015). Olive-sided

Flycatcher is documented to occur in the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the Study Area. The Kitsault mine project surveys (AMEC 2011) identified Olive-sided Flycatchers (5 occurrences) in the CWHws2, MHmm2 and MHmmp zones. Within these zones, Olive-sided Flycatchers are associated with young coniferous or mixed forests, often disturbed by fire or logging and often near water (COSEWIC 2007). Olive-sided Flycatcher habitat can range in elevation from 400 to 3,400 m, however typical range is 1,000 to 2,000 m (Environment Canada 2015).

4.10.4 Habitat Suitability Mapping

The Life Requisite of Reproducing, represented by nesting habitat, will be rated for Olive-sided Flycatcher in the Project area (Table 4-80).

Table 4-80. Monthly life requisites being rated for Olive-sided Flycatcher in the Project area

Month	*Season**	*Life Requisites*
April	Growing (Early Spring)	Reproducing–Eggs
May	Growing (Late Spring)	Reproducing–Eggs
June	Growing (Summer)	Reproducing–Eggs
July	Growing (Summer)	Reproducing–Eggs
August	Growing (Summer)	Reproducing–Eggs
September	Growing (Fall)	Reproducing–Eggs

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.10.4.1 Wildlife Habitat Ratings

There is no Provincial benchmark for Olive-sided Flycatcher habitat, therefore habitat ratings will be based on breeding site habitat attributes found in the literature (Table 4-81). A four-class rating scheme was used for habitat ratings as there is an intermediate knowledge of species habitat use (Table 4-82). Detailed ratings assumptions are presented in Table 4-83.

Table 4-81. Summary of habitat attributes for Olive-sided Flycatcher reproduction

Habitat Use	*Attributes of Olive-sided Flycatcher Habitat*	*Structural Stage[1]*
Reproducing–Eggs	Open forest habitat with numerous tall trees (alive or dead)	3-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Table 4-82. Relative suitability classes to be assigned to Olive-sided Flycatcher habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

4.10.4.2 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Old-growth conifer forest (structural stages 6 and 7) adjacent to openings (within 100 m) will be rated as Class 1. Openings include cutblocks, roads, wetlands, water bodies, and burnt areas.
- Forested area with structural stage 4-5 will be rated Class 3 or 4, and vegetated areas in structural stages 1-3a will be rated Class 4.
- Wetlands will be rated Class 1 only with age class 6 or 7 forest adjacent (within 100 m) to the wetland.
- Area with canopy closure class 5-6 will be rated Class 3, canopy closure classes 4 and under will be rated Class 1 or 2. Area with canopy closure class 7 or higher will be rated Class 4.
- Area with presence of standing dead trees or snags will be rated Class 1.

Table 4-83. Habitat ratings assumptions for Olive-sided Flycatcher Reproducing-Eggs-Growing

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Open forest habitat with numerous tall trees (alive or dead)
	Key Habitat Requirements	
	• Presence of tall snags for perching while foraging • Open areas for foraging	
	Ratings	**Assumptions**
	1 (high) [75-100%]	• CWHwm and MHmm1: Mature or old-growth conifer forest (structural stages 6 and 7) within 100 m of o cutblocks, o roads, o water bodies, o natural openings and burnt areas • Wetlands in CWHwm and MHmm1 with age class 6 or 7 forest adjacent to the wetland • Area with canopy closure class 1-2 • Area with high presence of standing dead trees or snags
	2 (moderate) [25-75%]	• MHmmp Mature or old-growth conifer forest (structural stages 6 and 7) within 100 m of: o cutblocks, o roads, o water bodies o natural openings and burnt areas • CWHwm and MHmm1 (SS 4 and 5) areas with: o Within 100 m of waterbodies o only some presence of snags o Area with canopy closure class 3-4
	3 (low) [1-25%]	• CWHwm and MHmm1 Forested area with structural stage 4-5 and little or no snags • Area with canopy closure class 5-6
	4 (nil) [0%]	• CMAun • All forested sites >100 m from an opening or water body • Vegetated areas in structural stages 1-3a • Area with canopy closure class 7 or greater

4.10.4.3 Habitat Ratings Summary

Overall suitability of Reproducing-eggs-growing (nesting) habitat within the LSA is relatively low. High quality (class 1) habitat is found in small patches throughout the CWHwm and MHmm1 zones (Figure 4-40). In total, 368 ha of class 1 habitat were identified and 441 ha of class 2 within the LSA (Table 4-84).

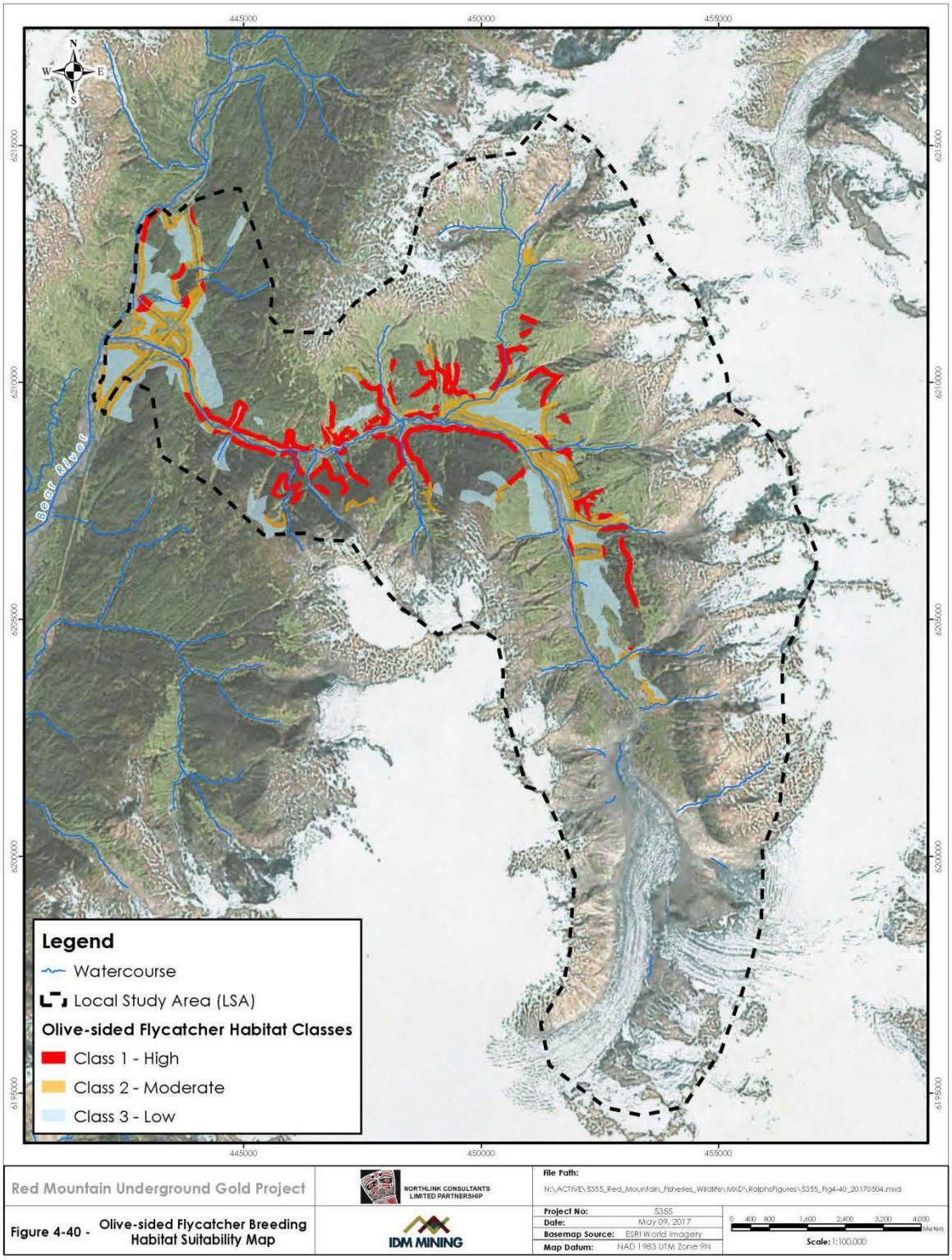
Table 4-84. Habitat suitability ratings summary for Olive-sided Flycatcher

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	368	2.5
	Moderate	441	3.0
	Low	623	4.3
	Nil	13163	90.2

4.10.4.4 Habitat Model Evaluation

The habitat model identified suitable habitat for Olive-sided Flycatcher 90% of the time compared to field ratings. The plots where field and modelled ratings disagreed were in the CWHwm zone and were most likely due to the TEM model's inability to differentiate the canopy closure ratings within individual stands of mature forest. No Olive-sided Flycatchers were detected during the 2016 Breeding Bird surveys.

Figure 4-40. Olive-Sided Flycatcher habitat suitability map



4.10.5 Field Surveys

Field surveys for Olive-sided Flycatcher relied on songbird point count surveys for detecting individuals. A total of 61 point count stations were surveyed between June 4 and July 10, 2016. These 61 point count stations were distributed throughout the LSA to sample representative portions of the habitat types available within each Biogeoclimatic Ecosystem Classification (BEC) zone, sub-zone, and variants. Approximately 52% of point count survey stations were located in habitat appropriate for Olive-sided Flycatcher. No Olive-sided Flycatchers were detected during the point count surveys or opportunistically through other surveys.

4.10.6 Conclusions

Suitable habitat for Olive-sided Flycatcher is very limited (less than 5% of the LSA) to small patches along the riparian forests in the lower and middle reaches of Bitter Creek. Several small patches of high or moderate habitat also exist around Clements Lake. Some suitable habitat may also be present in portions of the MHmm1 and mmp zones that are inaccessible due to steep cliffs etc. It is possible that songbird point count surveys may have missed this species as they may be present in very low densities within the LSA. Both the Brucejack mine project (Rescan 2103) to the north of the RSA and the Kitsault mine project (AMEC 2011) to the south of the RSA detected Olive-sided Flycatchers in similar habitats to those found within the LSA.

4.11 MacGillivray's Warbler

4.11.1 Identification and General Ecology

The MacGillivray's Warbler is a small migratory songbird with a slate-gray hood covering its head, nape, and throat, white crescents above and below the eyes, an olive-green back and wings, and a yellow chest and belly. Often referred to as shy, its elusive behaviour makes it difficult to detect during migration and on the breeding grounds (Pitocchelli 2013). MacGillivray's Warbler moves rapidly, taking short flights in and out of shrubs and dense vegetation.

There are two subspecies of MacGillivray's Warbler: *Geothlypis tolmiei tolmiei* and *Geothlypis tolmiei monticola*. The former occupies the Pacific coastal United States and western British Columbia while the latter occurs in the eastern portions of BC (Dunn and Garrett 1997; and Campbell et al. 2007).

MacGillivray's Warbler migrates in fall to central and South America. Migration is entirely over land and does not overlap with the Mourning Warbler. During migration it uses habitats that provide dense cover, including shrub patches, shrubby forest edges, brush piles, willow and Red-osier Dogwood thickets, shrub-grown wetlands, open woodlands, moist gullies choked with deciduous shrubs, and early second growth forests after clearcutting (Campbell et al. 2007). Winter populations from lower latitudes migrate farther north than wintering populations from higher latitudes (Pitocchelli 2013).

4.11.2 Habitat

MacGillivray's Warbler is relatively common in appropriate breeding habitat. It is most often associated with disturbed second growth and riparian vegetation, composed of low, dense undergrowth, shady thickets, shrubs, willows (Salix spp.), and saplings of various tree species (Pitocchelli 2013). Preferred habitats are often in or near riparian areas in mixed conifer forest, stream bottoms, brushy hillsides along canyons, as well as in open, logged areas with small, remnant forest patches, burned area, and areas recovering from avalanches with dead and fallen trees (Martell 2015 in Davidson et al. 2015). It is found in coniferous-forest clear-cuts with Engelmann Spruce (*Picea engelmannii*), Subalpine Fir (*Abies lasiocarpa*), Douglas-fir (*Pseudotsuga menziesii*), Lodgepole Pine (*Pinus contorta*), or mixed deciduous forests with Birch (*Betula* spp.), Trembling Aspen (*Populus tremuloides*), and Black Cottonwood (*P. balsamifera*). Preferred species of dense streamside vegetation understory are Sitka Alder (*Alnus sitchensis*), Red-osier Dogwood (*Cornus stolonifera*), willow (*Salix* spp.), huckleberry (*Vaccinium* spp.), Cow Parsnip (*Heracleum maximum*), and Highbush Cranberry (*Viburnum edule*) (Wiebe and Martin 1998).

MacGillivray's Warbler responds to opportunities created by the removal of old-growth coniferous forests in coastal areas. In summer, in coniferous forest of west-central Vancouver Island, Bryant et al. (1993) found this warbler to be consistently present in all age classes of forest except old-growth. It was most numerous in clear-cuts and in regenerating forests between 15 and 35 years old (Campbell et al. 2007).

Nests are an open cup of coarse grass and other plant fibre, placed at or near ground level (under 1.5 m; the majority are 0.3 to 0.6 m above ground), and well hidden under low dense shrub or Bracken Fern (*Pteridium aquilinum*) cover. Nests are often placed in upright forks of tree saplings or shrubs, frequently in shady damp areas. Clutch size is 1 to 5 eggs, with 50% having 4 eggs. Eggs are creamy white with variable tints and speckling. The incubation period is 12 to 13 days in BC (Campbell et al. 2007). On the coast, this warbler breeds from mid to late May to July 25, and has a nestling period of 8 to 9 days, in which both parents feed young (Pitocchelli 2013). Young are altricial and nidicolous, born with eyes closed; downy feathers appear on top of the head, back, and wings two days after hatching (Bent 1953).

MacGillivray's Warbler nests are susceptible to Brown-headed Cowbird (*Molothrus ater*) parasitism; Friedmann (1963) regarded this warbler as a regular but infrequent host for the Brown-headed Cowbird.

4.11.3 Study Area Distribution

MacGillivray's Warbler is widely distributed throughout the southern two-thirds of the province, with the highest abundance recorded in the Southern Interior Mountains, Sub Boreal Interior, and separate patches of the northern and southern Coast and Mountains Ecoprovinces and adjacent Georgia Depression. It is absent from Haida Gwaii and much of exposed coastal areas of western Vancouver Island, southern and northern regions of the Coast and Mountains between Port Hardy and Prince Rupert.

The few records north of Vancouver Island are from the heads of deep inlets where valleys cut through the mountains from the Interior (e.g., Kingcome Inlet, Rivers Inlet, and Portland Inlet). The northernmost coastal occurrence is from Stewart, BC (Erskine and Davidson 1976).

The pattern of abundance by elevation is complex, perhaps reflecting a preference for lower elevations in coastal areas and higher elevations in the interior, but there is a clear preference for three biogeoclimatic zones in which the species is most common: Coastal Western Hemlock, Interior Cedar-Hemlock, and Sub-Boreal Spruce (Martell 2015 in Davidson et al. 2015). The MacGillivray's Warbler is not confirmed as breeding in the Taiga Plains and Boreal Plains ecoprovinces, where the closely related Mourning Warbler (*Geothlypis philadelphia*) occupies similar habitat.

Distribution mapping compiled by E-Fauna BC shows nine occurrences in and near Stewart, BC. E-bird also reports 22 different checklists that include observations of MacGillivray's Warbler between Stewart, BC and Meziadin Lake. The highest breeding evidence recorded in the BC Breeding Bird Atlas is probable (Davidson et al 2015). This species breeds at low to moderate elevations from sea level to about 2,500 m (Martell 2015 in Davidson et al. 2015). Munro (1947) reports that breeding on the coast has been recorded from sea level to at least 1,500 m.

4.11.4 Habitat Suitability Mapping

4.11.4.1 Habitat Use – Life Requisites and Seasons

Two life requisites are rated for the MacGillivray's Warbler in the Project area (Table 4-855): Reproducing and Growing. Months where this species is not present are not considered.

Table 4-85. Seasons and the life requisites for MacGillivray's Warbler being rated in the Project Area

Month	*Season**	*Life Requisites*	*Specific Time Period*
April	Growing (Spring)	Living	
May	Growing (Spring)	Reproducing	Nesting mid-May
June	Growing (Summer)	Reproducing	Nesting
July	Growing (Summer)	Reproducing	Nesting/Fledging
August	Growing (Summer)	Reproducing	Fledging/Young
September	Growing (Fall)	Living	
October	Growing (Fall)	Living	

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

4.11.4.2 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for MacGillivray's Warbler are summarized in Table 4-866. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the four-class rating scheme (Table 4-877). Detailed habitat assumptions are presented in Table 4-88.

Table 4-86. Summary of habitat attributes for McGillivray's Warbler reproduction

Habitat Use	*Attributes of Suitable McGillivray's Warbler Habitat*	*Structural Stage[1]*
Reproducing	Riparian habitat, stream bottoms, brushy hillsides along canyons, or logged-over clear-cuts with second growth, areas recovering from avalanches with dense understory vegetation	3-5
Living	Dense thickets, with insects for forage on low braches and among foliage	3-5

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 4-87. Relative suitability classes to be assigned to MacGillivray's Warbler habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

4.11.4.3 Habitat Ratings Assumptions

Rating Assumptions for Living/Reproduction Habitat

- Riparian habitat, stream bottoms, brushy hillsides along canyons, or logged-over clear-cuts with second growth, areas recovering from avalanches with dense understory vegetation (>50% cover) of structural stage 3 are rated Class 1.
- Riparian habitat, stream bottoms, brushy hillsides along canyons, logged-over clear-cuts with second growth and areas recovering from avalanches or other disturbances with <50% but greater than 25% shrub cover in structural stages 4 or 5 are rated Class 2.
- Riparian habitat, stream bottoms, brushy hillsides along canyons, logged-over clear-cuts with second growth and areas recovering from avalanches or other disturbances with <25% understory vegetation in structural stages 6-7 are rated Class 3.

- Open habitats (structural stage 1, 2), and mature and old-growth forest lacking a dense understory, (structural stage 6 and 7) are rated Class 4.
- All other habitats are rated Class 4.

Table 4-88. Habitat ratings assumptions for MacGillivray's Warbler - Reproducing-Eggs-Growing

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Riparian areas and second growth, shrub dominated areas recovering from some type of disturbance such as avalanches, cutblocks, landslides, etc.
	Key Habitat Requirements	
	• Dense shrub understory • Open areas for foraging	
	Ratings	**Assumptions**
	1 (high) [75-100%]	• CWHwm and MHmm1: regenerating forest (structural stages 3a and 3b) including: o Avalanche chutes o cutblocks o old roads o riparian areas o natural openings and burnt areas • Wetlands in CWHwm and MHmm1 with structural stage 3a and 3b adjacent to the wetland
	2 (moderate) [25-75%]	• CWHwm and MHmm1: regenerating forest (structural stages 4 or 5) including: o cutblocks o old roads o riparian areas o natural openings and burnt areas o wetlands in CWHwm and MHmm1 with structural stage 4 or 5 adjacent to the wetland • MHmmp Structural stage 3
	3 (low) [1-25%]	• CWHwm and MHmm1 Forested area with structural stage 6 and >25% shrub cover • Area with canopy closure class <5
	4 (nil) [0%]	• CWHwm and MHmm1 forested area with structural stage 7 • All non-vegetated areas • Vegetated areas in structural stages 1-2 • All other habitats not listed above

4.11.4.4 Habitat Ratings Adjustments

No ratings adjustments were conducted at this time.

4.11.4.5 Habitat Ratings Summary

The habitat model identified 356 ha of high suitability breeding habitat (Table 4-89) for MacGillivray's Warbler. Moderate suitability habitat was the most abundant within the LSA at 1,390 ha (9.5%).

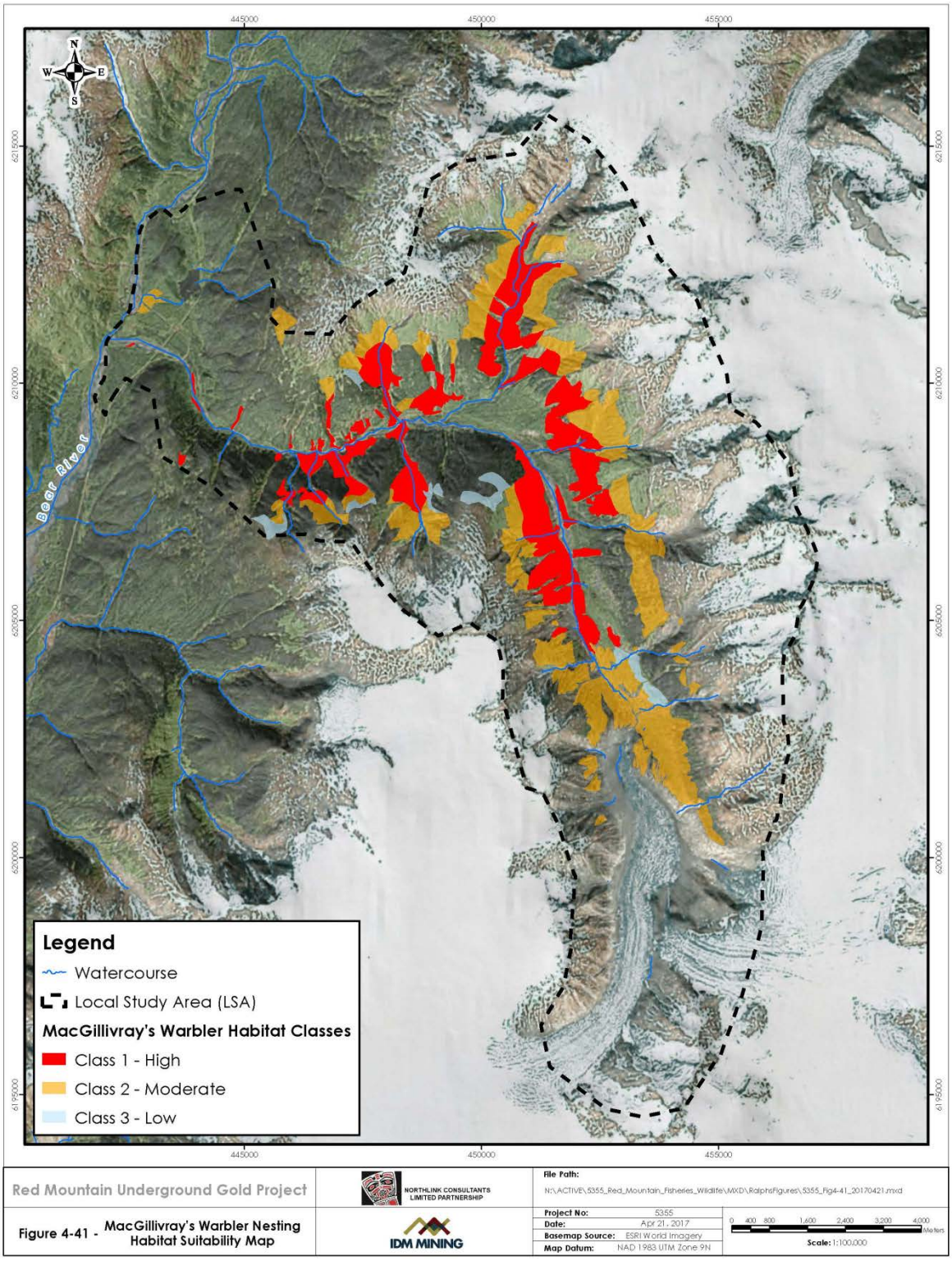
Table 4-89. Summary of habitat suitability for MacGillivray's Warbler within the LSA only

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	924	6.3
	Moderate	1,333	9.1
	Low	116	0.8
	Nil	12,222	83.7

4.11.4.6 Habitat Model Evaluation

The model correlated with the field ratings 90% of the time, therefore no further adjustments were necessary. Six out of seven detections made of MacGillivray's Warbler were made in habitat identified as high suitability by the model. All of the habitat plots that were in disagreement with the model rated the habitat higher in the field than what the model predicted. Within two of these plots the shrub component was under-represented in the TEM model thereby rating the habitat lower. Habitat plots RM02 and 03 were rated low by the model but were associated with a small wetland that was not detected by the TEM model and the shrub component surrounding the wetland increased the field rating for MacGillivray's Warbler to high. The other plot that was in disagreement was along the border of two polygons and did not adequately capture the edge effect.

Figure 4-41. MacGillivray's Warbler nesting habitat suitability map



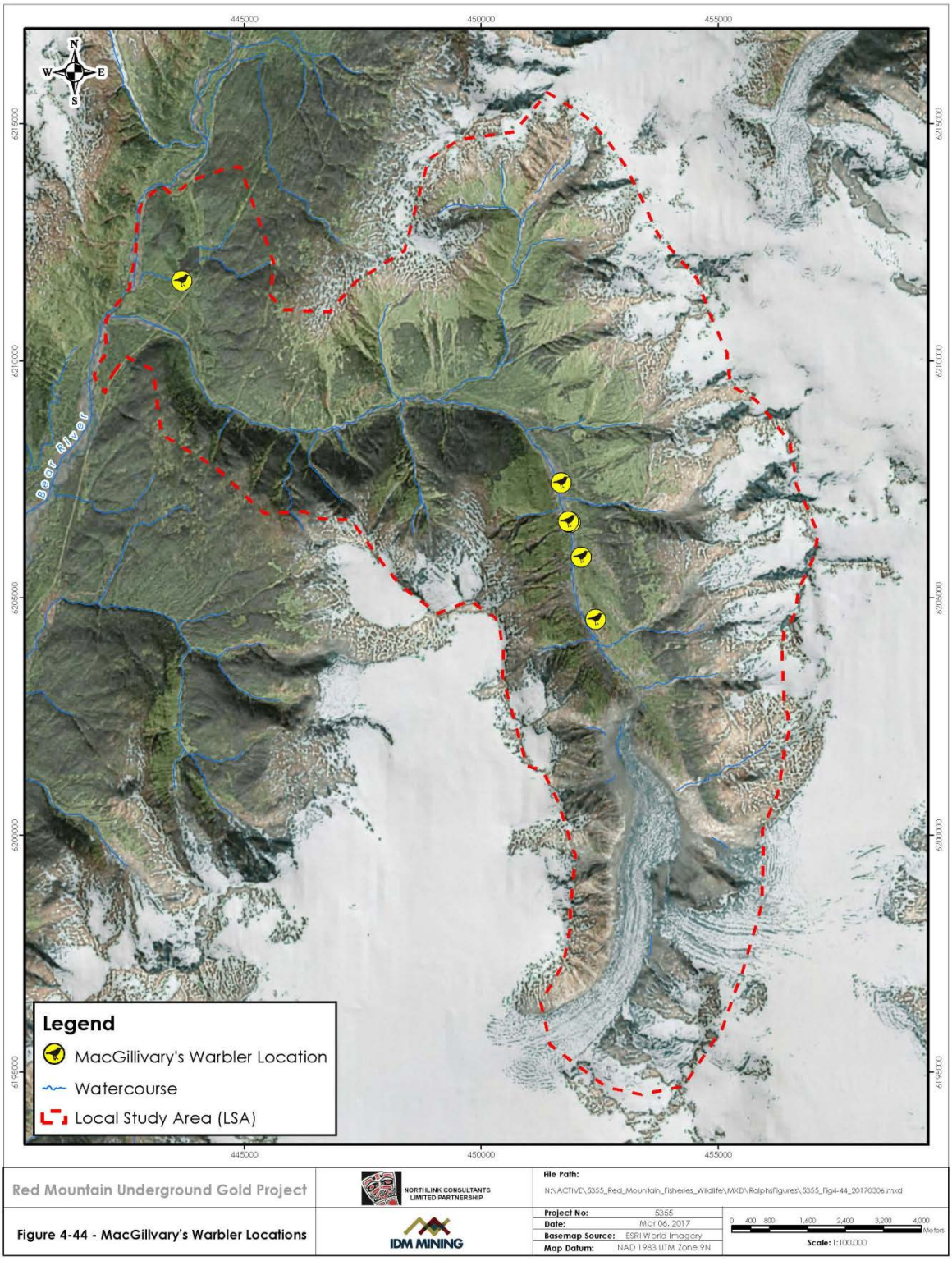
4.11.5 Field Surveys

Field surveys for MacGillivray's Warbler relied on songbird point count surveys for detecting individuals. A total of 61 point count stations were surveyed between June 4 and July 10, 2016. These 61 point count stations were distributed throughout the LSA to sample representative portions of the habitat types available within each Biogeoclimatic Ecosystem Classification (BEC) zone, sub-zone, and variants. See Breeding Birds section 4.8 for complete description. Approximately 38% of point count survey stations were located in habitat appropriate for MacGillivray's Warbler. Six point count stations had detections of seven singing males on breeding territories. All six point count stations were in the MHmm1 subzone (Figure 4-44).

Figure 4-42. Typical habitat for MacGillivray's Warbler, at point count station RM PC 05 close to the proposed Tailings Management Facility

Figure 4-43. Photo taken at the edge of small wetland at point count station RMPC 31

Figure 4-44. Map with MacGillivray's Warbler locations



4.11.6 Conclusions

The LSA provides approximately 356 ha of high suitability breeding habitat and 1,390 ha of moderately suitable breeding habitat. Approximately 38% of point count survey stations were located in habitat appropriate for MacGillivray's Warbler. Six point count stations had detections of seven singing males on breeding territories. All six point count stations were in the MHmm1 subzone and six out of the seven detections were made within habitat identified as high suitability.

4.12 Northern Goshawk

4.12.1 Identification and General Ecology

Two subspecies of Northern Goshawk occur in British Columbia: *A. g. atricapillus* and *A. g. laingi.* The former subspecies breeds throughout the mainland and interior of British Columbia (Campbell et al. 1990). The latter subspecies, or Queen Charlotte Goshawk, occurs only on coastal BC (Campbell et al. 1990), mainly Haida Gwaii, Vancouver Island, and other large coastal islands (McClaren 2003; Cooper and Chytyk 2000). Although breeding for Queen Charlotte Goshawk has not been confirmed on the coastal mainland of BC (Campbell et al. 1990), it seems likely that the goshawks that breed on the north and central mainland coast are of this subspecies (Cooper and Chytyk 2000; McClaren 2003; Doyle 2003). The distribution map (Northern Goshawk Recovery Team 2008) for *A. g. laingi* includes the entire coastal mainland divided into four distinct conservation regions (South Coast, North Coast, Haida Gwaii, and Vancouver Island). The Project study area is well within the boundaries of the Queen Charlotte Goshawk range. For the purpose of this report "Northern Goshawk" will refer to *A. gentilis* generally whereas "Queen Charlotte Goshawk" will refer specifically to the *A. g. laingi* subspecies. The relevant components of the Northern Goshawk model are presented here. For a full species account and detailed model description refer to Appendix 2.

Northern Goshawks are considered opportunistic hunters, foraging on a variety of medium-sized birds and mammals throughout the year (Squires and Reynolds 1997). The rounded wings and long tail of goshawks make them well-suited for manoeuvring through forested habitats while hunting.

Queen Charlotte Goshawks typically do not breed until they are >2 years, although occasionally they will breed in their second year (McClaren 2003). Individuals return to their breeding sites between early February and late March. Courtship consists of aerial displays, dawn vocalizations, nest building/repair, and frequent copulation, and occurs between February and early April, with peak activity occurring in March (Beebe 1974; Chytyk et al. 1997). Egg laying commences in mid to late April and incubation lasts for 30 to 32 days (Beebe 1974).

The size of Northern Goshawk breeding home ranges varies according to the familiarity of individuals with their home range, differences in hunting efficiency, food

requirements (brood size), and food availability (Kennedy et al. 1994). For example, in California, breeding home ranges averaged 1,280 ha (n=5) for Northern Goshawk females and 1,880 ha (n=5) for males (Keane and Morrison 1994) whereas in southeast Alaska, breeding home ranges for Queen Charlotte Goshawks averaged 19,215 ha (n=8) for females and 5,847 ha (n=8) for males (Titus et al. 1994). In southeast Alaska, female breeding season home ranges were primarily <1,000 ha; however, two females made large movements away from their breeding areas during the post fledging period, dramatically increasing estimates of mean breeding season home range size (Titus et al. 1994).

Northern Goshawk breeding ranges consist of three distinct areas: the nest area, post fledging area (PFA), and foraging area (Reynolds et al. 1992). The nest area usually contains several nest trees used as alternate nesting sites, roost trees, or plucking trees. Most of the courtship behaviour occurs in this area. Nest trees on Vancouver Island were found to be 800 m apart and individual PFAs were estimated at 58 ±11 ha (McClaren and Pendergast 2003). Other estimates for *A. g. atricapillus* PFAs range from 20 ha to 170 ha (Mahon et al. 2008; Kennedy et al. 1994). Although it is recognized that *A. g. laingi* likely needs larger PFAs, a minimum size of 20 ha was used for modelling in this report.

4.12.2 Habitat

Generally Queen Charlotte Goshawks have a very large foraging territory due to the low density of prey species that usually occur in the northern parts of their range. A brief mention of general foraging habitat characteristics is made here but foraging habitat suitability will not be rated for the Project.

Foraging Habitat Attributes:

- Abundant prey species
- Sufficient cover to hide goshawk approach
- Sufficiently open understory to provide flight lanes for attack
- Presence of suitable hunting perches

Nesting Habitat Attributes:

- Mature and old-growth stands (McGrath et al. 2003; Cooper and Stevens 2000; Daw et al. 1998; Squires and Reynolds 1997; McClaren 1998)
- High canopy closure >60% key feature of nesting habitat (Squires and Reynolds 1997; Daw et al. 1998)
- Open understory to provide unobstructed flyways for hunting
- Gentle to moderate slopes <40%
- Lower third or bottom of slope (Chytyk and Dhanwant 1999; Chytyk et al. 1997; Duncan and Kirk 1995)

- Northeast to northwest aspects
- Close to perennial water source
- Abundant prey source (Marshall 1992; Duncan and Kirk 1995)
- Small forest gaps (single or two or three trees falling) (Reynolds et al. 1982)
- Large diameter at breast height (dbh) trees (Daw et al. 1998)

4.12.3 Study Area Distribution

Specific occurrences of Queen Charlotte Goshawk within or near the Project area are not mapped. The closest mapped general goshawk observations, indicated on distribution mapping compiled by E-Fauna BC for this species, are approximately 140 to 180 km to the south and southeast near Terrace and Kitwanga. The Breeding Bird Atlas of BC lists several squares near Stewart including survey square 09VC41 which includes the lower reaches of Bitter Creek and the area around Clements Lake. Breeding evidence for Northern Goshawk has been listed as possible in this square based on bird observation in suitable habitat. There was no indication in the database as to where these birds were the interior or coastal subspecies (Davidson et al 2015). E-bird also lists six checklists containing Northern Goshawk observations just west of the RSA near Hyder, AK. Again no distinction was made between subspecies. Northern Goshawk is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the study area, although MH is considered less suitable than CWH (Mahon et al. 2008). Within this zone, Northern Goshawks prefer mature to old stands of Douglas-fir and Western Hemlock (BC Conservation Data Centre 2016).

Queen Charlotte Goshawks typically nest from sea level to 900 m although higher elevations may be avoided due to the increased energy expenditure required to access, especially if carrying food for offspring (Northern Goshawk Recovery Team 2008).

SNC Lavalin (2014) detected one juvenile Northern Goshawk in the lower reaches of Bitter Creek during 2014 summer field surveys (Figure 4-46).

4.12.4 Habitat Suitability

4.12.4.1 Habitat Use – Life Requisites and Seasons

Only nesting habitat will be rated for Queen Charlotte Goshawk. The life requisite will be Reproducing-eggs and the season is Growing (Table 4-90).

Table 4-90. Monthly life requisites being rated for Queen Charlotte Goshawk in the Project area

Month	*Season**	*Life Requisites*
March	Winter	Reproducing-Eggs

Month	*Season**	*Life Requisites*
April	Spring	Reproducing–Eggs
May	Spring	Reproducing–Eggs
June	Summer	Reproducing–Eggs
July	Summer	Reproducing–Eggs
August	Summer	Reproducing–Eggs

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

4.12.4.2 Existing Habitat Models

Mahon et al. (2008) developed a habitat model for Queen Charlotte Goshawk based on a combination of nesting and foraging habitat suitability models and a Territory Analysis Model. The wildlife habitat ratings for nesting habitat developed for the Project closely follow the nesting habitat suitability model developed by Mahon et al. (2008). For elevation, the Habitat Suitability Index (HSI) remains constant at 1.0 from 0 to 600 m then declines linearly between 600 and 1,200 m. For the Project, the assumption has been made that above 1,200 m HSI is 0 to reflect the upper elevation limit of the MHmm1 subzone, beyond which vegetation is stunted or absent and habitat is unsuitable for Northern Goshawk.

4.12.4.3 Wildlife Habitat Ratings

Wildlife habitat ratings will be based on the following habitat suitability model:

Nesting HSI = mean (Age, Height) x CC x StandComp x Elev x Slope pos

Age = Stand age; Height = Stand height; CC = Canopy closure; StandComp = Tree species composition in the stand; Elev = Elevation; Slope pos= Slope position.

4.12.4.4 Habitat Ratings Assumptions

A four level rating scheme was used for Queen Charlotte Goshawk habitat ratings (Table 4-91). The nesting habitat variables rated are outlined in Table 4-92 and detailed habitat assumptions are presented in Table 4-93.

Table 4-91. Cross reference for HSI values with respect to wildlife habitat ratings classes

HSI Ratings	*Class*	*Value*	*Interpretation*
0 to 0.250	Nil	4	Unsuitable. Habitat fails to provide minimum requirements.
0.251 to 0.500	Low	3	Suitability Unknown. Habitat provides theoretical minimum requirements for supporting a nest, but use by goshawks is rarely observed. Suitability of two or more habitat variables is suboptimal, substantially reducing the overall suitability of the stand. Goshawks are not normally expected to use

HSI Ratings	*Class*	*Value*	*Interpretation*
			Low class habitats, but may do so if that is all that is available.
0.501 to 0.750	Moderate	2	Suitable. Suitability of one or two habitat variables is slightly lower than optimal conditions but minimum requirements still exceeded. Minority of nest sites expected to occur in Moderate class habitat.
0.751 to 1.000	High	1	Suitable. All habitat variables meet optimal conditions. Majority of nest sites are expected to occur in High class habitat.

Table 4-92. Nesting habitat variables ratings table for *A. g. laingi*

Mapping Attribute	*FC Class*	*Rating*	*HSI Value*
Stand Age	≥8 (141+yrs)	H (1)	1
	6-7 (101 to 140 yrs)	M (2)	0.75
	5 (81 to 100)	L (3)	0.4
	≤4 (≤80 yrs)	N (4)	0
Stand Height	≥5 (≥37.5 m)	H (1)	1
	4 (28.5 to 37.4 m)	M (2)	0.75
	3 (19.5 to 28.4 m)	L (3)	0.4
	≤2 (≤19.4 m)	N (4)	0.1
Crown Closure	≥7 (≥66%)	H (1)	1
	6 (56 to 65%)	M (2)	0.75
	5 (46 to 55%)	L (3)	0.4
	≤4 (≤45%)	N (4)	0.1
Elevation	≤600 m ASL	H (1)	1.0
	600 – 700 m ASL	H (1)	0.9
	700 – 799 m ASL	H (1)	0.8
	800 – 899 m ASL	M (2)	0.7
	900 – 999 m ASL	M (2)	0.6
	1,000 – 1,099 m ASL	L (3)	0.5
	1100 – 1,199 m ASL	L (3)	0.5
	≥1,200 + m ASL	N (4)	0
Slope	0 to 40%	H (1)	0.8
	40 to 60%	M (2)	0.6
	≥60%	L (3)	0.4
Stand Species Composition	Hw leading	H (1)	1
	Ss Leading	H (1)	0.9
	Cw or Ba leading	M (2)	0.6
	Deciduous Act leading	M (2)	0.6
Distance to edge	≥201 m	H (1)	1
	101 to 200 m	M (2)	0.75

Mapping Attribute	*FC Class*	*Rating*	*HSI Value*
	51 to 100 m	L (3)	0.4

Nesting Habitat Variable assumptions:

- Stand Age: Older age classes are rated high. Stands less than 80 years are rated Class 4 (Nil).
- Stand Height: Taller trees (>28.5 m) are rated higher and trees below 20 m are rated low or Nil.
- A combined average rating of stand height and stand age is used for rating Goshawk nesting habitat.
- Structural stage 6 and 7 are rated high (Class 1) except for structural stage 7b where vertical structure complexity reduces potential flyways. Structural stage 7b is rated Class 2.
- Stand species composition stands with hemlock (Hw) or Sitka spruce (Ss) leading are rated Class 1. Aamabilis fir (Ba), Western redcedar (Cw), or deciduous black cottonwood (Act) stands are rated Class 2.
- Crown closure code 7 (>66%) is rated Class 1 and crown closure below 45% is rated Class 4.
- Distance to edge ratings listed in the ratings table apply to natural openings and clear-cuts. All habitat within 50 m of an opening is rated Class 4 (Nil).

Table 4-93. Northern Goshawk habitat ratings assumptions

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Mature or old-growth forests with open understories
	Key Habitat Requirements	
	• Mature and old-growth stands • High canopy closure >60% key feature of nesting habitat • Open understory to provide unobstructed flyways for hunting • Gentle to moderate slopes <40% • Lower third or bottom of slope • Northeast to northwest aspects • Close to perennial water source • Abundant prey source • Small forest gaps • Large diameter at breast height (dbh) trees	
	Ratings	**Assumptions**

	1 (high) [0.751-1]	• Stand age ≥ 8 (141+ yrs) —*HSI 1* • Stand height ≥5 (≥37.5m) —*HSI 1* • Crown closure ≥7 (≥66%) —*HSI 1* • Slope 0-40% —*HSI 0.8* • Hw leading —*HSI 1* • Ss leading —*HSI 0.9* • Distance to edge ≥201 m —*HSI 1*
	2 (moderate) [0.501-0.75]	• Stand age 6-7 (101 to 140yrs) —*HSI 0.75* • Stand height 4 (28.5 to 37.4m) —*HSI 0.75* • Crown closure 6 (56 to 65%) —*HSI 0.75* • Slope 40-60% —*HSI 0.6* • Cw or Ba leading —*HSI 0.6* • Deciduous Act leading —*HSI 0.6* • Distance to edge 101 to 200 m —*HSI 0.75*
	3 (low) [0.251-0.50]	• Stand age 5 (81 to 100) —*HSI 0.4* • Stand height 3 (19.5 to 28.4m) —*HSI 0.4* • Crown closure 5 (46 to 55%) —*HSI 0.4* • Slope >60% —*HSI 0.4* • Distance to edge 51 to 100 m —*HSI 0.4*
	4 (nil) [0-0.25]	• Stand age ≤4 (≤80yrs) —*HSI 0* • Stand height ≤2 (≤19.4m) —*HSI 0.1* • Crown closure ≤4 (≤45%) —*HSI 0.1* • Distance to edge ≤50 m—*HSI 0.1*

4.12.4.5 Habitat Ratings Adjustments

- All non-forested units are rated 0.

4.12.4.6 Habitat Ratings Summary

The habitat model predicted very limited amounts (80 ha) of high suitability breeding habitat within the LSA (Table 4-94). This high habitat was located along the toe of the slopes in the lower Bitter Creek valley where old-growth spruce and hemlock forests combined with gentle slopes. Moderate habitat (273 ha) was distributed in very small discontinuous patches throughout the slopes of the lower and middle reaches of Bitter Creek.

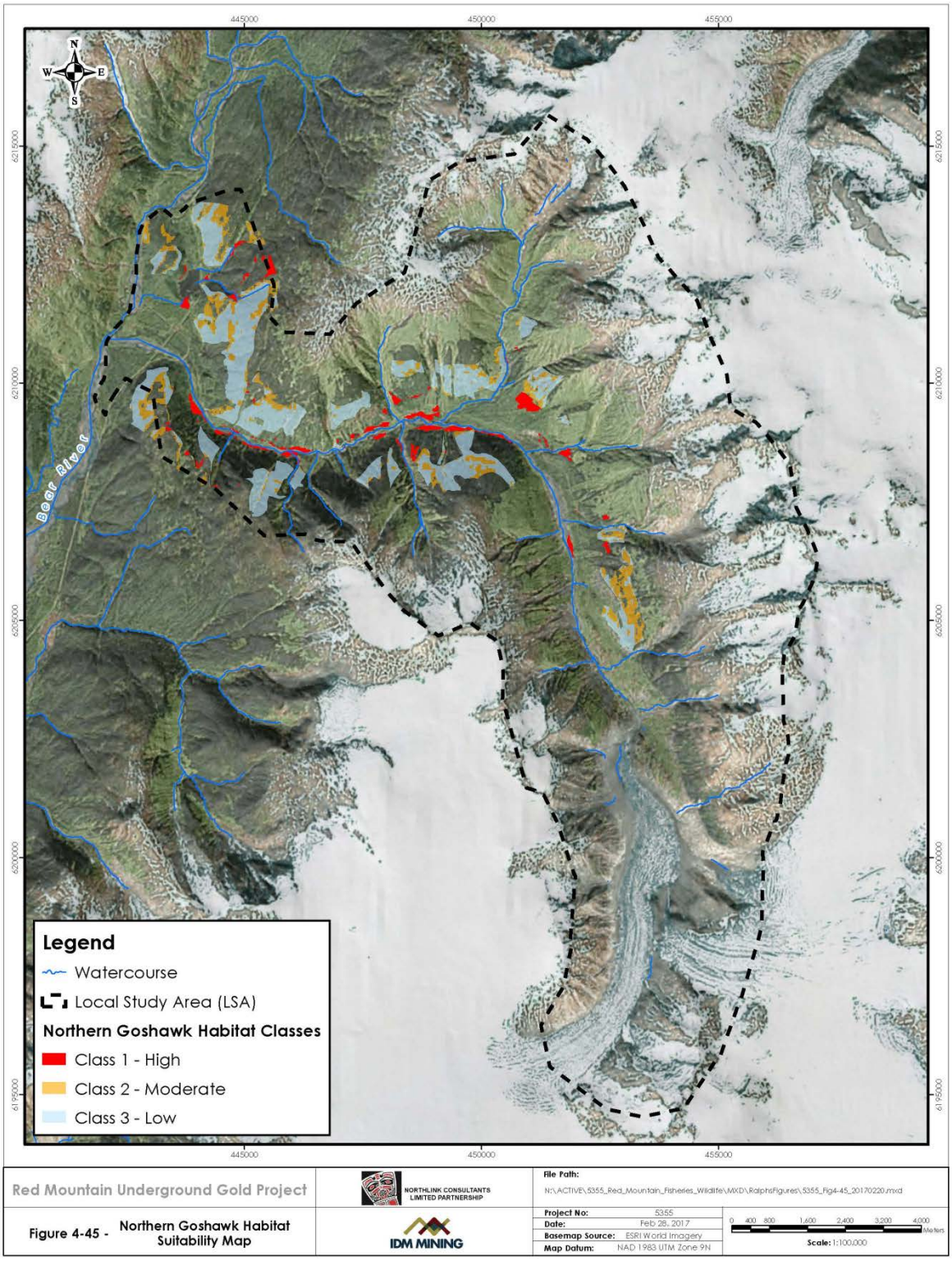
Table 4-94. Habitat Suitability ratings summary for Northern Goshawk in the LSA only

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	80.0	0.6
	Moderate	273.0	1.9
	Low	721.4	4.9
	Nil	13,521	93.6

4.12.4.7 Habitat Model Evaluation

The habitat suitability model for Northern Goshawk breeding habitat agreed with the field ratings 90% of the time. Four plots had field ratings higher than the model due to canopy closure and micro topography that could not be detected by the TEM model. Both the 2014 detection of a juvenile Goshawk by SNC Lavalin and the 2016 detection from our call-playback surveys were located in areas identified as high by the suitability model. No further adjustments were made to the model.

Figure 4-45 Northern Goshawk habitat suitability map



4.12.5 Field Surveys

A total of 17 Northern Goshawk call-playback stations were established within the LSA (Table 4-95). The location of each station was based on the presence of at least some suitable habitat components such as stand structure, prey abundance, or both. Call-playback surveys were conducted twice at each station during the 2016 field season. The first surveys conducted in June used an adult male alarm call in attempts to elicit responses from Goshawks that might be present. In July, during the brood rearing stage of the breeding season, juvenile begging calls were used at each of the 17 stations. Responses from all species were recorded (Table 4-95). One Northern Goshawk responded to call-playback at station NOGO-6 by flying in and perching on a large Western hemlock approximately 150 m away from the observers. The Goshawk called briefly and then flew off again. Two other raptors, a possible Sharp-shinned Hawk and a Red-tailed Hawk (stations 4 and 11 respectively) responded by flying in and investigating. Many other smaller bird species and small mammals reacted to the call-playback as well. Figure 4-46 presents a map of all the Northern Goshawk call-playback stations and detections made.

Table 4-95. Summary of Northern Goshawk call-playback locations and responses

Survey Station	*UTM*	*Call Playback Response*	*Response Type*	*Field Habitat Rating*
NOGO-1	9 V 451004 6208518	No	None	3 (low)
NOGO-2	9 V 451150 6208405	No	None	2 (Moderate)
NOGO-3	9 V 451362 6208278	No	Dark-eyed Junco Alarm calling	2 (Moderate)
NOGO-4	9 V 451550 6208022	Yes	Small dark raptor flew in left very quickly. Too small for NOGO. Possibly Sharp-shinned Hawk.	1 (High)
NOGO-5	9 V 447797 6208871	No	None	1 (high)
NOGO-6	9 V 447649 6209061	Yes	Northern Goshawk flew in from north and perched on large Western hemlock 150 m away	1 (high)
NOGO-7	9 V 445655 6208698	No	Spotted Sandpiper started alarm calling	1 (high)
NOGO-8	9 V 443682 6211229	No	None	3 (low)
NOGO-9	9 V 442956 6211088	No	None	1 (high) but patch is very small
NOGO-10	9 V 444175 6212230	No	Pacific Wren started alarm calling	2 (Moderate)
NOGO-11	9 V 444072 6212554	Yes	Red-breasted Sapsucker started alarm calling. Red-tailed Hawk flew in silent and perched on tree approx. 150 m away.	1 (high)
NOGO-12	9 V 444019 6213258	No	Red-breasted Sapsucker	2 (Moderate)

Survey Station	***UTM***	***Call Playback Response***	***Response Type***	***Field Habitat Rating***
			started alarm calling. Red Squirrel started alarm calling.	
NOGO-13	9 V 444078 6209847	No	none	3 (low)
NOGO-14	9 V 444143 6210178	No	none	3 (low) previously logged
NOGO-15	9 V 444267 6209985	No	Red-breasted Sapsucker started alarm calling	3 (low)
NOGO-16	9 V 444249 6209653	No	None	3 (low) but high density of Red Squirrel prey
NOGO-17	9 V 443909 6210354	No	none	3 (low)

Figure 4-46. Map with Northern Goshawk stations and detections

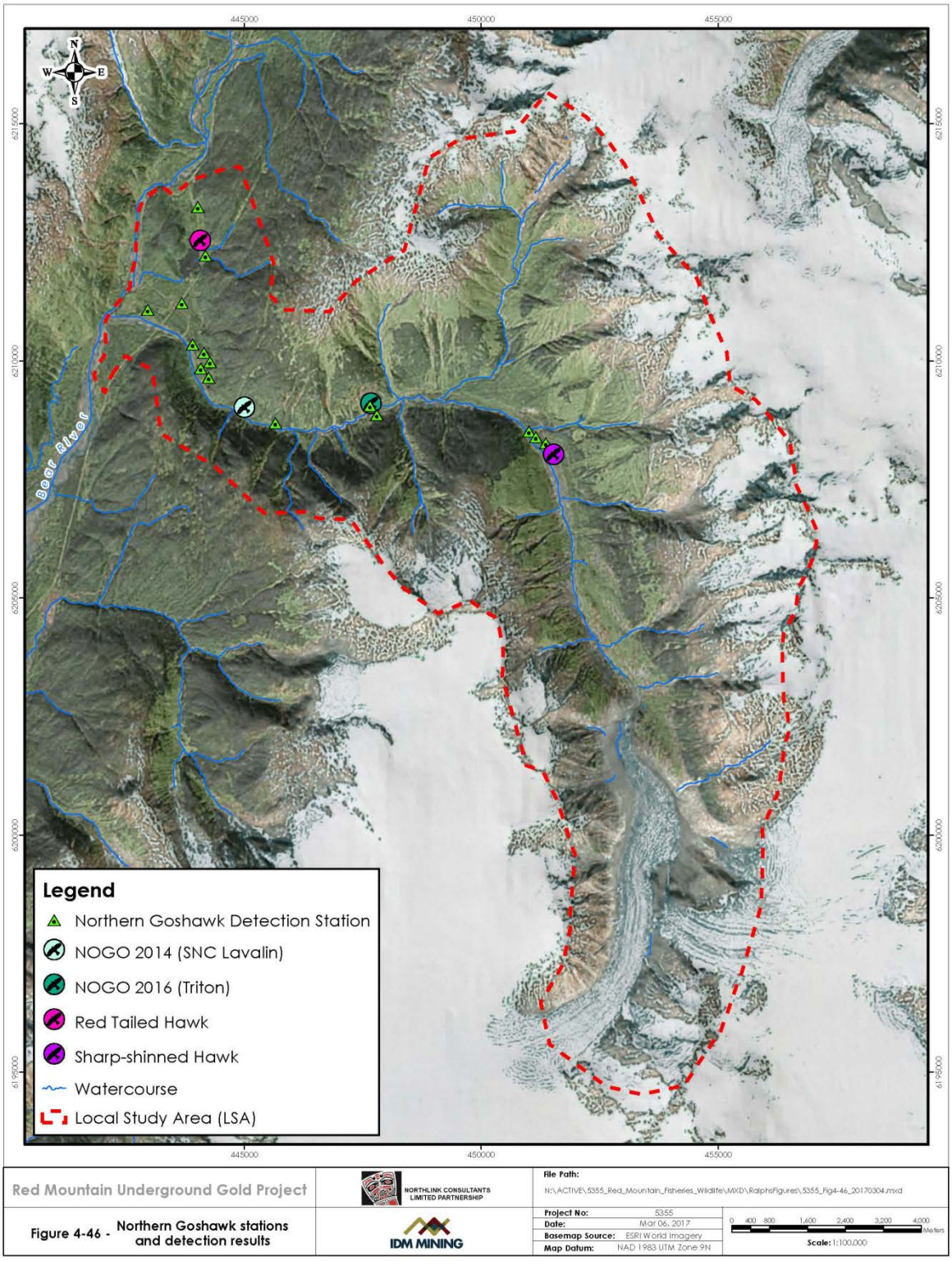


Figure 4-47. Photo of Class 1 Northern Goshawk habitat within the upper limits of the CWHwm and the lower portions of the MHmm1 zones, showing mature closed canopy with open flyways in the understory

Figure 4-48. Photo of mature/old-growth stand at NOGO-6 where Northern Goshawk was detected. This area was rated as Class 1 habitat.

4.12.6 Conclusions

Overall suitable breeding habitat for Northern Goshawk was limited to the lower slopes near the floodplains of the Bitter Creek valley and to some extent around Clements Lake.

The habitat model slope restrictions (based on literature) may be slightly limiting in identifying all the suitable habitat within the LSA. Goshawks in this area may have adapted to utilizing the steeper slopes in areas where canopy closure was high and the understory characteristics enabled adequate hunting opportunities. A narrow band of suitable habitat exists at the upper limits of the MHmm1 zone above Clements Lake and towards the lower reaches of Bitter Creek, where old growth hemlock forests provide high quality habitat. This area occurred near the 600m elevation level and is likely the upper limit of possible habitat for Northern Goshawk in this area. This is further supported by the detections made during 2014 and 2016 indicating that Northern Goshawks do use portions of the LSA, especially in the lower reaches of Bitter Creek and toward Clements Lake. Very little habitat was observed above the confluence of Roosevelt Creek and Bitter creek and it is very unlikely that Northern Goshawks would be present upstream of Roosevelt Creek.

4.13 Western Screech-Owl

4.13.1 Identification and General Ecology

Two subspecies of Western Screech-Owl are known to Canada, both of which occur in British Columbia. *Megascops kennicottii macfarlanei* occurs entirely in the southern BC interior (well away from the project RSA) whereas *M. k. kennicottii* occurs on the coast and Vancouver Island but is notably absent from Haida Gwaii, and the few observations from there are considered unreliable (Campbell et al. 1990). In general, where the range of *M. k. kennicottii* extends inland, it generally follows fjords or river valleys (COSEWIC 2012).

Western Screech-Owl is a small owl up to 25 cm long (females are generally larger than males). It has ear tufts and yellow eyes. It is usually grey to brown however *M. k. kennicottii* may have a slight red colouration (COSEWIC 2012).

The Western Screech-Owl is nocturnal and feeds on a variety of small animals and insects. It is commonly hunted by other animals, including other owl species (COSEWIC 2012).

Nesting occurs in the spring and clutch size is typically 3 to 7 eggs (COSEWIC 2012) however most commonly 2 to 3 (Campbell et al. 1990). Fledging and dispersal occur in mid to late summer (COSEWIC 2012) after 35 to 42 days (Campbell et al. 1990). Birds are sexually mature after the first year, however survival to adulthood is low (MOE 2013). Birds may live for over a decade, however more commonly less (COSEWIC 2012).

4.13.2 Habitat

Foraging Habitat

Foraging habitat for *M. k. kennicottii* is not well studied, however *M. k. macfarlanei* forages near permanent water, typically streams, near the edge of its home range (MOE 2013). Urban areas may be used very infrequently for foraging. Home ranges for the interior subspecies vary with season and ranged from 20.4 ha during breeding to 88.6 ha outside of the breeding season (Davis and Weir 2008).

Roosting Habitat

Although roosting may occur in cavities, other roosting habitats are also important for Western Screech-Owl. Roosts mostly occur in large deciduous or coniferous trees, however conifers may be preferred by the coastal subspecies. Mature forests are preferred for roosting however young forests may also be used (COSEWIC 2012).

Nesting Habitat

Western Screech-Owl is a secondary cavity nester and prefers to nest in large deciduous trees (although coniferous trees will also be used), generally over 25 cm diameter at breast height (dbh), with either naturally occurring cavities or cavities created by other animals (often woodpeckers or Northern Flickers). Nest boxes will also frequently be used. Cavity nests range from 1.2 to 12.2 m above ground but generally between 3.0 and 4.6 m. Cavity openings are about 15 cm wide (Campbell et al. 1990). Nesting trees are typically located along streambanks (COSEWIC 2012) however nesting will also occur near bodies of standing water including marshes, bogs, and lakes (Campbell et al. 1990).

4.13.3 Study Area Distribution

Specific occurrences of Western Screech-Owl within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for this species occur on Vancouver Island and the Sunshine Coast. However, the range map for Western Screech-Owl includes the Project area (COSEWIC 2012). This report will focus on *M. k. kennicottii* as the Project area is within the range of this subspecies. For the purpose of this report "Western Screech-Owl" will refer to the *kennicotti* subspecies unless otherwise specified. Western Screech-Owl is known to many forest types including the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) BEC zones, which occur within the study area (BC Conservation Data Centre 2016). Within these zones, Western Screech-Owl generally prefers mixed forests near streams with trees large enough for nest cavities (COSEWIC 2012). The relevant components of the Western Screech-Owl model are presented here. For a full species account and detailed model description refer to Appendix 2.

Western Screech-Owl generally prefers low elevations below 600 m however the range map for Western Screech-Owl *kennicottii* in the COSEWIC Status Report (COSEWIC 2012) include only coastal areas below 300 m. Campbell et al. (1990) reports no nests

observed above 540 m. Observations for *M. k. macfarlanei* suggest it occupies habitat below 1,000 m (Cannings and Davis 2007).

4.13.4 Habitat Suitability Modelling

4.13.4.1 Habitat Use – Life Requisites and Seasons

Because Western Screech-Owls are residents, year-round habitat will be assessed for Food/Cover and for Reproducing-Eggs (Table 4-96).

Table 4-96. Monthly life requisites being rated for Western Screech-Owl in the Project area

Month	*Season**	*Life Requisites*
January	Winter	Food/Cover
February	Winter	Food/Cover
March	Winter	Reproducing–Eggs
April	Spring	Reproducing–Eggs
May	Spring	Reproducing–Eggs
June	Summer	Reproducing–Eggs
July	Summer	Reproducing–Eggs
August	Summer	Reproducing–Eggs
September	Fall	Food/Cover
October	Fall	Food/Cover
November	Winter	Food/Cover
December	Winter	Food/Cover

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

4.13.4.2 Existing Habitat Models

Jacques Whitford (2010) developed a habitat rating model for Western Screech-Owl for a proposed project in northern BC, and the wildlife habitat ratings for Western Screech-Owl developed for the Project closely follows their habitat rating model.

4.13.4.3 Wildlife Habitat Ratings

There is no Provincial benchmark for Western Screech-Owl habitat; therefore ratings are based on attributes found in literature. The attributes of suitable habitat for the life requisites of Western Screech-Owl are shown in Table 4-97 . A moderate amount of knowledge exists for the habitat requirements of Western Screech-Owl, therefore a four class rating scheme will be used (Table 4-98).

Table 4-97. Summary of habitat attributes for Western Screech-Owl

Habitat Use	*Attributes of Suitable Western Screech-Owl Habitat*	*Structural Stage[1]*
Food/Cover Reproducing-eggs	Mature or old-growth riparian forests near streams	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80 years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 4-98. Relative suitability classes to be assigned to Western Screech-Owl habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

4.13.4.4 Habitat Ratings Assumptions

The model only applies for CWH as the maximum elevation for this BEC zone is 600 m and Western Screech-Owl is unlikely to occur above that elevation. This model assumes a preference for mixed forests or coniferous forests with open canopy (Table 4-99). Ratings assumptions for Food/Cover and Reproducing habitat include the following:

- Units with structural stage 1-4 will be rated Nil (Class 4).
- Mixed forest units with structural stage 5 will be rated Low (Class 3).
- Coniferous forests with structural stage 7 will be rated Moderate (Class 2).
- Mixed forest units with structural stage 6-7 will be rated High (Class 1).

Table 4-99. Western Screech-Owl habitat assumptions table

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Old-growth riparian and mixed forest with multi-layered canopy, canopy gaps, and large diameter snags for nesting
	Key Habitat Requirements	
	Mature/old-growth forests in close proximity to open riparian areas and fields for hunting: • Structural stage 7 • Large diameter snags • High component of Black cottonwood • Adjacent riparian areas or large openings for hunting	

	Ratings	Assumptions
	1 (high) [76-100%]	• Old-growth (structural stage 7) mixed forests (>25% deciduous), and: o Within 200 m of wetlands, lakes, and rivers o Stands with age class 9 (>250 yrs) • Old-growth (structural stage 7) Black cottonwood riparian areas
	2 (moderate) [26-75%]	• Mature (structural stage 6) mixed forests (>25% deciduous), and: o Within 200 m of wetlands, lakes, and rivers o Stands with age classes 8 (>140 yrs) • Mature (structural stage 6) Black cottonwood riparian areas
	3 (Low) [1-25%]	• Mature and Old-growth (structural stages 6 or 7) pure coniferous forests, and: o Within 200 m of wetlands, lakes, and rivers o Stands with age class 9 (>250 yrs)
	4 (Nil) [0%]	• All forests in structural stage 5 or less • All non-vegetated areas

4.13.4.5 Habitat Ratings Adjustments

- Pure coniferous forest units with a closed canopy will be downgraded by one class.
- Forest units greater than 250 m from permanent water will be adjusted downward by two classes.

4.13.4.6 Habitat Ratings Summary

Suitable nesting habitat (Table 4-100) within the LSA (Figure 4-49) is very limited and consists of small fragmented patches of class 1 and class 3 habitat. Much of the lower riparian floodplain forests consist of younger (<100 year old) Red alder with only the occasional Black cottonwood mixed in. Several small patches of mature/old-growth forest with suitable large snags exist near the confluence of Bitter Creek and the Bear River.

Table 4-100. Habitat suitability ratings summary for Western Screech-Owl nesting habitat within the LSA

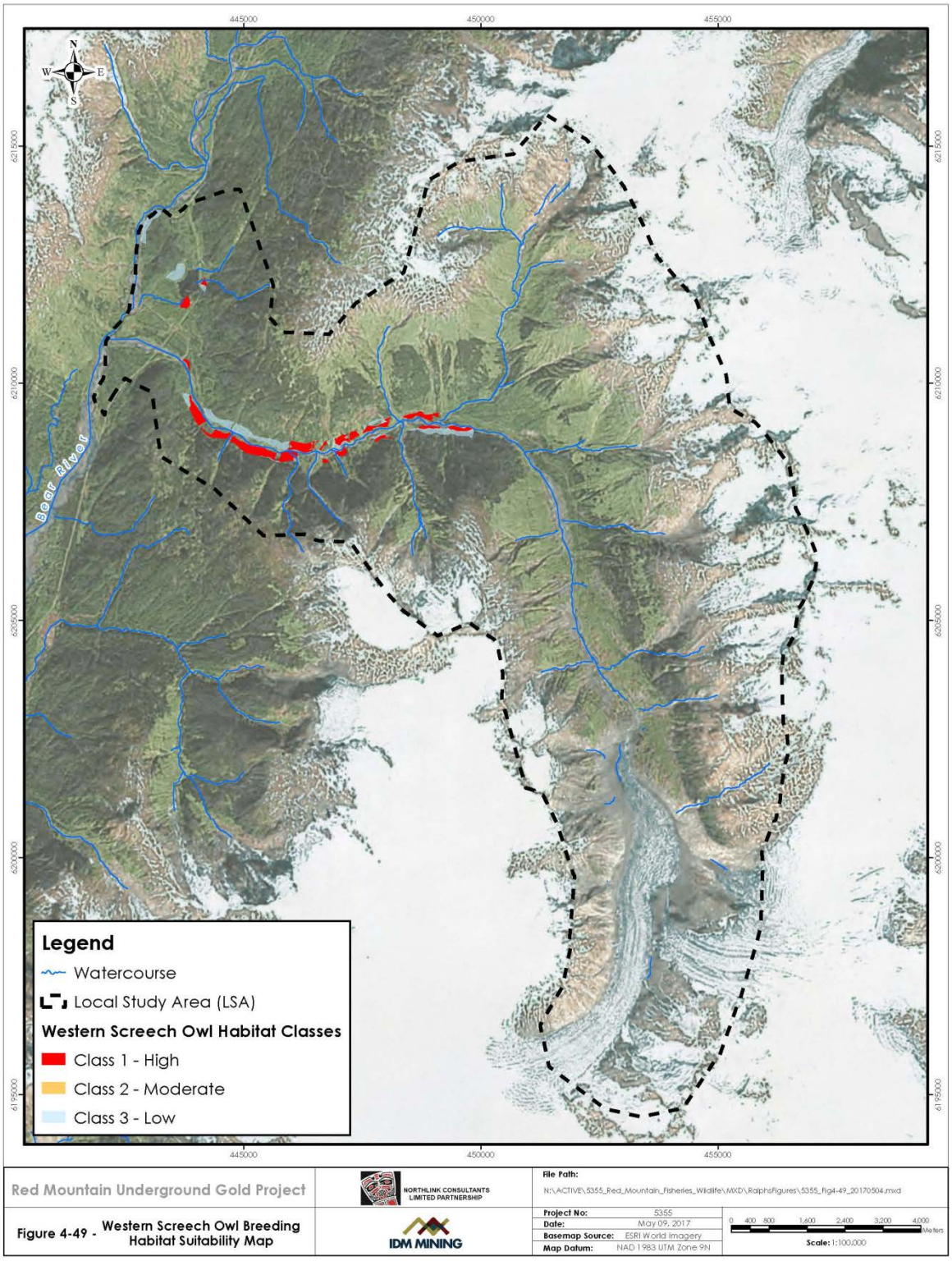
Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	71	0.5
	Moderate	0	0
	Low	70	0.5

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
	Nil	14,454	99.0

4.13.4.7 Habitat Model Evaluation

During the field surveys, habitat plots contained only a few wildlife trees with a dbh greater than 25cm and only 1 plot had one wildlife tree greater than 40cm dbh. The Western Screech Owl breeding habitat suitability model agreed with the field ratings 98% of the time, therefore no further adjustments were necessary.

Figure 4-49. Western Screech-Owl habitat suitability map



4.13.5 Field Surveys

During the 2015 field surveys several areas were identified as low potential Western Screech-Owl habitat along the lower portions of the LSA between Highway 37 and the confluence of Bitter Creek and the Bear River. Several large suitable snags were observed and searched for evidence of nesting including large cavity openings, whitewash, pellets, or prey remains. No evidence of Western Screech-Owl nesting was observed. Due to only a small amount of low habitat encountered throughout the LSA, call-playback surveys were not recommended. In 2016, field surveys did not focus on Western Screech-Owl, however several incidental observations were made with respect to potential habitat. Within the LSA, close to the confluence of Bitter Creek and the Bear River, several small patches of higher quality habitat were discovered. These small areas, less than one hectare each, had several large older trees and snags with cavities sufficiently large enough to accommodate a screech owl. The area around these snags was searched for whitewash, prey remains, or owl pellets, however no evidence of owl use was found. Although several trees were large enough for Western Screech Owls, the surrounding area had very little to no value and it is highly unlikely that these small patches could support a breeding pair.

During the July 2016 RSA overview flight, a large stand of old Black cottonwood (trees well in excess of 100 cm dbh) was observed near the inlet of Strohn Creek and Meziadin Lake (Appendix 6 photos). This stand of cottonwoods was adjacent to large wetlands and meadows providing excellent nesting habitat adjacent to high quality foraging habitat.

4.13.6 Conclusions

Suitable nesting habitat for Western Screech-Owl was limited to a few very small patches of old-growth Western Hemlock near the confluence of Bitter Creek with the Bear River. Habitat identified by the model as high or moderate was less than 1% of the entire LSA. The patches of suitable habitat are very small and fragmented, therefore it is very unlikely that the Western Screech-Owl is present within the LSA. If Western Screech-owls were to occur within the LSA, they would be in very low numbers and restricted to the lower floodplain where Bitter creek flows into the Bear River.

4.14 White-tailed Ptarmigan

4.14.1 Identification and General Ecology

White-tailed Ptarmigan (*Lagopus leucura*) is a common year-round resident at high elevation alpine areas throughout the mainland of BC, from the Coast and Cascade Mountains east to the Rocky Mountains. It is uncommon at high elevations on Vancouver Island, and is absent from all other coastal islands (including Haida Gwaii). It is also absent from areas of the province that lack alpine habitats, such as much of the central interior and the northeastern lowlands east of the Rocky Mountains (Peace River area, Fort Nelson lowlands, etc.). Although it occurs year-round within its range, some individuals wander to lower elevations during the winter and can occasionally be found

in areas that they would not normally inhabit (exceptionally as low as sea level along the coast; Campbell et al. 1990 in Fenneman 2014). It occurs almost exclusively in rocky alpine tundra, alpine rockslides, talus, krummholz vegetation, and at the edges of glaciers and snowfields. Most of its habitat is remote from human disturbance, so it is still present in most of its original range. The relevant components of the White-tailed Ptarmigan model are presented here. For a full species account and detailed model description refer to Appendix 2.

Breeding males and females undergo continual moult from spring to fall, therefore "breeding plumage" is merely the stage of moult that corresponds with the breeding season (May to June). Transitional plumage is a patchwork of white and brown in April to May as birds begin to acquire dark-barred brown feathers of summer. Following the peak breeding season, birds gradually acquire white winter plumage between June and October.

White-tailed Ptarmigan is distinguished from the two other ptarmigan species in BC (Willow Ptarmigan and Rock Ptarmigan) as being the smallest of the three, and having white tail feathers (Sibley 2000; Martin et al. 2015). Additionally, White-tailed Ptarmigan generally occupies elevations that are above those that are used by the other two species of ptarmigan, and is particularly fond of rocky or stony substrates.

4.14.2 Habitat

Nesting

White-tailed Ptarmigan nests in alpine tundra, in rocky areas or sparsely vegetated, grassy slopes, as well as in areas of willow shrubs with subshrub, moss, and boulder cover. Birds tend to search for vacant territory in their natal area, and exhibit a high fidelity to breeding territory in successive years (Frederick and Gutierrez 1992).

Nests are constructed by the female and consist of little more than a shallow scrape on the ground (13 to 15 cm wide and 3 to 4 cm deep) that is lined with dried vegetation, moss, needles, and a few body feathers. The nest is typically situated in open, often rocky terrain or in brushy willow or krummholz vegetation and is usually at least partially concealed by overhead vegetation (Campbell et al. 1990; Martin et al. 2015).

A single clutch of 4 to 7 eggs is laid between mid-May and early July (variable, depending on latitude and local snow conditions) and is incubated by the female alone for 22 to 26 days before hatching. The smooth, slightly glossy eggs are pale buff to pinkish buff with sparse but regular reddish-brown or dark brown speckling. Eggs are present in BC between mid-May and late July.

The young are downy and fully precocial, leaving the nest within 6 to 12 hours of hatching. The chicks are mottled brown on the upperparts and are greyish-white on the underparts. The chicks follow closely behind the parents when young and are regularly brooded by the female, particularly during inclement weather. The young are able to

feed themselves within one day of hatching and are not fed by the female (although she does direct them to sources of food). The young are able to fly weakly at approximately 10 days of age, and remain together as a family group throughout the first winter (dispersing the following spring). Family groups that include young chicks have been observed in BC between late June and mid-September (Campbell et al. 1990; Braun et al. 1993; Baicich and Harrison 1997; and Madge and McGowan 2002, in Fenneman 2014).

Brooding hens in Sierra Nevada show preference to moist meadows, and flocks prefer the artic willow (*Salix anglorum*) vegetation alliance on rocky, north-facing slopes; willow abundance and proximity to water were important habitat factors (Frederick and Gutierrez 1992).

Feeding

This species forages exclusively on the ground, where it picks food from the surface of the soil and rocks, or browses on low shrubs and herbaceous vegetation. It consumes the buds, leaves, stems, seeds, fruits, catkins, and flowers of a wide variety of shrubs, grasses, and forbs, and also consumes insects during the breeding season. White-tailed Ptarmigan shows a particular fondness for willow, and its winter diet is composed largely of willow buds; the buds of birch and alder are also consumed in areas where willow is absent. These buds are often available, even at the highest elevations, in windswept areas where the shrubby vegetation beneath the snow is exposed throughout the winter. Foraging birds occur singly or in pairs during the breeding season, but aggregate into small to medium-sized flocks of up to 35 individuals during the winter. When not foraging, winter flocks sometimes roost in burrows beneath the snow (Braun et al. 1993; Madge and McGowan 2002, in Fenneman 2014; and Martin et al. 2015).

4.14.3 Study Area Distribution

There are five *Lagopus leucura* subspecies, two of which are found in BC: *Lagopus leucura leucura* (i.e., *Lagopus leucura*) and *Lagopus leucura saxatilis*. The former ranges throughout the mainland portion of the species' range in BC; the latter is endemic to Vancouver Island (Martin et al. 2015). White-tailed Ptarmigan is a year-round resident in the northwest of British Colombia, and can be expected to inhabit areas within the Project Area that meet its habitat requirements.

White-tailed Ptarmigan is found almost exclusively in high elevation alpine habitats (up to 4,054 m), but generally always above the treeline (Martin et al. 2015). It occasionally descends to lower elevations where it can be found in subalpine parkland or, rarely, below the treeline in high elevation coniferous forests, montane meadows, clear-cuts, burns, or along lakeshores (especially in winter). While an exception, White-tailed Ptarmigan has been recorded in winter as low as sea level along the coast (Campbell et al. 1990 in Fenneman 2014).

These birds are primarily found at elevations of 1,200 to 2,700 m in British Columbia (lower along the coast and in northern BC where alpine habitats occur at lower

elevations), sometimes descending as low as 500 to 900 m during the winter (Campbell et al. 1990; and Braun et al. 1993, in Fenneman 2014).

In BC, alpine tundra begins at elevations above 1,000 m in the northwest of British Columbia, above 1,400 m in the northeastern mountains, above 1,650 m in coastal areas, and above 2,500 m in the southern interior.

4.14.4 Habitat Suitability

4.14.4.1 Habitat Use – Life Requisites and Seasons

White-tailed Ptarmigan are year-round residents within the LSA, however, habitat will be assessed for Food/Cover and for Reproducing-Eggs (Table 4-101) during the breeding season.

Table 4-101. Life requisites of the White-tailed Ptarmigan within the Project area rated by month and season

White-tailed Ptarmigan Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Living
February	Winter	Living
March	Winter	Living
April	Growing (Early Spring)	Living,
May	Growing (Late Spring)	Living, Reproducing (eggs)
June	Growing (Summer)	Living, Reproducing (eggs)
July	Growing (Summer)	Living, Reproducing (eggs)
August	Growing (Summer)	Living, Reproducing (eggs)
September	Growing (Fall)	Living, Reproducing (eggs)
October	Growing (Fall)	Living
November	Winter	Living
December	Winter	Living

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

4.14.4.2 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for White-tailed Ptarmigan are summarized in Table 4-102. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the four-class rating scheme (Table 4-103).

Table 4-102. Summary of habitat attributes for White-tailed Ptarmigan reproduction

Habitat Use	***Attributes of Suitable White-tailed Ptarmigan Habitat***	***Structural Stage[1]***
Living	Alpine tundra, rocky areas, or sparsely vegetated, grassy slopes, brushy willow, or krummholz vegetation	1-3a,b

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 4-103. Relative suitability classes to be assigned to White-tailed Ptarmigan habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

4.14.4.3 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Alpine habitat with arctic willow vegetation associations is rated Class 1.
- Areas with low shrub and herbaceous vegetation, providing buds, leaves, stems, seeds, fruits, catkins, and flowers of a wide variety of shrubs, grasses, forbs, and also insects during the breeding season are rated Class 1.

4.14.4.4 Habitat Ratings Adjustments

No ratings adjustments were conducted at this time.

4.14.4.5 Habitat Ratings Summary

White-tailed Ptarmigan is common throughout the alpine portions of the LSA. Herbaceous Alpine Meadows (AM) and Mountain Heather complexes (HM and HP) had the highest concentration of individuals and sign and were given a field suitability rating of class 1 (high). Table 4-104 outlines the extent of each suitability class in hectares identified by the habitat model.

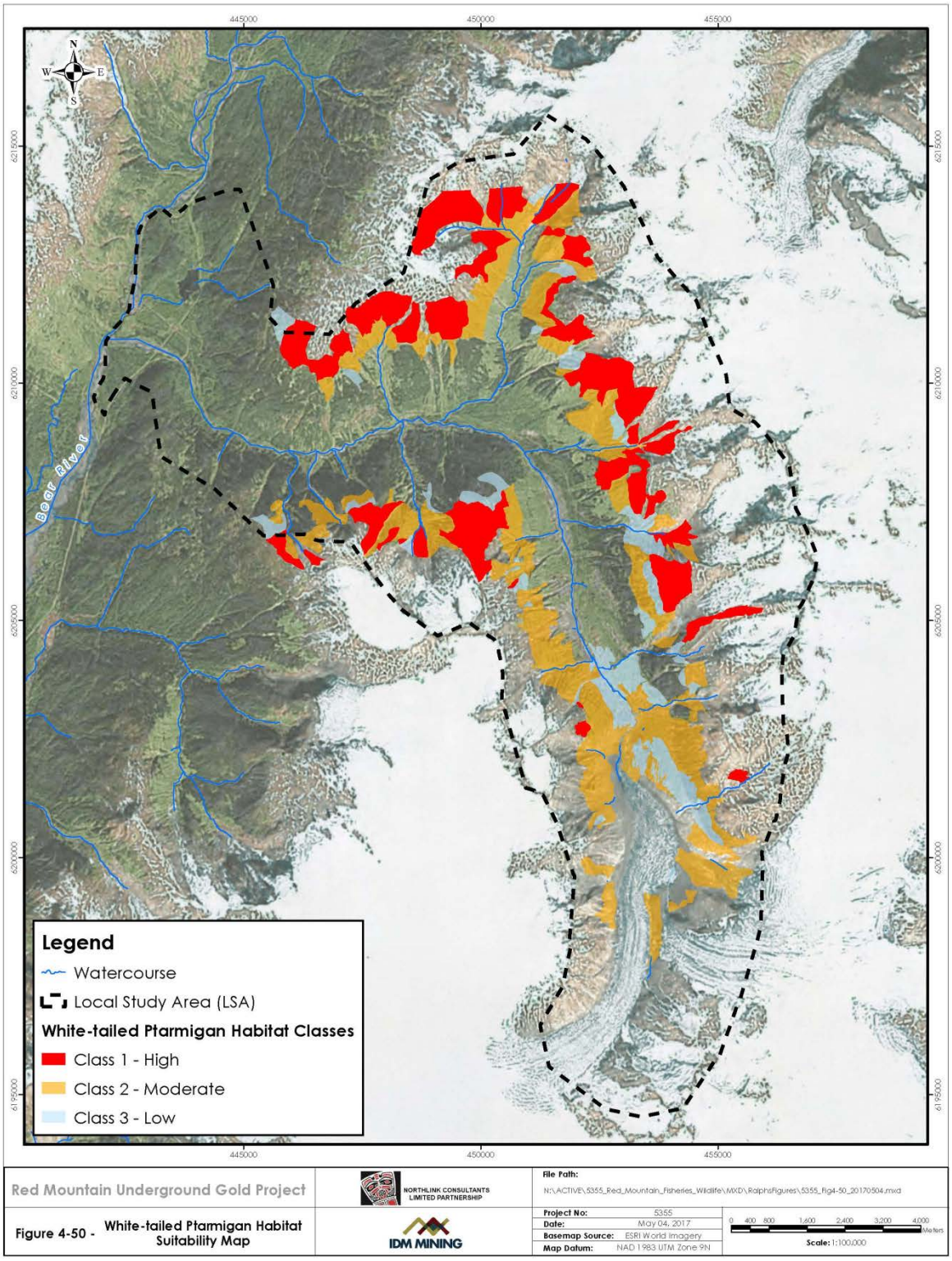
Table 4-104. Habitat suitability ratings summary for White-tailed Ptarmigan

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	1,170	8.0
	Moderate	1,698	11.6
	Low	523	3.5
	Nil	11,204	76.8

4.14.4.6 Habitat Model Evaluation

Field ratings and habitat suitability model results agreed 93% of the time, therefore no further model adjustments were necessary. Refer to the complete field ratings table in Appendix 3.

Figure 4-50. White-tailed Ptarmigan habitat suitability map



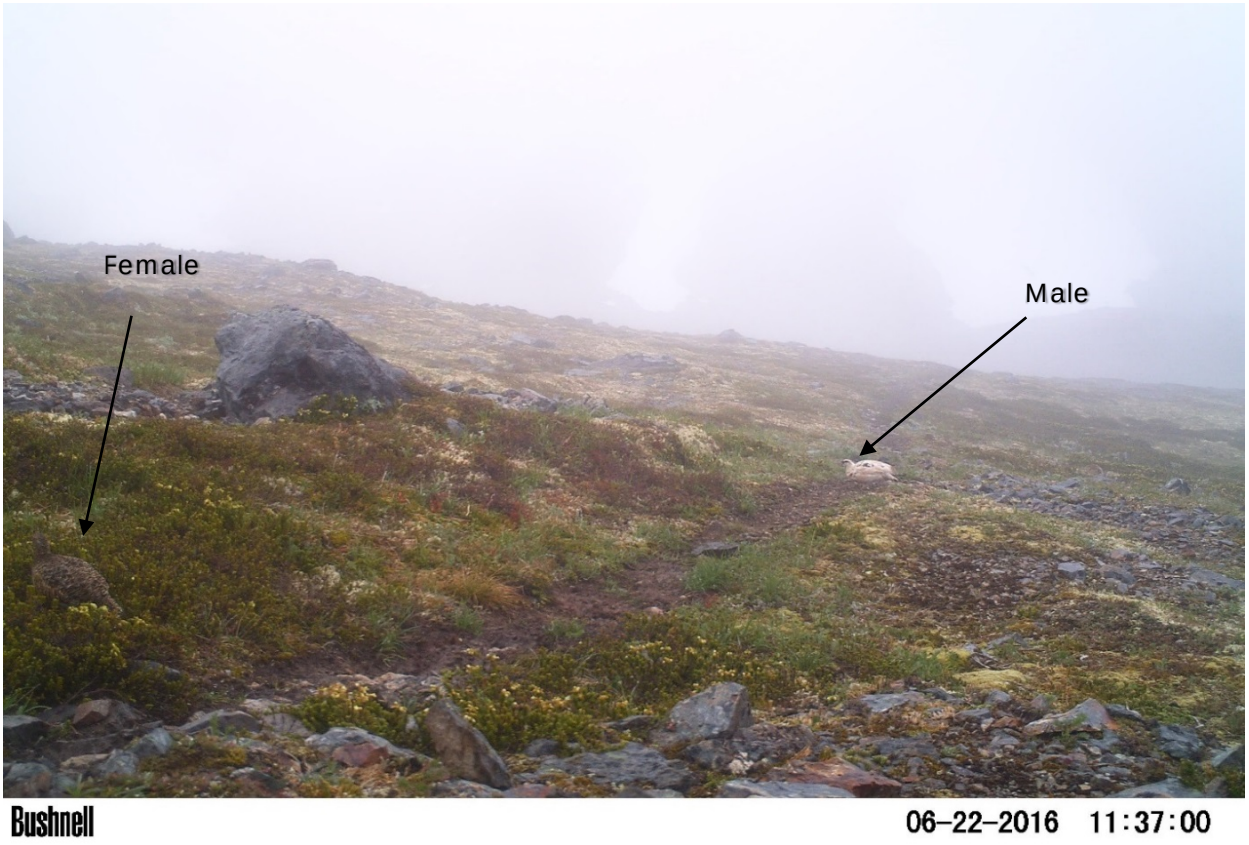
4.14.5 Field Surveys

No specific surveys were conducted for White-tailed Ptarmigan, however numerous incidental observations (Table 4-105 and Appendix 5-2) were made during other surveys in both 2015 and 2016. White-tailed Ptarmigans were also recorded on several wildlife cameras (Figure 4-51).

Table 4-105. White-tailed Ptarmigan observations during the 2015 and 2016 field seasons

Observation type	*Date*	*UTM*	*BEC Zone*	*Structural Stage*	*Breeding Evidence*
Incidental	Aug 13, 2015	9 455757 6201748	CMAun	3a (Mtn Heather)	Female with 2 chicks
Incidental	Aug 13, 2015	9 456719 6201613	CMAun	2 Heather/ lichen	scat
Incidental	Aug 14, 2015	9 453882 6201555	CMAun	2 Lichen	Scat (2)
Incidental	July 2016	9 449929 6206793	CMAun	Herbaceous meadow	Male
Incidental	July 2016	9 453976 6205309	CMAun	Herbaceous meadow	Female
Wildlife Camera	June 2016	9 455018 6201801	CMAun	Heather/Lichen	Male and female feeding
Wildlife Camera	June 2016	9 455018 6201801	CMAun	Heather/Lichen	Male and female feeding
Wildlife Camera	June 2016	9 455018 6201801	CMAun	Heather/Lichen	Male and female feeding

Figure 4-51. Photo from Wildlife Camera #4 capturing a male and female White-tailed Ptarmigan feeding in a Mountain heather/Lichen complex just above the current Mine Camp



4.14.6 Conclusions

White-tailed Ptarmigan was relatively common throughout the alpine areas of the LSA. Breeding evidence was observed in 2015 with the detection of one female with two chicks close to the existing mine camp in the Goldslide Creek drainage.

4.15 Sooty Grouse

4.15.1 Identification and General Ecology

The species, formerly known as the Blue Grouse (*Dendragapus obscurus*), was reclassified in 2006 based on mitochondrial DNA analysis as well as behavioural and habitat differences to include two species: Dusky Grouse (*D. obscurus*) and Sooty Grouse (*D. fuliginosus*) (Starzomski 2015 in Davidson et al. 2015). There are two subspecies of Sooty Grouse that exist in British Columbia which include *D. f. sitkensis* and *D. f. fuliginosus* (Zwickel and Bendell 2005).

The adult male Sooty Grouse has sooty-grey upperparts tinged with brown, and fine darker grey vermiculation. The tail is generally black or dark gray with pale grey tips forming a distinct pale grey band on the tail. The breast and underparts are dark grey, darker on the upper breast, and lack brown tinge. Side and flank feathers contain white shaft streaks, and are white-tipped. The head is dark-grey or blackish with the throat area being the darkest, and usually contains white flecking on the chin and throat. Large areas of yellow can be seen on each side of the neck when chambers are inflated upon male displaying behaviour. The yellow patches consist of warty, wrinkly bare skin surrounded by a large circular ruff of dark-tipped white feathers. Another identifying characteristic of the male Sooty Grouse when displaying is orange-yellow or bright red combs above the eyes. The grouse has a short blackish bill, dark grey legs, and feet with yellow soles. The legs and toes have a dense covering of grayish-brown feathers.

The adult female has mottle upperparts in shades of brown, reddish-brown, grey, and black, and has narrow white tips and shaft streaks on the shoulders and some wing feathers. The flight feathers are black with brown mottling. The tail is mottled with alternating grey, blackish, and rusty-brown bands, and contains a pale grey terminal band. The breast is also mottled, but slightly paler than the upperparts, as is the belly, however belly feathers contain bold whitish tips, giving the underparts a white-spotted appearance. The head and neck are sooty grey-brown, with brownish mottling on the head and whitish spotting and mottling on the throat and fore-neck. Legs and feet as well as leg feathers are similar in colour to the male birds.

Juveniles appear very similar to the adult females, however many of the body feathers have diagnostic pale shaft areas, and the narrow pointed tail feathers have pale shaft streaks on the outer portions. The crowns generally have varying amounts of rusty-brown.

Distinguishing the Sooty Grouse from other grouse species is relatively simple, with its habitat, as the only other grouse species that exists within most of its range is the Ruffed Grouse (*Bonasa umbellus*), which is easily identifiable due to its much smaller size, pronounced crest, and black sub-terminal band on the tail of the females. In some areas along the crest and eastern slopes of the Coast and Cascade Mountains, where the occurrence of Sooty Grouse is less common, the range can overlap with the Spruce

Grouse (*Falcipennis canadensis*). The female Spruce Grouse are also much smaller, have a shorter neck, and tail which lacks the pale terminal band which distinguishes the female Sooty Grouse (Zwickel and Bendell 2005).

4.15.2 Habitat

The Sooty Grouse commonly occurs in brushy open areas within forested habitats, such as burns, clear-cuts, mountain meadows, and forest openings. It can also often be found along road sides. The species is closely associated with mature or second-growth coniferous forests throughout its range, including low elevation forests where the dominant tree species include Douglas-fir, Sitka Spruce, Western Hemlock, or Western Redcedar. The grouse can also be found at higher elevations in forests which are dominated by Amabilis Fir, Mountain Hemlock, and Yellow-cedar. During the summer, the grouse is known to inhabit open subalpine areas including parkland or meadows where there is little to no tree cover (Campbell et al. 1990; Zwickel and Bendell 2005).

Sooty Grouse begins courtship activities in late winter and early spring and continues throughout April and early May. Males are known to mate with multiple females throughout the breeding season, however it is unknown if females mate with more than one male.

Nesting

Nests are constructed by the females in April or May, however this may occur earlier in lowland areas. Sooty Grouse females construct their nests on the ground within small depressions which are generally 17 to 23 cm across and 4 to 5 cm deep, and which are protected by some form of cover above, which may include grasses, shrubs, ferns, small trees, log, stumps, etc. Nest materials are gathered from the immediate vicinity of the nest location; the nest is lined with dry vegetation including grasses, leaves, moss, twigs, conifer needles, or bark, as well as some feathers.

Most foraging occurs on the ground or in trees. Foraging within trees (arboreal foraging) is most important during the winter months when food on the ground is inaccessible due to the presence of snow.

Sooty Grouse diet consists of conifer needles (particularly *Tsuga heterophylla*) which are consumed most of the year, and form almost 100% of the diet in winter months. Other food sources include plant materials such as berries, fruits, seeds, leaves, buds, and flowers from a wide array of shrubs and forbs, as well as the tips of fern fronds, including Bracken Fern (*Pteridium aquilinum*) and Lady Fern (*Athyrium filix-femina*). During the breeding season, juveniles and some adults are known to consume insects such as ants and grasshoppers. In addition, the species regularly ingests gravel material to aid in digestion (Zwickel and Bendell 2005).

4.15.3 Study Area Distribution

The species is a common resident in British Columbia, and is found in most areas along the coast, including Vancouver Island and Haida Gwaii, however it is less common at lower elevations; its distribution coincides with the mountains throughout its range. Distribution of the species is thought to be rare in the Lower Mainland due to lack of suitable remaining habitat. The species most commonly occurs along the Pacific slopes of the Coast and Cascade Mountains, but is rare to uncommon along the eastern slopes where the occurrence is replaced by the closely related Dusky Grouse. In northern British Columbia and the Alaskan Panhandle, the Sooty Grouse exists in small numbers along the western slopes and valleys of the Coast Mountains (Campbell et al. 1990). The relevant components of the Sooty Grouse model are presented here. For a full species account and detailed model description refer to Appendix 2.

Distribution mapping compiled by E-Fauna BC for *D. fuliginosus* shows four occurrences within the immediate vicinity (2 km) of Stewart, BC. Seventeen additional occurrence observations are mapped along the western border of British Columbia and Alaska within an area which extends 40 km to the north of Stewart.

Throughout the year the species is known to migrate in altitude, though some individuals remain relatively sedentary. Beginning in late summer, typically in August, and throughout the fall until approximately November, birds breeding in the lowlands as well as those breeding at alpine elevations will begin to migrate to their winter grounds at middle elevations where they will spend the winter alongside other Sooty Grouse that have bred at middle elevations. The birds will begin migrating back to their breeding territories around mid-winter, and most will reach their breeding grounds by late March or early April (Campbell et al. 1990). Point counts suggest that the Sooty Grouse is most common below 750 m elevation, however the species has been observed up to 2,000 m (Starzomski 2015 in Davidson et al. 2015).

4.15.4 Habitat Suitability Mapping

4.15.4.1 Habitat Use – Life Requisites and Seasons

Living habitat pertaining to the Life Requisites of the Sooty Grouse which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-106). Life Requisites include Living and Reproducing.

Living

The habitat requirements of the Sooty Grouse vary between seasons. In the winter the Sooty Grouse typically inhabits mature or second-growth coniferous forests, relying on conifer needles as a main food source. During the growing season the Sooty Grouse can be found in open subalpine areas including parkland or meadows where there is little to no tree cover, where their diet consists of forbs, berries, seeds, leaves, and insects.

Reproducing

Eggs are typically laid in April or May, or sometimes earlier in lowland habitats. Occasionally, replacement clutches may be laid into June and July. Eggs are present in BC between late April and early August. Eggs hatch after an average 26 day incubation period, with an average fledgling period of 15 days. Breeding occurs in various habitats, though it is generally within or adjacent to open subalpine areas such as meadows or parkland. Nests are constructed on the ground within small depressions, and are usually hidden by some form of cover.

Table 4-106. Life Requisites of the Sooty Grouse within the Project area rated by month and season

Sooty Grouse Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Living
February	Winter	Living
March	Winter	Living, Reproducing (eggs)
April	Growing (Early Spring)	Living, Reproducing (eggs)
May	Growing (Late Spring)	Living, Reproducing (eggs)
June	Growing (Summer)	Living, Reproducing (eggs)
July	Growing (Summer)	Living, Reproducing (eggs)
August	Growing (Summer)	Living
September	Growing (Fall)	Living
October	Growing (Fall)	Living
November	Winter	Living
December	Winter	Living

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.15.4.2 Wildlife Habitat Ratings

The mappable TEM attributes for suitable Living and Reproducing (eggs) Life Requisites in relation to specific ecosystem attributes are summarized in Table 4-107 and the general habitat requirements for the Sooty Grouse are summarized by season and structural stage in Table 4-108.

Table 4-107. Terrestrial Ecosystem Mapping relationships for each Life Requisite of the Sooty Grouse

Sooty Grouse Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: site disturbance, structural stage, slope • Vegetation: % cover by layer, plant species, cover for species by layer
Reproducing (eggs) Habitat	• Site: site disturbance, structural stage, slope • Vegetation: % cover by layer, plant species, cover for species by layer

Table 4-108. Summary of habitat requirements for Sooty Grouse by season and structural stage

Sooty Grouse Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Conifer forests, forest openings, subalpine open areas, krummholz	2-7
Growing	Reproducing	Conifer forests, forest openings, subalpine open areas, krummholz	2-7
Winter	Living	Conifer forests	2-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

An intermediate level of knowledge exists on the habitat requirements for the Sooty Grouse, therefore a four-class rating scheme will be used.

4.15.4.3 Habitat Ratings Assumptions

Habitat assumptions are listed below, detailed winter habitat assumptions are outlined in Table 4-109, and detailed nesting season habitat assumptions are outlined in Table 4-110.

Living-Winter

- Alpine and subalpine meadows during the winter season will be rated Nil (Class 4).
- Riparian areas and deciduous forests during the winter season will be rated Nil (Class 4).
- Mesic, mature, old-growth forests on gentle to steep slopes with reasonable understory development rate up to High (Class 1) for living in winter.
- Young to old-growth forests will be rated up to High (Class 1) for reproducing if forest has a moderate to high understory cover and canopy closure.

Reproducing-Growing

- Young to old-growth forests, alpine and subalpine meadows, and krummholz during the growing season will be rated High (Class 1) for reproducing.
- Riparian areas and deciduous forests during the growing season will be rated up to Moderate (Class 2) for reproducing.
- Mesic, mature, old-growth forests on gentle to steep slopes with reasonable understory development rate up to High (Class 1) for living.

Table 4-109. Sooty Grouse Winter living habitat assumptions table

Living – Winter (LI-W)	**General Habitat**	Mature or old-growth forest with high canopy closure
	Key Habitat Requirements	
	• Mature or Old-growth coniferous forest • High canopy Closure for snow interception and thermal cover • Some shrub understory development for forage	
	Ratings	**Assumptions**
	1 (high) [76-100%]	• Old-growth coniferous stands (structural stage 7)
	2 (moderate) [26-75%]	• Mature structural stage 6 coniferous stands
	3 (low) [1-25%]	• Younger coniferous forest (structural stages 4 or 5)
	4 (nil) [0%]	• CMAun • MHmmp • All deciduous forest

Table 4-110. Sooty Grouse Nesting habitat assumptions table

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Sub-alpine and alpine habitat with a significant shrub component for hiding cover
	Key Habitat Requirements	
	• Foraging habitat includes open meadows and shrub habitat • Nesting habitat is located within dense patches of shrub or krummholz	
	Ratings	**Assumptions**
	1 (high) [76-100%]	• CMAun and MHmmp and o Structural stage 2d –3b
	2 (moderate) [26-75%]	• MHmm1 with o Structural stage 2d –3b
	3 (low) [1-25%]	• Structural stage 6/7 forest • CWHwm structural stage 2 – 3a
	4 (nil) [0%]	• Structural stage 4 and 5 forests all elevations • All non-vegetated areas • All permanent snow, ice, and glaciers

4.15.4.4 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

4.15.4.5 Habitat Ratings Summary

Summer nesting habitat is readily available with 3,600 ha (24.7%) identified as either high or moderate (Figure 4-53). Winter habitat (Figure 4-52) is restricted to the lower elevation mature forest ecosystems and makes up only 1,958 hectares (13.4% of the LSA). Table 4-111 outlines the habitat ratings identified by the model for both summer (nesting) and winter (living) seasons.

Table 4-111. Habitat suitability ratings summary for Sooty Grouse within the LSA for both Winter and Growing seasons

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	1,868	12.8
	Moderate	1,866	12.8
	Low	2,087	14.3
	Nil	8,774	60.1
Living-Winter	High	805	5.5
	Moderate	1,154	7.9
	Low	984	6.7
	Nil	11,652	79.8

4.15.4.6 Habitat Model Evaluation

The habitat suitability model for Sooty Grouse summer habitat predicted the habitat 93% of the time compared to the field ratings. Sooty Grouse observations from 2015 and 2016 summer field visits, including the known nest location, were all located in habitat identified as class 1 nesting habitat. The winter habitat suitability map performed equally well, predicting suitable winter habitat 98% of the time compared to field ratings. No further adjustments were necessary for either model. Full field ratings are found in Appendix 3.

Figure 4-52. Sooty Grouse Winter habitat suitability map

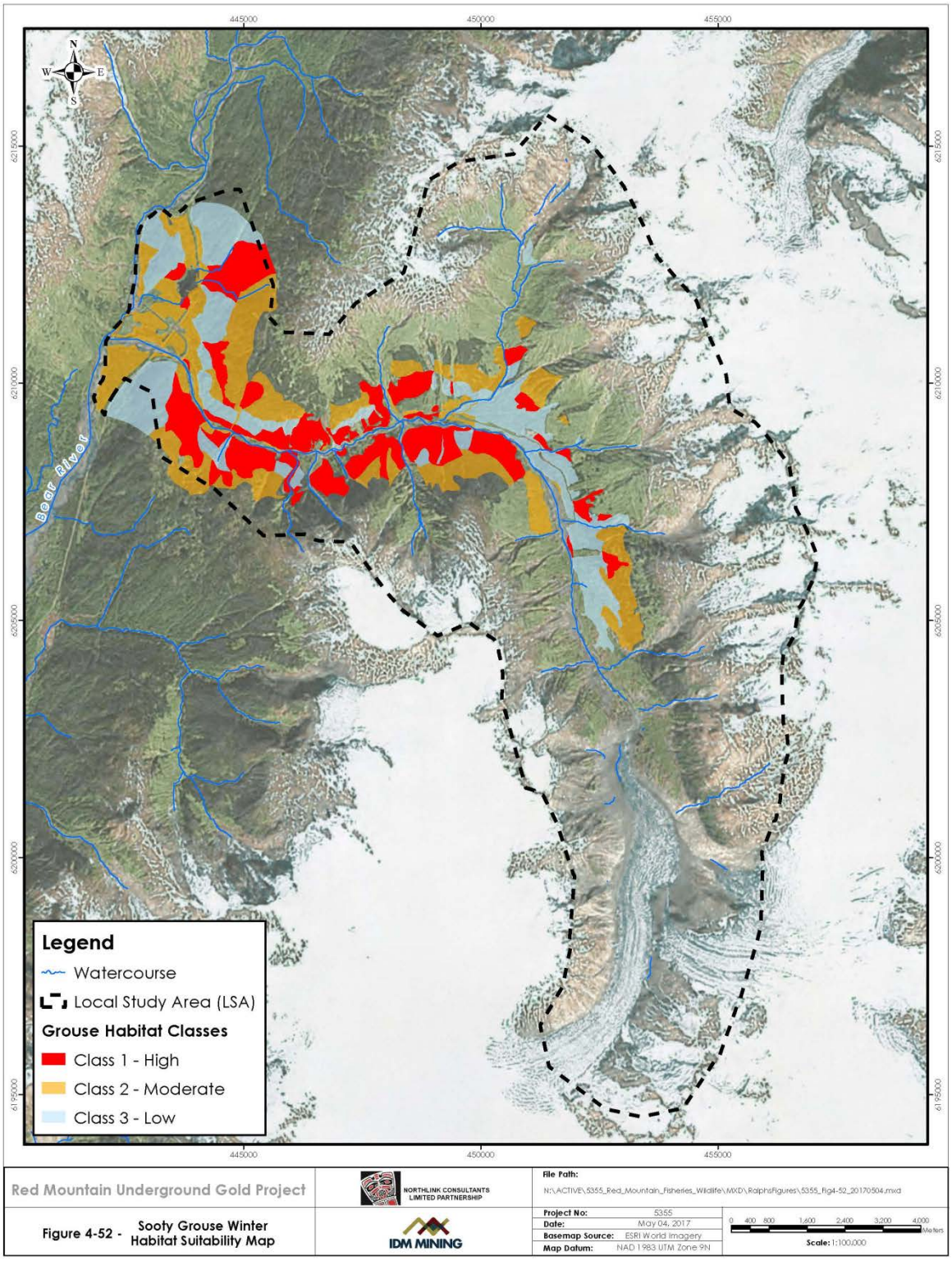
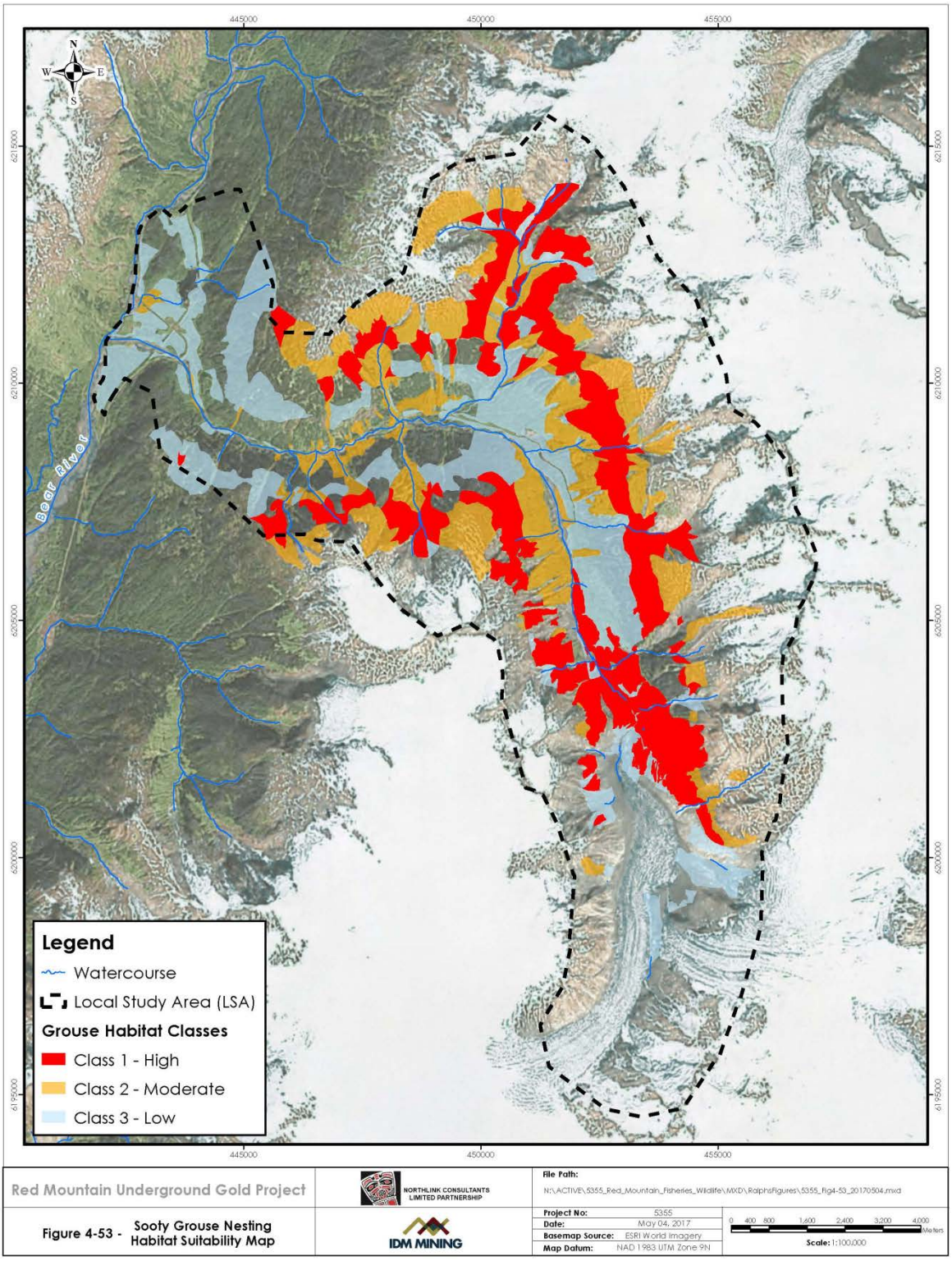


Figure 4-53. Sooty Grouse Nesting habitat suitability



4.15.5 Field Surveys

Specific surveys for Sooty Grouse were not conducted during 2015 or 2016 field visits. Sooty Grouse were recorded 5 times during songbird point counts (Table 4-112 and Figure 3-6). During the point count surveys, males were heard hooting and in two instances counter-hooting. Sooty Grouse were also encountered opportunistically (Appendix 5-2) during field surveys (Figure 4-55) and on wildlife cameras. One female Sooty Grouse was found incubating eggs on June 6, 2016 in the MHmm1 subzone at UTM 9U 454045 6202047 (Appendix 5-2). The nest was located under a thick layer of Mountain Hemlock (*Tsuga mertensiana)* regeneration and *Ribes* and *Vaccinium* shrubs (Figure 4-54). In addition to the thick vegetation the nest was protected by a large uprooted Mountain Hemlock stump.

Figure 4-54. Sooty Grouse female on nest in low shrub habitat within the MHmm1 zone

Table 4-112. Summary of Sooty Grouse observations within the LSA (Map Appendix 5-2)

Observation Type	*Date*	*UTM*	*BEC Zone*	*Structural Stage*	*Breeding Evidence*
Incidental	June 6, 2016	9U 454045 6202047	MHmm1	3a blueberry/ raspberry	Female on nest
Incidental	June 9, 2016	9V 443523 6211284	CWHwm	3b willow/alder	Male hooting
Incidental	June 7, 2016	9 U 454160 6201738	MHmm1	3a edge of krummholz	
Point Count (RM-PC05)	June 7, 2016	9U 452406 6204564	MHmm1	3b willow/alder	2 Males counter hooting
Point Count (RM-PC06)	June 7, 2016	9 U 451973 6205185	MHmm1	3a	Male hooting
Point Count (RM-PC47)	July 5, 2016	9 U 453984 6201537	MHmm1	3b alder/willow	Male hooting
Point Count (RM-PC58)	July 7, 2016	9 V 449865 6207421	CMAun	2d/3a heather krummholz	Female
Point Count (RM-PC34)	June 11, 2016	9 V 443674 6211703	CWHwm	3b willow/alder	Male hooting

Figure 4-55. Sooty Grouse in Heather Lichen complex at the edge of a Mountain Hemlock krummholz patch

4.15.6 Conclusions

Summer nesting habitat is readily available, with 3,600 ha (24.7%) identified as either high or moderate within the LSA. This habitat is widely distributed throughout the upper MHmm1 zone, the MHmmp, and CMAun zones. Breeding evidence was detected throughout the LSA at all elevations, however the majority was in the upper MHmm1 and MHmmp zones. Several incidental observations were recorded in the alpine zone in close proximity to the treeline. Winter habitat is restricted to the lower elevation mature forest ecosystems and makes up only 1,958 ha (13.4%) of the LSA.

4.16 Marbled Murrelet

4.16.1 Identification and General Ecology

The Marbled Murrelet is a small (approximately 25 cm) seabird that belongs to the Auk family (Alcidae). Its plumage changes from the typical seabird colouring of black and white to a mottled grey/brown during the breeding season. Marbled Murrelet breeds inland and forages at sea. Foraging grounds are typically located in sheltered bays or inlets, but it will forage within 500 m of the coast on the open ocean. It dives for prey, using its muscular wings to propel itself underwater. The Pacific Sand Lance (*Ammodytes hexapterus*) is the most common prey item, but Murrelets will also take other epipelagic schooling fish including immature Pacific Herring (*Clupea pallasii*) (Burger 2002; COSEWIC 2012c). Emigration of adults and fledglings from breeding grounds to overwintering and/or moulting areas does occur, however the data on this topic are lacking (Burger 2004b, COSEWIC 2012c).

The breeding period in BC occurs from late April until September. During this time a single egg is laid by the female and incubated by both sexes. Incubation lasts for approximately 30 days and the chick remains at the nest for 30 to 40 days. Both parents continue to forage at sea during this period, with the hours before sunlight being the preferred time for food delivery to the nest. Nesting success ranges between 0.33 to 0.46 fledglings per nest and 95% of fledglings reach sea after leaving the nest. This, along with adjustments based on nesting attempts and proportion of adult females breeding, results in an at-sea fecundity (number of female offspring which reach the ocean per year per female of breeding age) ranging from 0.16 to 0.22 (Burger 2002). The low recruitment of this species is offset by high adult survival (approximately 85%; COSEWIC 2012c).

4.16.2 Habitat

Marbled Murrelet breeds exclusively in coastal old-growth forests, primarily in the CWH biogeoclimatic zone but also in the MH and CDF zones. Nesting habitat is typically found within 30 km of sea water. In BC, the average distance of nest trees from the ocean was 11.5 km (Hamer and Nelson 1995). Typical nest patch tree species include: Yellow Cedar (*Chamaecyparis nootkatensis*), Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*), Coastal Douglas-fir (*Pseudotsuga menziesii* var.

menziesii), and Western Redcedar (*Thuja plicata*), with few nests found in Amabilis Fir (*Abies amabilis*) and Mountain Hemlock (*Tsuga mertensiana*) (Hamer and Nelson 1995). Nesting takes place on nest platforms, created by large branches or branches with deformities, located close to the tree trunk. These branches must have a thick covering of moss and other epiphytes to provide substrate for the nest (Burger 2002; COSEWIC 2012). Hull (1999) found that nest patches had a higher density of large diameter trees and a higher number of platforms per tree than in random patches, and Hamer and Nelson (1995) found detection numbers were most accurately predicted by the same variables. A review of Marbled Murrelet habitat associations generated the following stand level structural characteristics that were positively associated with nesting (Burger 2002):

- Density of large trees (dbh >80 cm)
- Tree diameter (dbh)
- Variation in tree size (dbh or height)
- Epiphyte cover on branches
- Epiphyte thickness
- Density of potential platforms per ha
- Density of trees with platforms

These larger features are correlated with a suite of required microhabitat variables which are outlined in Table 4-113.

Table 4-113. Key microhabitat characteristics of breeding habitat for Marbled Murrelet in BC

Murrelet Requirements	*Key Habitat Attributes*
Sufficient height to allow stall-landings and jump-off departures	Nest trees are typically >40 m tall (range 15 to 80 m), and nest heights are typically >30 m (range 11 to 54 m); nest trees are often larger than the stand average.
Openings in the canopy for unobstructed flight access	Small gaps in the canopy are typically found next to nest trees, and vertical complexity of the canopy is higher in stands with nests than in other nearby stands.
Sufficient platform diameter to provide a nest site and landing pad	Nests are typically on large branches or branches with deformities, usually with added moss cover; nest limbs range from 15 to 74 cm in diameter; nests typically located within 1 m of the vertical tree trunk.
Soft substrate to provide a nest cup	Moss and other epiphytes provide thick pads at most nest sites, but duff and leaf litter are used in drier areas.
Overhead cover to provide shelter and reduce detection by predators	Most nests are overhung by branches.

Source: Burger (2004a)

Edge effects on nesting success are apparent from various studies throughout the species' range. An increase in predation on edge-associated nests is the main edge effect observed (Nelson and Hamer 1995; Burger 2002; Malt and Lank 2009). Eggs and chicks are most commonly predated by Steller's Jay (*Cyanocitta stelleri*), followed by other corvids, owls, and birds of prey (Malt and Lank 2009; COSEWIC 2012). The extent of predation varies between studies, although the general consensus is that nest patches further from forest edges have higher success rates than those close to edges (Nelson and Hamer 1995; Manley and Nelson 1999). Malt and Lank (2009) further distinguish between the type of edge and probability of nest predation; they found higher probability of predation on nests closer to hard edges (e.g., roads and recent clear-cuts) than on interior nests, lower predation probability on soft edge nests (regenerating forests) than interior nests, and no edge effects on predation for nests near natural edges (e.g., riparian areas).

4.16.3 Study Area Distribution

The Marbled Murrelet can be found in all coastal areas of BC, except some small sections in the Strait of Georgia (COSEWIC 2012). It is found in all coastal regional districts, with the vast majority of breeding habitat located in the Coastal Western Hemlock (CWH) biogeoclimatic zone, and small amounts in the Coastal Douglas-fir (CDF) and Mountain Hemlock (MH) zones (BC Conservation Data Centre 2013). Nesting habitat is most likely found within 0.5 to 30 km from the ocean, but can be found outside that range as well. Population estimates for BC range from 55,000 to 94,000, with the most recent estimate being 99,100 individuals (COSEWIC 2012). Most population trends indicate a slightly decreasing population size, with a population growth parameter between 0.859 and 0.985 for Marbled Murrelet in Desolation Sound (Cam et al. 2003). There are seven regions delineated as conservation regions for this species in BC: East Vancouver Island, West and North Vancouver Island, Southern Mainland Coast, Central Mainland Coast, Northern Mainland Coast, Haida Gwaii, and Alaska Border (CMMRT 2003).

Specific occurrences of Marbled Murrelets within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for this species are on the north mainland of British Columbia and Haida Gwaii. These records include observations of birds and nests. Marbled Murrelet is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification zones, which occur within the study area. Within the CWH zone, Marbled Murrelets inhabit ocean shorelines within several kilometres off shore from old-growth forests (BC Conservation Data Centre 2016).

Marbled Murrelet nest sites can be found from sea level up to 1,100 m elevation (Hamer and Nelson 1995). Nests are most likely found in locations under 600 m, are moderately likely to be found within 600 to 900 m, and are least likely to be found above 900 m elevation (COSEWIC 2012).

4.16.4 Habitat Suitability Mapping

Critical habitat for Marbled Murrelet has been identified (Environment Canada 2014) as the suitable nesting habitat as defined by the BC Model (CMMRT 2003). The criteria used to identify critical habitat are summarized in Environment Canada (2014). Figure 4-56 shows the critical habitat identified within the RSA as well as one tiny polygon inside the LSA (see inset Figure 4-56). The total area of critical habitat identified within the RSA is 6,383.51 ha and the small patch within the LSA is 1.42 ha. This small patch within the LSA was field verified and it was determined that there was no suitable nesting habitat within this polygon and therefore is not considered critical habitat.

Marbled Murrelet nesting habitat suitability within the LSA was modelled using parameters described in CMMRT (2003). The following section outlines a brief description of the habitat attributes modelled and the general approach. For a full species account and model description see Appendix 2.

Marbled Murrelet has been extensively studied and a wide variety of literature outlines the habitat requirements for nesting sites. Key habitat features are summarized in Table 4-114. While there is no Provincial benchmark habitat for Marbled Murrelet breeding sites, there is a standard method for ranking nesting habitat (Burger 2004a). The 6-class rating scheme presented in Burger (2003) was followed. This rating scheme better facilitates identification of low quality habitats that may be capable of supporting Murrelets (Table 4-115).

Table 4-114. Summary of habitat attributes for Marbled Murrelet reproduction

Habitat Use	*Attributes of Suitable Marbled Murrelet Habitat*	*Structural Stage[1]*
Reproducing–Eggs	Old-growth forest with multi-layered canopy, canopy gaps and large, tall trees with adequate nest platforms	7

Source: Burger (2003)

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

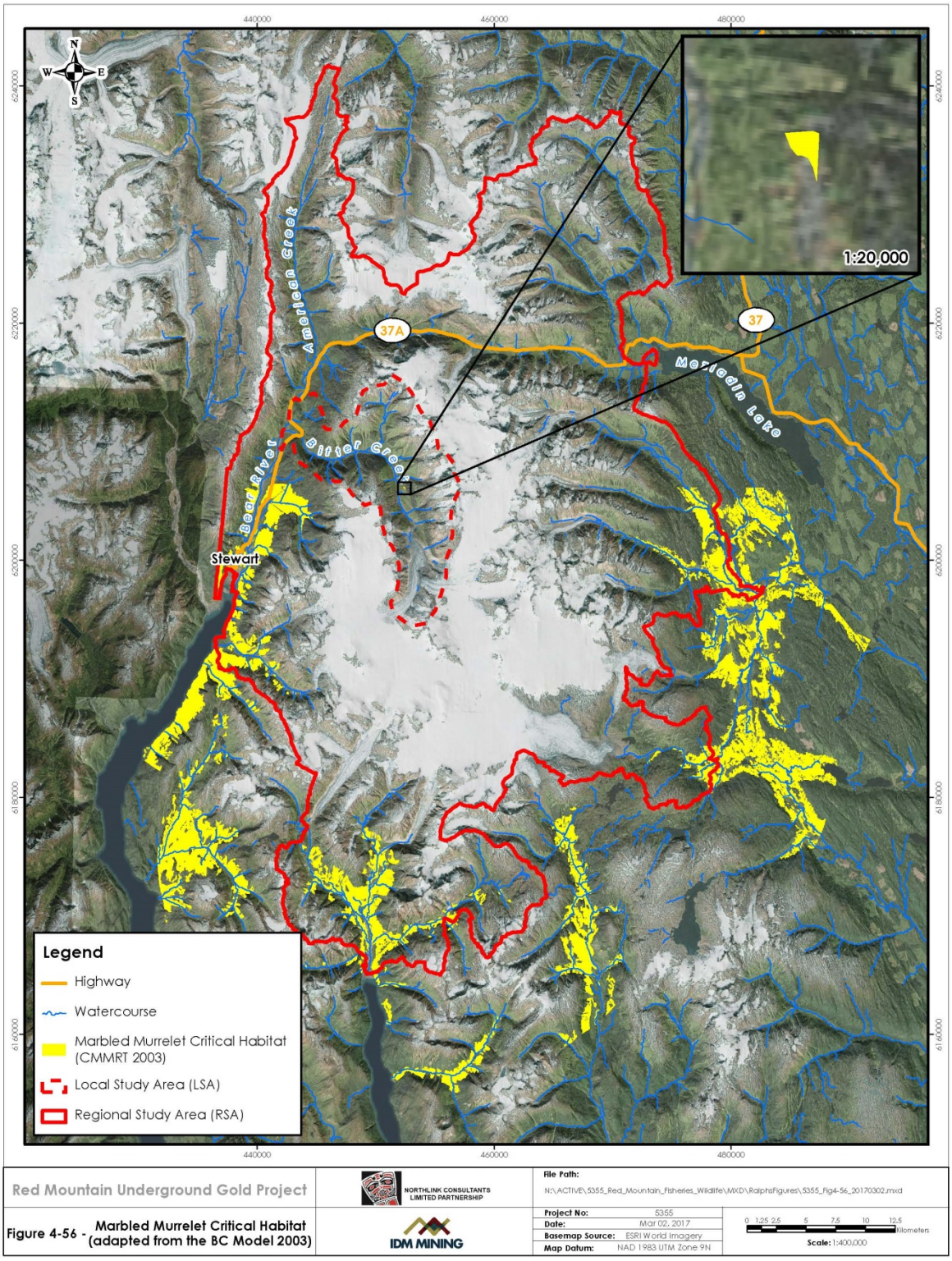
Table 4-115. Relative suitability classes to be assigned to Marbled Murrelet habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Habitat Quality and Likelihood of Nesting*
1	Very High	>50 to 100	Key habitat features present in abundance; nesting highly likely
2	High	>25 to 50	Key habitat features common and widespread; nesting likely
3	Moderate	6 to 25	Key habitat features present but uncommon and patchy; nesting likely but at moderate to low densities
4	Low	2 to 5	Key habitat features all evident but patchy and sparse; nesting possible but unlikely or

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Habitat Quality and Likelihood of Nesting*
			at very low density
5	Very Low	about 1	Key habitat features sparse and might not all be present; nesting highly unlikely
6	Nil	0	All key habitat features absent; nesting impossible (e.g., bogs, bare rock)

Source: Burger (2003)

Figure 4-56. Critical habitat mapped as suitable nesting habitat (adapted from the BC Model 2003)



4.16.4.1 Habitat Ratings Assumptions

Nesting habitat for Marbled Murrelets depends on old growth Sitka spruce dominated stands with very large old trees that provide large mossy platforms, generally within 50km of the ocean (although nest have been found further inland) and multi-layered canopies. Detailed habitat suitability ratings assumptions are listed in table 4-116.

Table 4-116 Detailed habitat suitability ratings assumptions for Marbled Murrelet nesting habitat

<table>
<tr><td colspan="3">Marbled Murrelet (B-MAMU)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Old growth forest with multi-layered canopy, canopy gaps and large, tall trees with adequate nest platforms</td></tr>
<tr><td rowspan="5">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">Mature/old growth forests in close proximity to the ocean that possess nesting platforms with the following characteristics:
Sufficient height to allow stall landings and jump-off departures
Openings in the canopy for unobstructed flight access
Sufficient platform diameter to provide a nest site and landing pad
Soft substrate to provide a nest cup
Overhead cover to provide shelter and reduce detection by predators
Note: Habitat within 50 m of edges, specifically roads and clearcuts, will be adjusted downwards by 2 classes.</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (very high)
[50-100%]</td><td>CWHwm and ICHvc:
Old growth Sitka spruce stands (CWHwm 04 and 05 and ICHvc 06)
Stands with age class 9 (>250 yrs)
Structural Stage 7
Area with site index productivity class I
Area with tree height class 6-7
Area with canopy closure class 5-6
Area with vertical canopy complexity of moderately uniform (21 to 30% height difference, some canopy gaps visible, evidence of past disturbance) and non-uniform (31 to 40% height difference, canopy gaps often visible due to past disturbance)</td></tr>
<tr><td>2 (high)
[25-50%]</td><td>CWHwm 04 and 05; and ICHvc 03 and 04
Stands with age class 9 (>250 yrs)
Structural Stage 7
Area with site index productivity class II
Area with tree height class 4-5
Area with canopy closure class 4
Area with very non-uniform vertical canopy complexity (>40% difference, very irregular canopy)</td></tr>
</table>

	3 (moderate) [6-25%]	CWHwm and ICHvc • Stands with age class 8 (140 to 250 yrs) • Structural Stage 6 • Area with site index productivity class I • Area with tree height class 3 • Area with canopy closure class 3 and 7 • Area with uniform vertical canopy complexity (11 to 20% height difference, few canopy gaps visible, little or no evidence of disturbance
	4 (low) [2-5%]	• Stands with age class <8 • Area with site index productivity class IV • Area with tree height class <3 • Area with canopy closure class 2 and 8 • Area with very uniform vertical canopy complexity (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance)
	5 (very low) [~1%]	• Stands with age class <8 • Area with site index productivity class <IV • Area with tree height class <3 • Area with canopy closure class 2 and 8 • Area with very uniform vertical canopy complexity (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance)
	6 (nil) [0%]	• All other habitats not listed above

Rating Assumptions for Reproduction Habitat

- Old-growth (structural stage 7) CWHwm Sitka spruce-Salmonberry stands (ecosystem 09) are rated Class 1.
- Stands with age class 9 (>250 years) are rated Class 1 or 2, age class 8 (140 to 250 yrs) is rated Class 3, and stands with age class <8 are rated Class 4 or lower.
- Area with site index productivity class I and II are rated Class 1 or 2, class III is rated Class 3, and class IV is rated Class 4 or lower.
- Area with tree height class 4-7 (>27.5 m) is rated Class 1 or 2, tree height class 3 (19.5 to 28.4 m) is rated Class 3, and tree height class <3 (<19.5 m) is rated Class 4 or lower.
- Area with canopy closure class 4-6 is rated Class 1 or 2, classes 3 and 7 is rated Class 3, and classes 2 and 8 are rated Class 4 or lower.
- Stands with height class 6 or greater are rated Class 1, height class 5 is rated Class 2, and height classes 4 and under are rated Class 3 or less.

- Area with vertical canopy complexity of MU, NU, and VNU is rated Class 1 or 2, U is rated Class 3, and VU* is rated Class 4 or lower.

Notes:

- Many of the rating assumptions are based on Table 3 in CMMRT (2003).
- *VU = very uniform (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance)
- U = uniform (11 to 20% height difference, few canopy gaps visible, little or no evidence of disturbance)
- MU = moderately uniform (21 to 30% height difference, some canopy gaps visible, evidence of past disturbance, stocking may be patchy or irregular)
- NU = non-uniform (31 to 40% height difference, canopy gaps often visible due to past disturbance, stocking typically patchy or irregular)
- VNU = very non-uniform (>40% difference, very irregular canopy, stocking very patchy or irregular) (CMMRT 2003)

4.16.4.1 Habitat Ratings Summary

The nesting habitat suitability model developed for the LSA has identified additional high value nesting habitat not previously identified by the BC Model. A total of 20 ha of high (class 1) and 142 ha of moderately high (class 2) nesting habitat were identified in several small patches along the lower reaches of Bitter Creek (Table 4-117 and Figure 4-57).

Figure 4-57. Nesting habitat suitability for Marbled Murrelet within the LSA

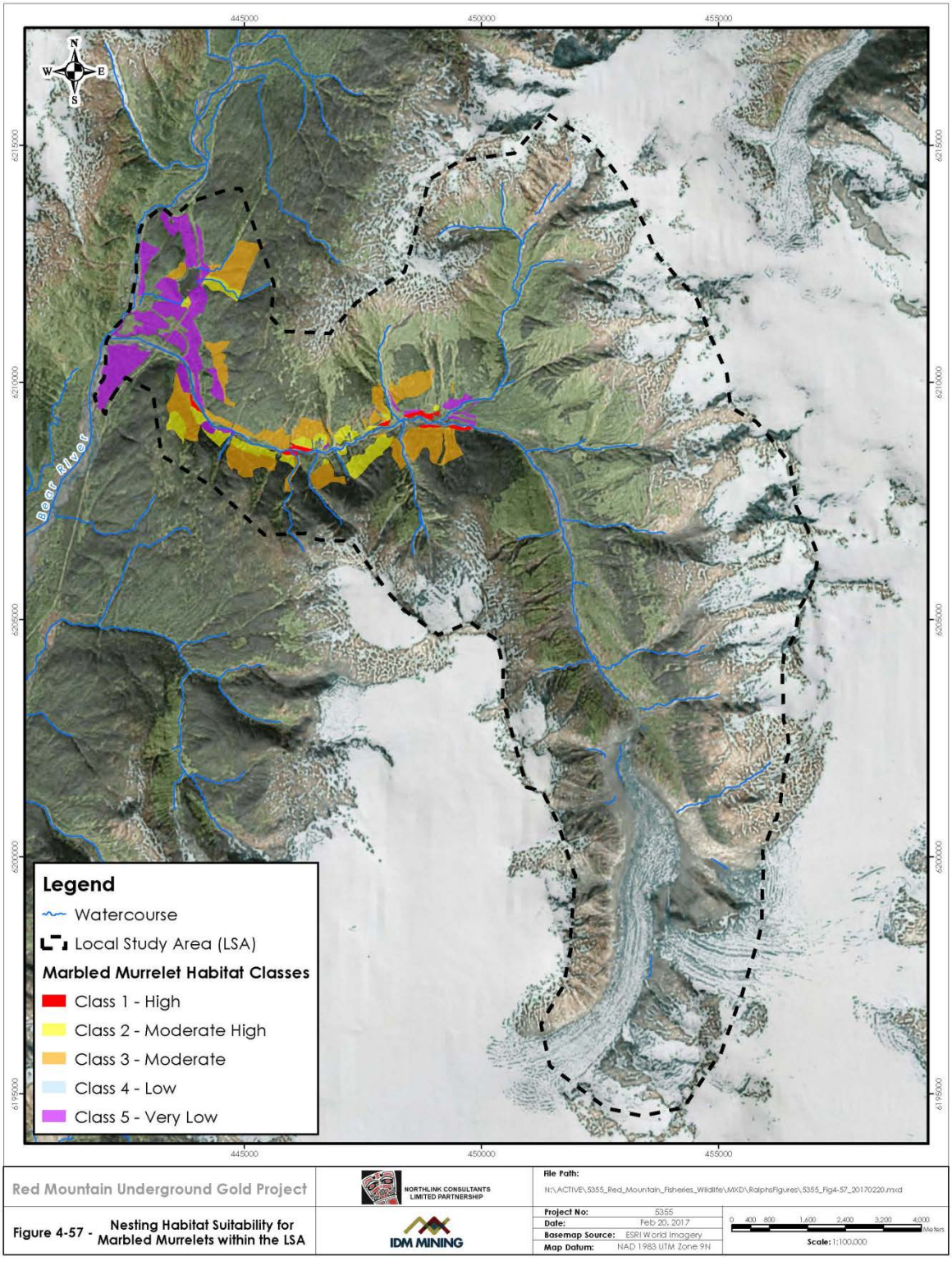


Table 4-117. Summary of nesting habitat suitability for Marbled Murrelet within the LSA

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	20	0.1
	Moderately High	142	1.0
	Moderate	410	2.8
	Low	0.0	0.0
	Very Low	340	2.3
	Nil	13,683	93.8

4.16.5 Field Surveys

Aerial Surveys

The small patch of critical habitat identified in the LSA by the BC model was field verified by helicopter survey on June 6, 2016 (Figure 4-56) following methods outlined in Burger et al. (2004). The entire polygon was flown at a very slow speed (approximately 20 to 40 knots) and full video and representative photos were taken along the flight lines. Field verification rejected this polygon as critical habitat based on the young age of the trees (80 to 120 years old), tree species (western hemlock, black cottonwood, and sub-alpine fir), a lack of nesting platforms, and relatively uniform stand heights and structure (Figure 4-58 and Figure 4-59).

Figure 4-58. Typical young even aged stand characteristics of the polygon originally identified as critical habitat for Marbled Murrelet

Figure 4-59. Clear lack of nesting platforms suitable for nesting Murrelets

Additional helicopter surveys following Burger et al. (2004) were conducted along both sides of Bitter Creek at the lower elevations where mature and old-growth forest had been identified during other surveys in both 2015 and 2016. A total of 31.3 km were flown at slow speed approximately 10 to 50 m above the tree tops. Video and representative photos were taken within each polygon. Polygons were derived from the preliminary TEM completed in 2015 (Table 4-118). Three polygons were rated either class 1 or 2 nesting habitat. Follow-up ground surveys were conducted in polygons that were rated class 1 or 2 from the air to further verify the suitability of nesting habitat (Figure 4-63).

Table 4-118. Aerial and ground field ratings summary for Marbled Murrelet nesting habitat assessment

Old 2015 Polygon #	*Final TEM Polygon #*	*Aerial Rating*	*Field Rating*
29	585	Class 4 (Low)	Not assessed
30	584	Class 3 (Moderate)	Not assessed
31	583	Class 2 (High)	Class 2 (High)
39	269	Class 4 (Low)	Not assessed
40	267	Class 3 (Moderate)	Class 2 – 3 (Moderate to High)
53	574	Class 3 (Moderate)	Not assessed
118	593/594/595	Class 3 (Moderate)	Not assessed
119	287	Class 3 (Moderate)	Not assessed
124/126/133	275/277/800	Class 4 (Low)	Not assessed
142	257	Class 3 (Moderate)	Not assessed

Old 2015 Polygon #	*Final TEM Polygon #*	*Aerial Rating*	*Field Rating*
145	424	Class 1 (Very High)	Class 1 (Very High)

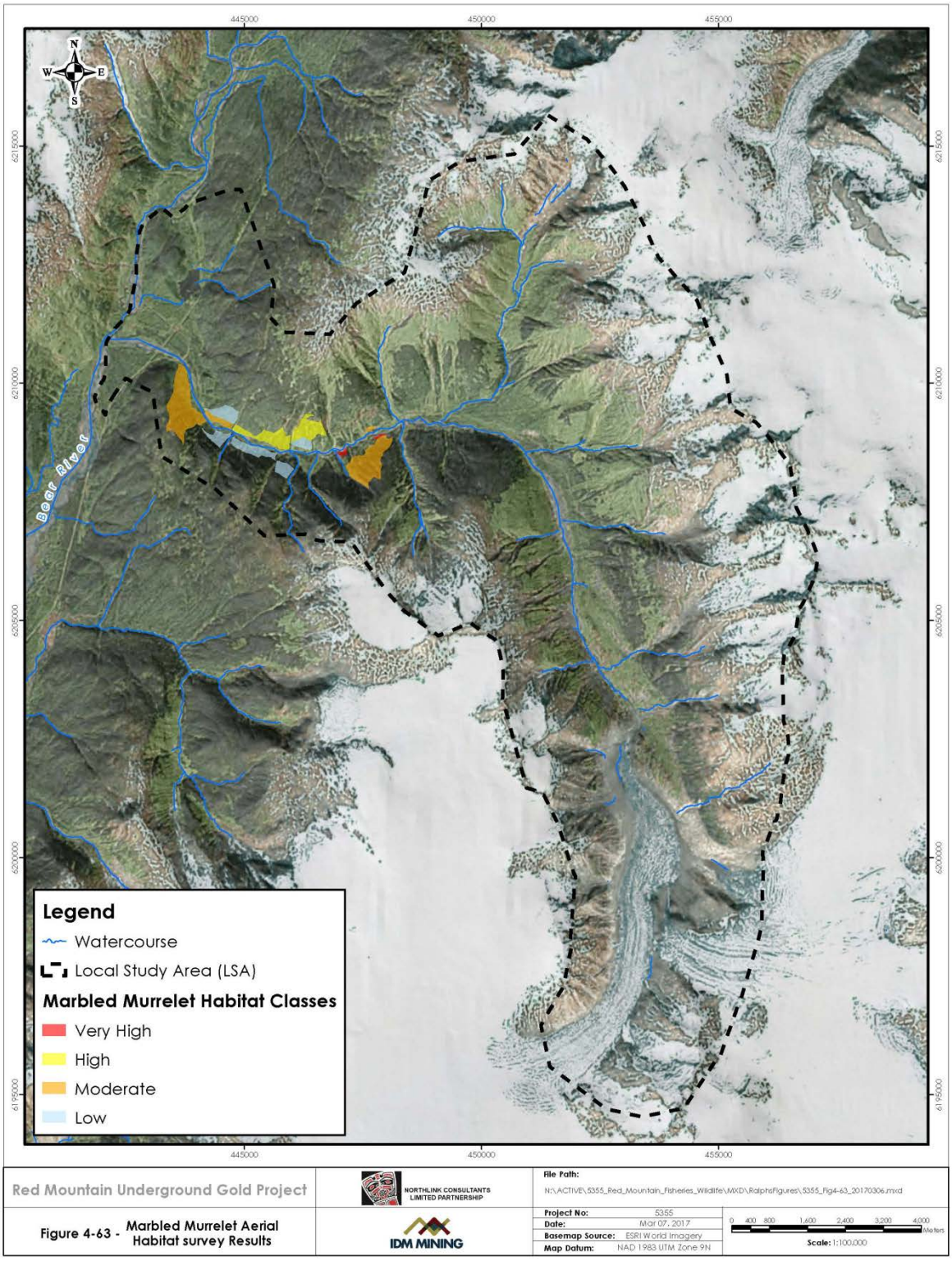
Figure 4-60. Photo of polygon 145 with large Sitka spruce and good vertical canopy diversity

Detailed systematic searches were conducted around suitable nest trees identified during the ground surveys. Searches were conducted in concentric circles around suitable nest trees to locate any egg shell fragments indicating potential nesting activity. A total of 25 potential nest trees were identified and searched during the July 2016 field visit. No egg shell remnants were found.

Figure 4-61. Photo of Sitka spruce in Polygon 145 with good large mossy platforms providing potential nesting habitat for Marbled Murrelet

Figure 4-62. Large Western Hemlock in Polygon 31 with large mossy covered platforms providing suitable nesting habitat. Ground search for egg shells conducted under trees like this one.

Figure 4-63. Map with Marbled Murrelet aerial survey results



4.16.6 Conclusions

The BC Model only identified one very small polygon of critical habitat within the LSA. Low level aerial assessments following protocols outlined in Burger et al. (2004) determined that this polygon was not critical habitat. However, the detailed habitat suitability modelling and subsequent aerial and ground surveys did identify class 1 and class 2 nesting habitat within the lower reaches of Bitter Creek. Several larger patches of structural stage 7 (old-growth) Sitka Spruce stands along the Bitter creek floodplain provided suitable nesting platforms. These class 1 and class 2 habitat polygons should be further verified for occupancy by Marbled Murrelets.

4.17 Western Toad

4.17.1 Identification and General Ecology

Western Toads (*Anaxyrus boreas)* are easily identified by their dry, bumpy skin, large parotid glands, and light coloured dorsal stripe. Sexual dimorphism is present in this species: males are usually <95 mm and the larger females can be up to 125 mm. Adult toads have stocky bodies with short legs, and range in colour from pale green to grey, dark brown, and red. Typically the bellies are pale coloured and mottled with black, and the toads have a pale coloured stripe down their backs (MOE 2016).

Their activity pattern can vary with geographic and elevational location, but they are known to be active from January to October in some areas (MOE 2016). During the active season adult toads are typically nocturnal in most areas, while a more diurnal pattern can be seen at higher elevations or at colder times of the year (Wind and Dupuis 2002; BC Conservation Data Centre 2016).

Western Toads utilize three types of habitat including breeding habitats, terrestrial summer range, and winter hibernacula. Preferred breeding sites include wetted areas of permanent or temporary water bodies with shallow sandy bottoms. The toads disperse into terrestrial habitats including forests and grasslands after breeding. In the winter they hibernate in underground burrows that can be up to 1.3 m deep under the frost line (MOE 2009).

Male Western Toads are known to make a faint bird-like chirping sound when grasped by other males which are actively searching for females, however females do not produce this call (Wind and Dupuis 2002).

4.17.2 Habitat

Breeding

Western Toad breeding sites can be found in a wide range of aquatic habitats, including littoral zones of lakes, temporary and permanent wetlands of all sizes and classifications, as well as roadside ditches and wheel ruts. The presence of water is required at breeding sites for at least 2 to 3 months to allow successful recruitment.

Breeding sites with shallow water and sandy substrates are preferred, although they can vary in the extent of tree/shrub canopy cover, coarse woody debris, and emergent vegetation. Eggs are laid in gelatinous double-strings, either directly on the bottom substrate or entwined in aquatic vegetation. Larvae hatch within 7 to 10 days into black tadpoles that aggregate in shallow areas, typically near the shoreline. Within 2 to 3 months of egg deposition, larvae metamorphose into toadlets and remain within the riparian area for a short time until they emigrate from the breeding site to seek terrestrial overwintering sites (BC Conservation Data Centre 2016).

Terrestrial

Western Toads spend a large portion of their time in terrestrial habitat. After breeding has finished, adults leave the breeding site and for the remainder of the active season they can be found in surrounding terrestrial habitat and, to a lesser extent, in non-breeding aquatic habitat (Bull 2006). Females generally move further than males, although both sexes have been observed moving several kilometres from breeding sites (Bartelt et al. 2004; Bull 2006). Western Toads do not have specific habitat requirements for terrestrial activity, although on a broad scale, they prefer open areas, such as meadows, shrubland, clear-cuts, and young forest stands, over closed or mature forest (Bartelt et al. 2004; Bull 2006). Habitat features of hibernating sites are not well known, although Western Toads in Alberta were found to utilize a wide variety of natural burrows and crevices, including squirrel middens, decayed root tunnels, and cavities under trees (Browne and Paszkowski 2010).

Foraging

The diet of adult Western Toads includes a wide variety of insects, including but not limited to: flying insects, beetles, ants, crayfish, spiders, centipedes, slugs, and earthworms. Tadpoles are herbivores and typically feed on aquatic plants, dead organic materials, and algae (MOE 2016).

4.17.3 Study Area Distribution

Western Toads are widely distributed throughout the province. They are confident or certain to occur in all Regional Districts (BC Conservation Data Centre 2016). Two subspecies of the Western Toad exist, with only one (*Anaxyrus boreas boreas*) found in British Columbia, though the BC Conservation Data Centre only recognizes the species form in British Columbia. In addition, the Western Toad is the only amphibian species native to Haida Gwaii (Matsuda et al. 2006). In British Columbia, Western Toads can be found in semi-arid and wet forested regions of the province, except in areas of the far northeast (MOE 2016).

Specific occurrences of the Western Toad within or near the Project area are not mapped. The closest mapped observation indicated on distribution mapping compiled by E-Fauna BC for *A. boreas* is approximately 65 km to the south, however this species is known to reside throughout most of British Columbia (BC Conservation Data Centre 2016). Western Toads are documented to occur in the Coastal Western Hemlock (CWH) biogeoclimatic classification (BEC) zone, which occurs within the study area. Within this

zone, Western Toads are associated with old-growth coniferous forests, young seral and managed second-growth forests, riparian areas, wetlands, meadows, floodplains, lakes, and streams (Pojar et al. 1991). Western Toads inhabit a wide elevational range in BC, from sea level to a maximum observed of 3,600 m (BC Conservation Data Centre 2016).

4.17.4 Western Toad Habitat Suitability Modelling

4.17.4.1 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Western Toad which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 4-119). Life Requisites include Reproducing (Eggs), Living, and Hibernating.

Reproducing (Eggs)

Aquatic breeding habitat for Western Toad is considered critical habitat. Breeding sites often occur in and around littoral zones, shallow ponds, slow-flowing streams, marshes, bogs or fens, as well as roadside ditches and wheel ruts. Breeding sites with shallow water and sandy substrates are preferred, although they can vary in the extent of tree/shrub canopy cover, coarse woody debris, and emergent vegetation.

The activity of Western Toads, like most amphibian activity, is governed by environmental conditions, resulting in temporal variation of the breeding period between years. However, daily maximum temperature above 10°C and minimum above freezing are good indicators for the onset of breeding activity (Wind and Dupuis 2002). Breeding typically takes place between April and July (MOE 2016), but can extend into August in the Coast and Mountains Ecoprovince.

Living

During their terrestrial living period, adult Toads can be found in a wide variety of habitats including wet, semi-arid, and dry forest types, as well as fields, meadows, grasslands, clear-cuts, roads, dikes, and ditches. Western Toads tend to avoid open water outside of the breeding season (South Coast Conservation Program 2015).

Hibernating

Hibernacula consist of dens or burrows dug in stream banks, under logs, or may include burrows dug by other animals such as rodents and moles. Hibernacula can be communal, but are often individual (South Coast Conservation Program 2015). Hibernating usually takes place from November to April (MOE 2016).

Table 4-119. Life Requisites of the Western Toad within the Project area (near Stewart, BC) rated by month and season

Western Toad Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Reproducing (eggs)
May	Growing (Late Spring)	Reproducing (eggs)
June	Growing (Summer)	Reproducing (eggs)
July	Growing (Summer)	Reproducing (eggs)
August	Growing (Summer)	Reproducing (eggs)
September	Growing (Early Fall)	Living
October	Growing (Late Fall)	Living
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

4.17.4.2 Wildlife Habitat Ratings

The attributes for Western Toad suitable Living, Reproducing (eggs), and Hibernating life requisites in relation to specific ecosystem attributes are summarized in Table 4-120. Only habitat suitability for Reproducing (eggs) will be rated for the Project.

Table 4-120. Terrestrial Ecosystem Mapping relationships for each Life Requisite of the Western Toad

Western Toad Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: site series, site disturbance, elevation, structural stage • Vegetation: % cover by layer, plant species, structural stage, stand composition • Moisture Regime: mesic to sub-hydric
Reproducing (eggs)	• Site: site series, site disturbance, elevation, structural stage • Vegetation: % cover by layer, plant species, structural stage, stand composition • Moisture Regime: mesic to sub-hydric
Hibernating Habitat	• Thick soils with coarse woody debris that allows adults to burrow beneath frost line

There is no Provincial benchmark for Western Toad habitat, therefore habitat ratings for Western Toad will be based on breeding site habitat attributes found in the literature (Wind and Dupuis 2002). An intermediate level of knowledge exists on the habitat requirements for the Western Toad, therefore a 4-class rating scheme will be used (Table 4-121)

Table 4-121. Relative suitability classes to be assigned to Western Toad habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76 to 100	Equivalent
2	Moderate	26 to 75	Moderately less
3	Low	1 to 25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

The habitat requirements for the Western Toad are summarized by season and structural stage in Table 4-122. Detailed habitat ratings assumptions for Western Toad – Growing-Reproducing (eggs) are described in Table 4-123.

Table 4-122. Summary of habitat requirements for Western Toad by season and structural stage

Western Toad Habitat Requirements			
Season	*Life Requisite*	*Requirements*	*Structural Stage[1]*
Growing	Living	Forested areas, shrub, clearings, meadows, wetlands, burns, or clearcuts	2-7
Growing	Reproducing (eggs)	Herb-dominated shallow water wetlands that can be temporary or permanent	2-3
Winter	Hibernating	Thick soils with coarse woody debris for burrowing beneath frost line	5-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

4.17.4.3 Habitat Ratings Assumptions

Ratings assumptions for Living habitat:

- Units with structural stage 1 will be rated Nil (Class 4).
- Units within structural stages 2-7 will be rated High (Class 1).
- Units with wetlands (fens, bogs, and marshes) and within 30 m of riparian areas will be rated High (Class 1).

Ratings assumptions for reproducing habitat:

- All wetlands and riparian areas will be considered as potential breeding habitat and will be rated High (Class 1).

- Herb dominated wetland area (>50% structural stage 2) will be rated High (Class 1); shrub dominated (>50% structural stage 3) will be rated Moderate (Class 2); and wetland area with >50% structural stage 4-7 will be rated Low (Class 3).
- All other areas will be rated Nil (Class 4).

Rating assumptions for Hibernating habitat:

- Units with structural stages of 5-7 with thick soils and coarse woody debris will be rated High (Class 1).
- Units with structural stages 3-4 will be rated Low (Class 3).
- All other areas will be rated Nil (Class 4).

Table 4-123. Habitat ratings assumptions table for Western Toad Reproducing-Eggs-Growing

Reproducing-Eggs – Growing (RE-G)	**General Habitat**	Western Toads are habitat generalists that require terrestrial areas with sufficient refuge sites (CWD, rocks, litter, burrows, etc.) and aquatic habitat for breeding
	Key Habitat Requirements	
	Herb-dominated shallow water wetlands that can be temporary or permanent although almost any body of water may be used for breeding	
	Ratings	**Assumptions**
	1 (high) [76-100%]	• All BEC zones herb-dominated (SS 2) wetlands with shallow open water • Lake edges
	2 (moderate) [26-75%]	• All BEC zones shrub-dominated (SS 3) wetlands with some open water • All BEC zones <50 m from watercourse with <20% gradient
	3 (low) [1-25%]	• All BEC zones with wetland areas with >50% structural stage 4-7 and some open water
	4 (nil) [0%]	• No shallow open water present • All other habitats

4.17.4.4 Habitat Ratings Adjustments

No habitat ratings adjustments were made.

4.17.4.5 Habitat Ratings Summary

Breeding habitat for Western Toad is very limited within the LSA (Figure 4-64). Pockets of standing water and other wetlands are only found near Clements Lake in the northeastern corner of the LSA. A total of 21 ha (less than 0.1%) of high suitability breeding habitat was identified within the LSA. Even combined with the moderate value habitat, suitable breeding habitat (Table 4-124) is only 93.2 ha (0.6%).

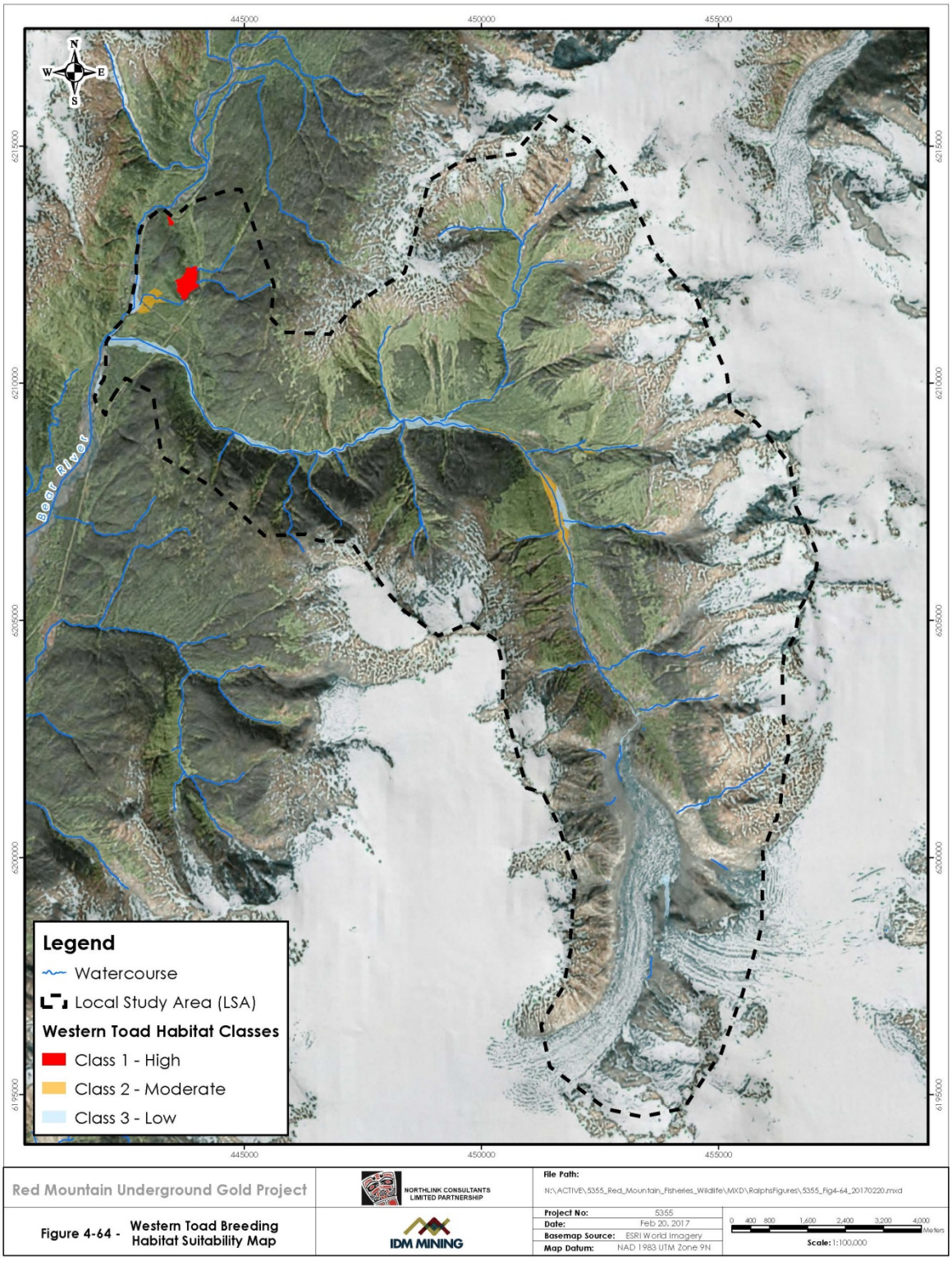
Table 4-124. Summary of habitat suitability classes for Western Toad breeding habitat

Life Requisite	*Habitat Suitability Rating*	*LSA*	
		Area (ha)	**Area (%)**
Reproducing-eggs	High	21.0	0.1
	Moderate	72.2	0.5
	Low	164.0	1.1
	Nil	14,337.8	98.2

4.17.4.6 Habitat Model Evaluation

Areas identified as high and moderate habitat within the LSA corresponded 100% with field ratings, therefore no further adjustments are necessary. The area around Clements Lake that was identified as high did have observations of Western toadlets in 2015. Several perched wetlands at higher elevations, in the MHmm1 zone just outside (approximately 1 km west) of the northwestern boundary of the LSA, were found to contain Columbia Spotted Frogs (See Section 4.17.5). Although no Western Toads were observed in this area the potential remains high for Western Toad occurrence.

Figure 4-64. Western Toad breeding habitat suitability map



4.17.5 Field Surveys

Suitable habitat for pond breeding amphibians was very limited within the study area. Three main areas with suitable habitat were identified within the LSA as well as one area just outside the western boundary of the LSA (Appendix 5-1). A total of 24 hours of time constrained searching was conducted in suitable breeding habitat for Western Toad. Two Western toadlets were observed during the August 2015 surveys at Clements Lake (Figure 4-65). Western Toads were not observed in 2016 even though searches covered the full range of breeding season from early June to the end of August. Columbia Spotted Frogs (*Rana luteiventris)* were encountered at two locations (UTMs 9V 443845, 6206806 and 9V 443959, 6206867) just west (approximately 1 km) of the western boundary of the LSA (Figure 4-66 and 4-67). Tadpoles and adult Columbia Spotted Frogs were observed at Clements Lake in both 2015 and 2016.

Figure 4-65. High quality breeding habitat for Western Toad near the outlet of Clements Lake

Figure 4-66. Columbia Spotted Frogs were found in small pocket wetland in a wet fen perched on a bench along the western boundary of the LSA

Figure 4-67. Columbia Spotted Frog in small pocket wetland (photo 4-66 above)

4.17.6 Conclusions

Overall, breeding habitat for pond breeding amphibians is very low within the LSA (less than 1%). The area around Clements Lake provides the most suitable habitat for both Western Toad and Columbia Spotted Frog. Some moderate and low value habitat is scattered along the outer edges of the Bitter Creek floodplain where some back channels may provide enough standing water for Western Toads during the breeding season.

4.18 Coastal Tailed Frog

A total of seven creeks with at least some suitable habitat were identified within the LSA (Figure 3-10). Time constrained searches were conducted at each of these creeks between August 10 and 17, 2015. Time constrained searches consisted of two searchers turning cobbles within the streams for larval stages and inspecting the stream banks within 5 m of the water for adults and metamorphs. Both the terrestrial habitat characteristics (Table 4-125)) and the physical stream characteristics (Table 4-126) of each stream were also recorded. No Coastal Tailed Frogs were detected at any of the seven survey locations.

Table 4-125. Terrestrial habitat characteristics of the Coastal Tailed Frog survey stations

Site	*UTM*	*TCS (min)*	*Structural stage*	*Veg type*	*Disturbance*
TF-1	9 U 455925 6201822	30	1a	none	Ice and snow
TF-2	9 V 451828 6207122	30	3b	alder	High flow and debris
TF-3	9 V 449219 6209018	30	6	Sitka Spruce/ cottonwood	High scour during freshet
TF-4	9 V 448942 6209431	10	3b	alder	Ephemeral flow
TF-5	9 V 448849 6209397	30	3b	alder	Gravel fan indicating frequent debris movement
TF-6	9 V 448155 6209312	30	3b	willow	Debris scour, avalanche chute
TF-7	9 V 444075 6209795	30	5	Western Hemlock	Previously logged

Figure 4-68. Coastal Tailed Frog survey station TF-02

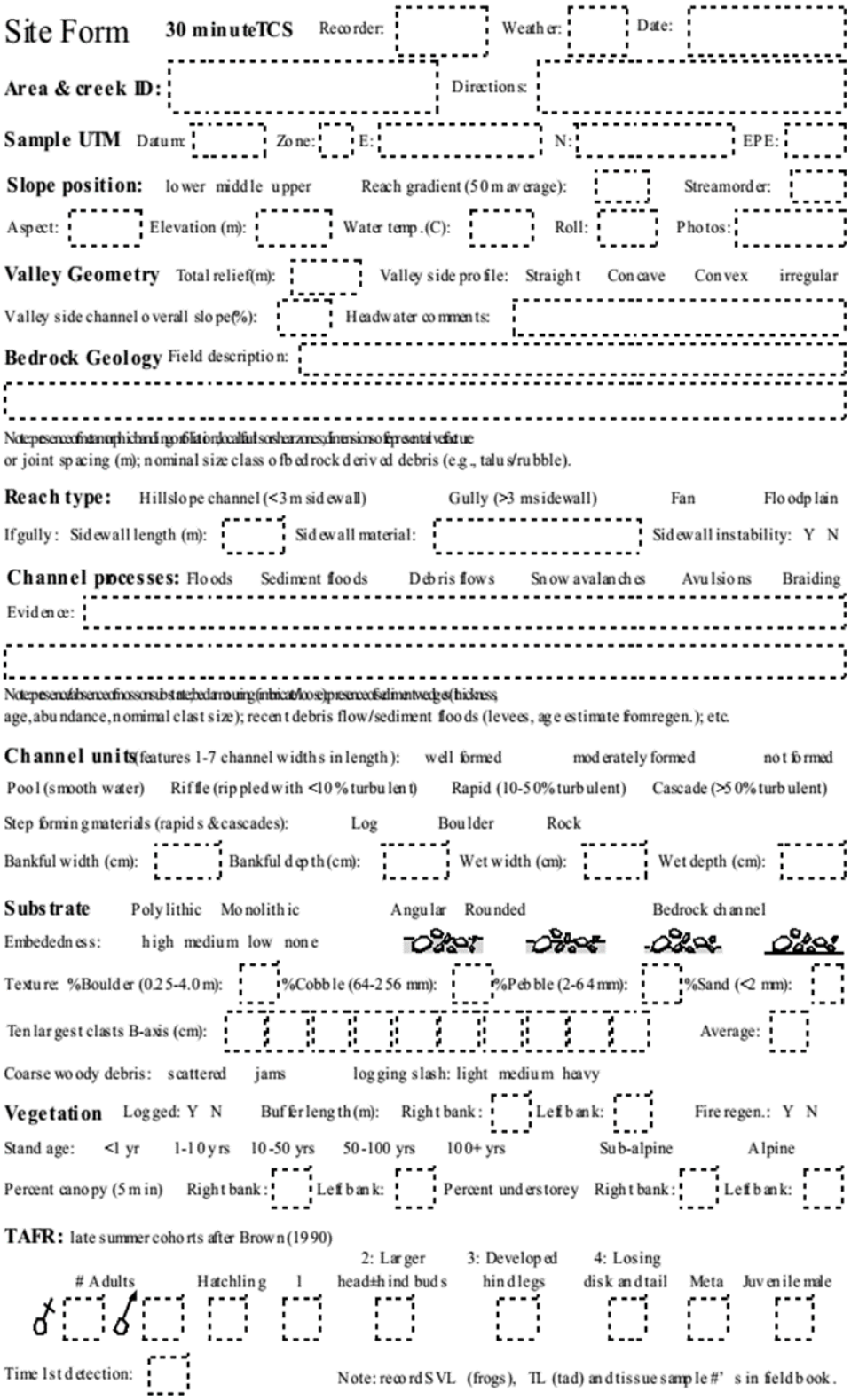
Table 4-126. Physical stream characteristics at Coastal Tailed Frog survey stations

Station ID	*Coastal Tailed Frogs Present*	*Gradient (%)*	*Bankfull width (cm)*	*Bankfull depth (cm)*	*Channel morph.*	*Avg D_{95} (cm)*	*Boulder (%)*	*Cobble (%)*	*Pebble (%)*	*Fines (%)*	*Embeddedness*	*Substrate shape*
TF01	N	16	680	110	C,P	155.0	60	30	10	0	low	round
TF02	N	26	1,670	150	C,P	175.0	70	25	5	0	low	round
TF03	N	32	155	50	C,P	80	50	30	20	0	low	angular
TF04	N	41	45	25	C,P	25	10	50	40	0	low	round
TF05	N	28	600	35	C,P	20	5	20	75	0	moderate	round
TF06	N	32	390	80	C,P	110	60	20	20	0	low	round
TF07	N	32	440	55	C,P	30	30	30	20	20	moderate	angular

R = riffle, C = cascade, P = pool

Figure 4-69. Coastal Tailed Frog survey station TF-06

Figure 4-70. Sample data form used during Red Mountain field assessments



Note: Adapted from Depuis and Friele (2003)

4.18.1 Conclusions

Habitat for Coastal Tailed Frog is extremely limited within the LSA. Tributary creeks surveyed within the LSA had signs of active annual flooding events including mass debris and substrate movements, making habitat unsuitable for tailed frogs. One creek, an un-named tributary flowing into Clements Lake, was encountered incidentally during one of the Northern Goshawk surveys. This creek at UTM: 9 V 444243 6212359 had good potential habitat but was not formally surveyed. Two surveyors spent approximately 10 minutes doing a quick visual search turning cobbles and looking for larval tailed frogs but none were observed. This stream appeared to be relatively stable and the cobble substrate had very low embeddedness. Additional surveys would be warranted given that the suitability of the habitat is high for tailed frogs.

4.19 Wildlife Cameras

Wildlife cameras were deployed at 10 locations within the LSA during the summer of 2016. Table 4-127 summarizes the detections and species captured at each camera.

Table 4-127. Deployment and detection summary of wildlife cameras installed within the LSA

Camera	*Date Range*	*Hours deployed*	*Total Detections*	*Detections/ hour*	*Elevation (m)*	*# species*
TC 1	June 6 – August 31	2,088	6	0.003	382	Black Bear (67%) Swainson's Thrush (17%) Red Squirrel (17%)
TC 2	June 6 – August 31	2,086	11	0.005	305	Black Bear (69%) Swainson's Thrush (8%) Red Squirrel (23%)
TC 3	June 6 – August 31	2,082	127	0.06	1008	Mountain Goat (72%) Grizzly Bear (21%) Black Bear (5.1%) Stellers Jay (4.7%)
TC 4	June 7 – August 31	2,060	1,240	0.6	1530	Mountain Goat (84.5%) Grizzly Bear (7%) Hoary Marmot (7%) American Robin (1%) White-tailed Ptarmigan (0.5%)
TC 5	June 8 – August 31	2,034	6	0.003	222	Black Bear (100%)
TC 6	June 11 – August 31	1,964	7	0.004	195	Black Bear Female with cub (100%)

Camera	Date Range	Hours deployed	Total Detections	Detections/ hour	Elevation (m)	# species
TC 7	July 5 – August 31	1,392	3	0.003	1004	Hermit Thrush Dark-eyed Junco Stellers Jay
TC 8	July 5 – August 31	1,396	38	0.03	1500	Hoary Marmot (100%)
TC 9	July 5 – August 31	1,388	729	0.5	1390	American Robin (5%) Common Raven (1%) Gray-crowned Rosy (Finch3%) Hermit Thrush (4%) Mountain Goat (18) Hoary Marmot (69%)
TC 10	July 6 – August 31	1,367	888	0.7	1570	Mountain Goat (88%) Hoary Marmot (12%)

A total of 12 species were detected throughout the LSA. Only cameras above 1000m detected Mountain goats. Grizzly bears were detected on cameras at 1008m and 1530 m elevation. The forested areas at lower elevations below 1000m confirmed that the majority of bear activity lower down in the Bitter Creek watershed was from Black Bears.

5.0 Disclaimer

This report is rendered solely for the use of IDM Mining Ltd (IDM) in connection with The Red Mountain Underground Gold Project (the Project), and no person may rely on it for any other purpose without Northlink Consultants LP's (Northlink) prior written approval. Should a third party use this report without Northlink's approval, they may not rely upon it. Northlink accepts no responsibility for loss or damages suffered by any third party as a result of decisions made or actions taken based on this report.

- The objective of this report is to address the following scope requirements:
    - Provide a summary of field activities conducted to support the environmental assessment of the Project
    - Determine the presence and/or relative abundance of selected wildlife species within the Local Study Area; and
    - Identify, rate, and quantify suitable wildlife habitat for selected wildlife species within the LSA and RSA.
- This report is based on facts and opinions contained within the referenced documents, including the results of any data collection programs carried out in relation to this report. We have attempted to identify and consider facts and documents relevant to the scope of work, accurate as of the time period during which we conducted this analysis. However, the results, our opinions, or recommendations may change if new information becomes available or if information we have relied on is altered.
- We applied accepted professional practices and standards in developing and interpreting data. While we used accepted professional practices in interpreting data provided by IDM Mining or third party sources we did not verify the accuracy of any such data.
- This report must be considered as a whole; selecting only portions of this report may result in a misleading view of the results, our opinions, or recommendations.

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APPENDIX 1

BREEDING BIRDS DETECTED DURING POINT COUNT SURVEYS

Common Name	Scientific Name	Species Code	Habitat	Nest Strata	Nest Height
American Pipit	*Anthus rubescens*	AMPI	Alpine	ground	0 m
American Redstart	*Setophaga ruticalla*	AMRE	Riparian Deciduous Forest	Deciduous tree and shrub	3 - 10 m
American Robin	*Turdus migratorius*	AMRO	Generalist	all	0 - 30 m
Black Swift	*Cypseloides niger*	BLSW	Old-growth forest	Cliff, possibly larger cavities in snags	Insufficient data
Cassin's Vireo	*Vireo cassinii*	CAVI	Lower elevation deciduous and mixed forest	Deciduous tree and shrub	3 - 15 m
Chestnut-backed Chickadee	*Poecile rufescens*	CBCH	Mature and old forest	Cavity	1 - 30 m
Common Yellowthroat	*Geothlypis trichas*	COYE	Wetlands, ponds and lakes	Ground and low shrub	0 - 2 m
Dark-eyed Junco	*Junco hyemalis*	DEJU	Generalist	Ground	0 m
Hammond's Flycatcher	*Empidonax hammondii*	HAFL	Lower elevation deciduous and mixed forest	Deciduous tree and shrub	3 – 15 m
Golden Crowned Kinglet	*Regulus satrapa*	GCKI	Coniferous forest	Coniferous tree	3 - 30 m
Hairy Woodpecker	*Picoides villosus*	HAWO	Mixed Deciduous and coniferous Forest	Cavity	5 - 30 m
Hermit Thrush	*Catharus guttatus*	HETH	Mixed Deciduous and coniferous forest (higher elevations)	Coniferous tree	0 - 3 m
Horned Lark	*Eremophila alpestris*	HOLA	Alpine	ground	0 m
Lincoln's sparrow	*Melospiza lincolnii*	LISP	Dense shrub	Ground to low shrub	0 - 1 m
MacGillivray's Warbler	*Geothlypis tolmiei*	MACW	Dense shrubs (tall and low) often riparian	Ground to low shrub	0 - 2 m
Nashville Warbler	*Oreothlypis ruficapilla*	NAWA	Dense shrub	Ground to low shrub	0 - 1 m
Orange Crowned Warbler	*Oreothlypis celata*	OCWA	Dense shrubs (tall and low) often riparian	Ground to low shrub	0 - 2 m
Pacific Wren	*Troglodytes pacificus*	PAWR	Mature to old Coniferous forest	Coniferous tree roots or cavities	0 - 2 m

Common Name	Scientific Name	Species Code	Habitat	Nest Strata	Nest Height
Pacific Slope Flycatcher	*Empidonax dificilis*	PSFL	Mixed Deciduous and coniferous forest	Tree or cliff	0 - 15 m
Red-breasted Sapsucker	*Sphyrapicus ruber*	RBSA	Mixed Deciduous and coniferous forest	Cavity	5 - 20 m
Ruby-crowned Kinglet	*Regulus calendula*	RCKI	Coniferous forest	Coniferous tree	3 - 30 m
Red-eyed Vireo	*Vireo olivaceus*	REVI	Mixed Deciduous and coniferous forest	Tree/shrub	3 - 15 m
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	Coniferous forest	Coniferous tree	5 - 25 m
Rufous Hummingbird	*Selasphorus rufus*	RUHU	Generalist edge species	Tree/shrub thickets	1 - 5 m
Savannah Sparrow	*Passerculus sandwichensis*	SASP	Herb/short shrub	Ground or low shrub	0 - 2 m
Sooty Grouse	*Dendragapus fuliginosus*	SOGR	Alpine/Sub-alpine (Summer) Mature Forest (Winter)	Ground (under shrubs)	0 m
Song Sparrow	*Melospiza melodia*	SOSP	Generalist	Low shrub	1 - 2 m
Spotted Sandpiper	*Actitis macularis*	SPSA	Riparian/riverine	Ground (bare gravel)	0 m
Steller's Jay	*Cyanocitta stellleri*	STJA	Mixed deciduous and coniferous forest	Coniferous trees	3 - 15 m
Swainson's Thrush	*Catharus ustulatus*	SWTH	Mixed Deciduous and coniferous Forest	Deciduous tree	2 - 10 m
Townsend's Warbler	*Setophaga townsendi*	TOWA	Mature to old Coniferous forest	Coniferous tree	10 - 40 m
Varied Thrush	*Ixoreus naevius*	VATH	Coniferous forest	Tree	3 - 15 m
Warbling Vireo	*Vireo gilvus*	WAVI	Mixed Deciduous and coniferous forest	Trees	10 - 35 m
Western Tanager	*Piranga ludoviciana*	WETA	Coniferous forest	Coniferous tree	3 - 30 m
Wilson's Warbler	*Cardellina pusilla*	WIWA	Riparian	Tall shrub	0 - 2 m
Yellow Warbler	*Setophaga petechia*	YEWA	Riparian	Low and Tall shrub	3 - 6 m
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	Mature to old Coniferous forest	Coniferous tree	10 - 40 m

APPENDIX 2

SPECIES ACCOUNTS

Western Toad (*Anaxyrus boreus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Western Toad Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 6
1.4.1 Species Description 6
1.4.2 Breeding Ecology and Habitat 6
1.4.3 Terrestrial Ecology and Habitat 7
1.4.4 Foraging Ecology and Habitat 7
1.5 Habitat Use – Life Requisites and Seasons 7
1.6 Wildlife Habitat Ratings 8
1.7 Habitat Ratings Assumptions 10
1.8 Habitat Ratings Adjustments 11
2.0 References 12

LIST OF TABLES

Table 1. Taxonomic and status information for Western Toad (*Anaxyrus boreas*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification 3
Table 5. Life Requisites of the Western Toad within the Project area (near Stewart, BC) rated by month and season 8
Table 6. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Western Toad 8
Table 7. Relative suitability classes to be assigned to Western Toad habitat polygons 9
Table 8. Summary of habitat requirements for Western Toad by season and structural stage 9

1.0 Western Toad Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Western Toad (*Anaxyrus boreas*)

Western Toad Species Data	
Identifier	***Description***
Common Name	Western Toad
Common Name Synonym	Boreal Toad
Latin Name	*Anaxyrus boreas*
Latin Name Synonym	*Bufo boreas*
Species Code	A-ANBO
Global Status	G4
Provincial Status	S3/S4
BC List	Blue
Identified Wildlife	N/A
SARA	Schedule 1 (Special Concern)
COSEWIC	Special Concern
BC Conservation Framework	CF Highest Priority: 2
	Priority 3 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 4 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, the Western Toad exists within North America from Alaska and the Yukon south to Baja California in Mexico and as far east as Colorado, Utah. It is widespread throughout most of BC (Matsuda et al. 2006).

1.2.1 Provincial Distribution

Western Toads are widely distributed throughout the province. They are confident or certain to occur in all Regional Districts (BC Conservation Data Centre 2016). Two subspecies of the Western Toad exist, with only one (*Anaxyrus boreas boreas*) found in British Columbia, though the BC Conservation Data Centre only recognizes the species form in British Columbia. In addition, the Western Toad is the only amphibian species native to Haida Gwaii (Matsuda et al. 2006). In British Columbia, Western Toads can be found in semi-arid and wet forested regions of the province, except in areas of the far northeast (MOE 2016).

1.2.2 Study Area Distribution

Specific occurrences of the Western Toad within or near the Project area are not mapped. The closest mapped observation indicated on distribution mapping compiled

by E-Fauna BC for *A. boreas* is approximately 65 km to the south, however this species is known to reside throughout most of British Columbia (BC Conservation Data Centre 2016). Western Toads are documented to occur in the Coastal Western Hemlock (CWH) biogeoclimatic classification (BEC) zone, which occurs within the Study area. Within this zone, Western Toads are associated with old-growth coniferous forests, young seral and managed second-growth forests, riparian areas, wetlands, meadows, floodplains, lakes, and streams (Pojar et al. 1991).

1.2.3 Elevation Range

Western Toads inhabit a wide elevational range in BC, from sea level to a maximum observed of 3,600 m (BC Conservation Data Centre 2016).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Western Toad Habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	CB	Cutbank
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	Rt	Rt	Rock talus
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	PD	Pond
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification and General Ecology

Western Toads are easily identified by their dry, bumpy skin, large parotid glands, and light coloured dorsal stripe. Sexual dimorphism is present in this species: males are usually <95 mm and the larger females can be up to 125 mm. Adult toads have stocky bodies with short legs, and range in colour from pale green to grey, dark brown, and red. Typically the bellies are pale coloured and mottled with black, and the toads have a pale coloured stripe down their backs (MOE 2016).

Their activity pattern can vary with geographic and elevational location, but they are known to be active from January to October in some areas (MOE 2016). During the active season adult toads are typically nocturnal in most areas, while a more diurnal pattern can be seen at higher elevations or at colder times of the year (Wind and Dupuis 2002; BC Conservation Data Centre 2016).

Western Toads utilize three types of habitat including breeding habitats, terrestrial summer range, and winter hibernacula. Preferred breeding sites include wetted areas of permanent or temporary water bodies with shallow sandy bottoms. The toads disperse into terrestrial habitats including forests and grasslands after breeding. In the winter they hibernate in underground burrows that can be up to 1.3 m deep under the frost line (MOE 2009).

Vocalizations

Male Western Toads are known to make a faint bird-like chirping sound when grasped by other males which are actively searching for females, however females do not produce this call (Wind and Dupuis 2002).

1.4.2 Breeding Ecology and Habitat

Western Toad breeding sites can be found in a wide range of aquatic habitats, including littoral zones of lakes, temporary and permanent wetlands of all sizes and classifications, as well as roadside ditches and wheel ruts. The presence of water is required at breeding sites for at least 2 to 3 months to allow successful recruitment. Breeding sites with shallow water and sandy substrates are preferred, although they can vary in the extent of tree/shrub canopy cover, coarse woody debris, and emergent vegetation. Eggs are laid

in gelatinous double-strings, either directly on the bottom substrate or entwined in aquatic vegetation. Larvae hatch within 7 to 10 days into black tadpoles that aggregate in shallow areas, typically near the shoreline. Within 2 to 3 months of egg deposition, larvae metamorphose into toadlets and remain within the riparian area for a short time until they emigrate from the breeding site to seek terrestrial overwintering sites (BC Conservation Data Centre 2016).

1.4.3 Terrestrial Ecology and Habitat

Western Toads spend a large portion of their time in terrestrial habitat. After breeding has finished adults leave the breeding site and for the remainder of the active season they can be found in surrounding terrestrial habitat and, to a lesser extent, in non-breeding aquatic habitat (Bull 2006). Females generally move further than males, although both sexes have been observed moving several kilometres from breeding sites (Bartelt et al. 2004; Bull 2006). Western Toads do not have specific habitat requirements for terrestrial activity, although on a broad scale, they prefer open areas, such as meadows, shrubland, clear-cuts, and young forest stands, over closed or mature forest (Bartelt et al. 2004; Bull 2006). Habitat features of hibernating sites are not well known, although Western Toads in Alberta were found to utilize a wide variety of natural burrows and crevices, including squirrel middens, decayed root tunnels, and cavities under trees (Browne and Paszkowski 2010).

1.4.4 Foraging Ecology and Habitat

The diet of adult Western Toads includes a wide variety of insects, including but not limited to: flying insects, beetles, ants, crayfish, spiders, centipedes, slugs, and earthworms. Tadpoles are herbivores and typically feed on aquatic plants, dead organic materials, and algae (MOE 2016).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Western Toad which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 5). Life Requisites include Reproducing (Eggs), Living, and Hibernating.

Reproducing (Eggs)

Aquatic breeding habitat for Western Toad is considered critical habitat. Breeding sites often occur in and around littoral zones, shallow ponds, slow-flowing streams, marshes, bogs or fens, as well as roadside ditches and wheel ruts. Breeding sites with shallow water and sandy substrates are preferred, although they can vary in the extent of tree/shrub canopy cover, coarse woody debris, and emergent vegetation.

The activity of Western Toads, like most amphibian activity, is governed by environmental conditions, resulting in temporal variation of the breeding period between years. However, daily maximum temperature above 10°C and minimum above freezing are

good indicators for the onset of breeding activity (Wind and Dupuis 2002). Breeding typically takes place between April and July (MOE 2016), but can extend into August in the Coast and Mountains Ecoprovince.

Living

During their terrestrial living period, adult toads can be found in a wide variety of habitats including wet, semi-arid, and dry forest types, as well as fields, meadows, grasslands, clearcuts, roads, dikes, and ditches. Western Toads tend to avoid open water outside of the breeding season (South Coast Conservation Program 2015).

Hibernating

Hibernacula consist of dens or burrows dug in stream banks, under logs, or may include burrows dug by other animals such as rodents and moles. Hibernacula can be communal, but are often individual (South Coast Conservation Program 2015). Hibernating usually takes place from November to April (MOE 2016).

Table 5. Life Requisites of the Western Toad within the Project area (near Stewart, BC) rated by month and season

Western Toad Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Reproducing (eggs)
May	Growing (Late Spring)	Reproducing (eggs)
June	Growing (Summer)	Reproducing (eggs)
July	Growing (Summer)	Reproducing (eggs)
August	Growing (Summer)	Reproducing (eggs)
September	Growing (Early Fall)	Living
October	Growing (Late Fall)	Living
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.6 Wildlife Habitat Ratings

The attributes for suitable Living, Reproducing (eggs), and Hibernating Life Requisites in relation to specific ecosystem attributes are summarized in Table 6.

Table 6. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Western Toad

Western Toad Ecosystem Attributes

Life Requisite	TEM Attribute
Living Habitat	• Site: site series, site disturbance, elevation, structural stage • Vegetation: % cover by layer, plant species, structural stage, stand composition • Moisture Regime: mesic to sub-hydric
Reproducing (eggs)	• Site: site series, site disturbance, elevation, structural stage • Vegetation: % cover by layer, plant species, structural stage, stand composition • Moisture Regime: mesic to sub-hydric
Hibernating Habitat	• Thick soils with coarse woody debris that allows adults to burrow beneath frost line

There is no provincial benchmark for Western Toad habitat, therefore habitat ratings for Western Toad will be based on breeding site habitat attributes found in the literature (Wind and Dupuis 2002). An intermediate level of knowledge exists on the habitat requirements for the Western Toad, therefore a 4-class rating scheme will be used (Table 7).

Table 7. Relative suitability classes to be assigned to Western Toad habitat polygons

Class	Suitability	% of Polygon Area with Habitat Feature Present	Relative Quality
1	High	76 to 100	Equivalent
2	Moderate	26 to 75	Moderately less
3	Low	1 to 25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

The habitat requirements for the Western Toad are summarized by season and structural stage in Table 8.

Table 8. Summary of habitat requirements for Western Toad by season and structural stage

Western Toad Habitat Requirements			
Season	**Life Requisite**	**Requirements**	**Structural Stage[1]**
Growing	Living	Forested areas, shrub, clearings, meadows, wetlands, burns or clearcuts	2-7
Growing	Reproducing (eggs)	Herb-dominated shallow water wetlands that can be temporary or permanent.	2-3
Winter	Hibernating	Thick soils with coarse woody debris for burrowing beneath frost line	5-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

1.7 Habitat Ratings Assumptions

Ratings assumptions for Living habitat:

- Units with structural stage 1 will be rated Nil (Class 4).
- Units within structural stages 2-7 will be rated High (Class 1).
- Units with wetlands (fens, bogs, and marshes) and within 30 m of riparian areas will be rated High (Class 1).

Ratings assumptions for Reproducing habitat:

- All wetlands and riparian areas will be considered as potential breeding habitat and will be rated High (Class 1).
- Herb dominated wetland area (>50% structural stage 2) will be rated High (Class 1); shrub dominated (>50 % structural stage 3) will be rated Moderate (Class 2); and wetland area with >50% structural stage 4-7 will be rated Low (Class 3).
- All other areas will be rated Nil (Class 4).

Rating assumptions for Hibernating habitat:

- Units with structural stages of 5-7 with thick soils and coarse woody debris will be rated High (Class 1).
- Units with structural stages 3-4 will be rated Low (Class 3).
- All other areas will be rated Nil (Class 4).

Reproducing-Eggs-Growing

<table>
<tr><td colspan="3">Western Toad (A-ANBO)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Western toads are habitat generalists that require terrestrial areas with sufficient refuge sites (CWD, rocks, litter, burrows, etc) and aquatic habitat for breeding</td></tr>
<tr><td rowspan="5">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">Herb-dominated shallow water wetlands that can be temporary or permanent although almost any body of water may be used for breeding.</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (high) [75-100%]</td><td>• All BEC zones Herb-dominated (SS 2) wetlands
• Lake edges (within 50m)</td></tr>
<tr><td>2 (moderate) [25-75%]</td><td>• All BEC zones Shrub-dominated (SS 3) wetlands
•</td></tr>
<tr><td></td><td>3 (low) [1-25%]</td><td>• All BEC zones with Wetland areas with >50% structural stage 4-7</td></tr>
</table>

		• All BEC zones <50m from watercourse with <20% gradient
	4 (nil) [0%]	• No shallow open water present • All other habitats

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape. Upwards adjustments will be made if incidental observations of breeding activity are recorded within specific units/areas.

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Coastal Tailed Frog (*Ascaphus truei*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Coastal Tailed Frog Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 5
1.4.1 Species Description 5
1.4.2 Breeding Ecology and Habitat 6
1.4.3 Terrestrial Ecology and Habitat 6
2.0 References 7

LIST OF TABLES

Table 1. Taxonomic and status information for Coastal Tailed Frog (*Ascaphus truei*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Coastal Tailed Frog habitat 3

1.0 Coastal Tailed Frog Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Coastal Tailed Frog (*Ascaphus truei*)

Coastal Tailed Frog Species Data	
Identifier	***Description***
Common Name	Coastal Tailed Frog
Common Name Synonym	Pacific Tailed Frog
Latin Name	*Ascaphus truei*
Species Code	A-ASTR
Global Status	G4
Provincial Status	S3S4
BC List	Blue
Identified Wildlife	Y
SARA	Schedule 1 (Special Concern)
COSEWIC	Special Concern
BC Conservation Framework (CF) 2013	CF Highest Priority: 1
	Priority 4 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 1 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 2 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, the Coastal Tailed Frog is found in British Columbia, Washington, Oregon, and northern California (COSEWIC 2011).

1.2.1 Provincial Distribution

Coastal Tailed Frogs are found throughout the Coast and Cascade mountains. They are found in all coastal regional districts except the Stikine RD, as well as the following inland regional districts: Squamish-Lillooet, Fraser Valley, Okanagan-Similkameen, and Thompson-Nicola. Biogeoclimatic zone associations include Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) in coastal areas and Interior Douglas-fir (IDF), Montane Spruce (MS), Engelmann Spruce - Subalpine Fir (ESSF), and Interior Cedar – Hemlock (ICH) within interior locations (COSEWIC 2011; BC Conservation Framework 2014).

1.2.2 Study Area Distribution

Specific occurrences of the Coastal Tailed Frog within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for *A. truei* are just north of Terrace approximately 200 km south-southeast of the Project. Coastal Tailed Frogs are documented to occur in the Coastal Western

Hemlock (CWH) biogeoclimatic classification (BEC) zone, which occurs within the Study area. Within this zone, they are associated with small, fast streams in old-growth forests (BC Conservation Data Centre 2016).

1.2.3 Elevation Range

Coastal Tailed Frogs inhabit streams near sea level up to approximately 2,000 m elevation (COSEWIC 2011).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Coastal Tailed Frog habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RI	River
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	SW	Shrubland (Willow/Alder Thicket)
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	SW	Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	RI	River
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RI	River
	00	SW	Shrubland (Willow/Alder Thicket)
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland

BEC Zone/Subzone	Site Series	Map Code	Site Associations
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	32	---	Non-forested fen/marsh
	51	---	Avalanche Chutes
MHmm1	01	MB	Mountain Hemlock-Amabilis Fir-Blueberry
	03	MO	Amabilis Fir-Mountain Hemlock-Oak Fern
	04	AB	Mountain Hemlock-Amabilis Fir-Bramble
	05	MT	Amabilis Fir-Mountain Hemlock-Twisted Stalk
	51	---	Avalanche Chutes

MHmmp	00	AM	Herbaceous Meadows
	00	KC	Krummholz Cliffs
	00	---	HM-Lichen Complex
	00	MH	HM-Heather Complex
	00	LM	Lichen-HM Parkland
CMAun	00	AM	Herbaceous Meadows
	00	CC	Talus Slope and Rock Outcrop Complex
	00	HL	Heather Lichen Meadow
	00	HM	Heather Meadow
	00	HP	Mountain Heather-partridge Foot
	00	KC	Krummholz Cliffs
	00	MC	Moss Campion-Coral Lichen Meadows
	00	MH	Mountain Heather
	00	TR	Talus and Rock Outcrop

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification and General Ecology

Coastal Tailed Frogs are the only stream-dwelling anurans in BC. They are a primitive species of frog whose life history involves spending several years (up to four years in colder northern systems) in streams as larvae, while adults use a mixture of stream, riparian, and upland habitat (COSEWIC 2011). Adult Coastal Tailed Frogs are relatively small (2.2 to 5.1 cm), with a streamlined body ideal for fast-flowing stream habitat and squeezing into interstitial spaces. Females are larger than males, and males have the characteristic 'tail' which is an extension of the cloaca (COSEWIC 2011).

The 'tail' is used in copulation; it facilitates internal fertilization which ensures effective transfer of sperm in the stream environment. Mating takes place in streams in the fall, and females lay the fertilized eggs the following summer (June/July) (COSEWIC 2011). Eggs are laid in clutches of 30 to 70 eggs at a nest site generally underneath a large cobble or boulder. Nests may be solitary or communal (Palmeri-Miles et al. 2010; COSEWIC 2011).

Hatchlings emerge 4 to 6 weeks after oviposition and remain in the nest site until their sucker mouth is fully developed. Larvae can be up to 6.5 cm in total length and are dark brown or brownish-grey in colour, usually with a characteristic white spot on the tail. The larval period in the northern part of their range is reported to last up to 4 years, although this can vary with climate and elevation (COSEWIC 2011).

Adult tailed frogs are not obligate stream-dwellers like larvae, although they typically remain close to streams. They are generalist predators consuming a wide variety of insects, and may feed underwater, on stream banks, and in terrestrial habitat (Metter 1964; Bury 1970). Tailed frog larvae are herbivores; their specialized mouthparts facilitate scraping of periphyton from the surface of rocks (Altig and Brodie 1972). Specifically, diatoms were found to be the main component of stomach contents in larval tailed frogs (Metter 1964).

1.4.2 Breeding Ecology and Habitat

Coastal Tailed Frogs are habitat specialists associated with clear, fast-flowing, permanent streams within mature or old growth forest (Metter 1964; Welsh and Ollivier 1998; Dupuis and Steventon 1999; Dupuis and Friele 2003; Mallory 2004). An abundance of coarse stream substrate and the associated interstitial spaces are essential for tailed frogs. These spaces are used as refugia, feeding, and overwintering habitat for larvae and interstitial spaces under large rocks may be used as nest sites where oviposition and rearing of hatchlings occurs (Metter 1964; Mallory 2004; Palmeri-Miles et al. 2010). Water temperature is also an important habitat characteristic as the temperature tolerance range for tailed frogs is very low. Eggs require 5 to 18.5°C for survival, larval development requires 7 to 22°C, and lethal temperatures for adults range from 21 to 24.1°C (Brown 1975).

Research conducted by Dupuis and Friele (2003) in the North Coast and Kalum Forest District found Coastal Tailed Frogs to be most abundant in streams within rugged watershed basins (30 to 70% average basin slope) that drained areas of 0.3 to 10 km^2. On a local scale, highest larval abundance was associated with stream characteristics including channel gradient (3 to 40%), stream temperature between 8 to 12°C, low to nil substrate embeddedness, low to moderate channel disturbance, streamside canopy cover of 20 to 70%, and old growth forest (Dupuis and Friele 2003).

1.4.3 Terrestrial Ecology and Habitat

The terrestrial habitats of juveniles and adults are not very well-known due to the secretive nature of this species. In wet coastal areas, adults have been reported to travel up to 100 m from stream habitat, while in drier areas they tend to remain closer to stream habitat (COSEWIC 2011). Seasonal movements are suspected to occur as well. Hayes et al. (2006) found adult tailed frogs higher in the stream basin during the non-breeding active season, suggesting they spend time in habitats upstream from suitable breeding habitat.

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Common Nighthawk (*Chordeiles minor*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Common Nighthawk Species Account....1
1.1 Species Data....1
1.2 Species Distribution....1
1.2.1 Provincial Distribution....1
1.2.2 Study Area Distribution....1
1.2.3 Elevation Range....2
1.3 Study Area....2
1.4 Ecology and Key Habitat Requirements....6
1.4.1 Species Description....6
1.4.2 Breeding Ecology and Habitat....6
1.4.3 Feeding Ecology and Habitat....7
1.4.4 Migration....7
1.5 Habitat Use – Life Requisites and Seasons....7
1.6 Wildlife Habitat Ratings....8
1.7 Habitat Ratings Assumptions....8
1.8 Habitat Ratings Adjustments....9
2.0 References....10

LIST OF TABLES

Table 1. Taxonomic and status information for Common Nighthawk (*Chordeiles minor*). 1
Table 2. Study area administrative boundaries....2
Table 3. Study area physiographic setting....2
Table 4. Study area Biogeoclimatic Ecosystem Classification....3
Table 5. Life Requisites of the Common Nighthawk within the Project area rated by month and season....7
Table 6. Summary of habitat attributes for Common Nighthawk....8
Table 7. Relative suitability classes to be assigned to Common Nighthawk habitat polygons....8

1.0 Common Nighthawk Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Common Nighthawk (*Chordeiles minor*)

Common Nighthawk Species Data	
Identifier	***Description***
Common Name	Common Nighthawk
Latin Name	*Chordeiles minor*
Species Code	B-CONI
Global Status	G5
Provincial Status	S4B
BC List	Yellow
Identified Wildlife	No
SARA	Schedule 1 (Threatened)
COSEWIC	Threatened
BC Conservation Framework	CF Highest Priority: 2
	Priority 6 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 4 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

1.2.1 Provincial Distribution

Common Nighthawks can be found throughout British Columbia including Vancouver Island, but are absent from the Coast Mountains and from Haida Gwaii (Campbell et al. 2006). The species breeds in the southern part of the Yukon up to the Dawson region (COSEWIC 2007). The highest probability of observation is in the valley systems of BC's Southern Interior, Central Interior, and Southern Interior Mountains Ecoprovinces. In the southern interior the highest abundance overlaps with the Interior Douglas-fir (IDF), Ponderosa Pine (PP), and Bunchgrass (BG) biogeoclimatic zones, principally between 400 and 1,000 m elevation (Boyd 2015). The species becomes less common, and more local, northward through the interior, and numbers decrease as elevation increases. On the south coast, it is an uncommon to common migrant, summer resident, and breeder. Along the central and northern mainland coast, it is rare and most often recorded at the head of long inlets (Campbell et al. 2006).

In most Canadian provinces, including British Columbia, the Common Nighthawk is not at risk and therefore is not monitored by Conservation Data Centres.

1.2.2 Study Area Distribution

Common Nighthawk habitat may be present within the Project boundaries as it is distributed widely throughout most of British Columbia and most often recorded at the

head of long inlets. Migration, foraging, and roosting habitats occur from sea level to at least 2,067m (Campbell et al. 2006.). This elevation range would encompass most of the Project Area. They can be found in almost any open or semi-open habitat where flying insects are common such as cultivated fields, rangeland, marshes, sloughs, estuaries, subalpine, and alpine (Campbell et al. 2006.). The Project Area would include some of these habitats, however it is unlikely that the Common Nighthawk breeds in the Project Area as coastal breeding grounds are limited to Vancouver Island, the Gulf Island, adjacent mainland coast north to Powell River, and in the lower Fraser River valley to Hope (Campbell et al. 2006).

1.2.3 Elevation Range

Common Nighthawk nest sites can be found from sea level up to 1,250 m (Campbell et al. 1990) with the abundance between 400 and 1,000 m elevation (Boyd 2015).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	00	RI	River

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification and General Ecology

The Common Nighthawk is a medium-sized bird (21 to 25 cm long, 65 to 98 g) and is characterized by long, slender, pointed wings and a long, slightly notched tail (COSEWIC 2007). It has a large flattened head, large eyes, a small bill, and a large mouth. Common Nighthawks have cryptic colouration, generally dark brown, with black, white, and buff mottling on the wings and upper parts and fine buff bars on the under parts. In flight, adults have a pronounced white patch at the base of the primaries, which are dark brown.

1.4.2 Breeding Ecology and Habitat

The nesting season from egg-laying to fledging is short and usually completed within 40 days. Peak egg laying occurs from late June through mid-August. The full breeding period in BC extends from May 22 to September 21 (Campbell et al. 2006).

No nest is constructed, but nest scrapes are found in soft substrates. Eggs have been found in two distinct habitat types: on the ground in open country and on flat roofs

(typically gravel) in cities. Eggs are laid on gravel, soil, sand, bare rock, lichen, fallen logs, moss, grass, dried cow manure, live dandelions rosettes, crushed rock, sawdust, wood chips, deciduous leaves, conifer needles, debris of rotten stumps, old Bracken Fern (*Pteridium aquilinum*) fronds, pebbles, and gravel and tar roofs of buildings (Campbell et al. 2006). Incubation is provided by the female alone, who broods the chicks for up to 15 days after hatching (Campbell et al. 2006).

Males use communal roost sites, three of which are identified in BC and are all in small patches of individually spaced Ponderosa Pine trees (*Pinus ponderosa*) bordering rivers (Campbell et al. 2006).

1.4.3 Feeding Ecology and Habitat

The diet of the Common Nighthawk includes a wide variety of insects. They are aerial insectivores that feed primarily at dusk and dawn (Pouline et al. 1996) at heights varying from 1 m to more than 80 m (COSEWIC 2007). The Common Nighthawk visually detects its prey, aided by a highly developed *tapetum lucidum* (biological reflector system) in the eye which improves its vision in low-light environments (Pouline et al. 1996). The majority of foraging occurs in a period of 45 to 60 minutes around dusk, and 30 to 60 minutes around dawn. Foraging at night can occur and is usually associated with anthropogenic sources of illumination (Campbell et al. 2006).

1.4.4 Migration

The Common Nighthawk has one of the longest north-south migration distances of any species in North America (Pouline et al. 1996). They arrive in Canada from early May to the beginning of June and migration to South America occurs from mid-August to mid-September. These autumnal migratory flights are often associated with the emergence of flying ants (Hymenoptera) in August and involve flocks ranging from 10 to an estimated 16,000 individuals.

1.5 Habitat Use – Life Requisites and Seasons

Two life requisites are listed for the Common Nighthawk in the Project area (Table 5): Reproducing and Growing. Only the Reproducing life requisite is modelled for the Red Mountain Project.

Table 5. Life Requisites of the Common Nighthawk within the Project area rated by month and season

Month	*Season**	*Life Requisites*	*Specific Time Period*
January	Winter	n/a	
February	Winter	n/a	
March	Winter	n/a	
April	Growing (Spring)	Living	
May	Growing (Spring)	Reproducing	Nesting late-May
June	Growing (Summer)	Reproducing	Nesting

July	Growing (Summer)	Reproducing	Nesting
August	Growing (Summer)	Living	Nesting
September	Growing (Fall)	Living	
October	Growing (Fall)	Living	
November	Winter	n/a	
December	Winter	n/a	

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.6 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for Common Nighthawk are summarized in Table 6. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the 4-class rating scheme (Table 7).

Table 6. Summary of habitat attributes for Common Nighthawk

Habitat Use	*Attributes of Suitable Common Nighthawk Habitat*	*Structural Stage[1]*
Reproducing (eggs)	Open habitat with bare surfaces or gravel roofs	1-3
Living (growing)	Open habitat	1-5

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Table 7. Relative suitability classes to be assigned to Common Nighthawk habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

1.7 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Open habitat with bare surfaces, gravel roofs for nesting is rated Class 1.
- Habitat of structural stage 1 and 2 is rated Class 1 for nesting.
- Open habitat in structural stage 3a is rated Class 2.
- Structural stage 3b or 4 with large openings is rated Class 3.

- Structural stage 4 or greater is rated Class 4.
- Suitable habitat located below 900m is rated Class 1; habitat above 1,250m is rated Class 4.

Table 8. Habitat Ratings assumptions for Reproducing-Eggs-Growing

<table>
<tr><td colspan="3">Common Nighthawk (B-CONI)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Dry Open forest habitat with bare ground, rocky outcrops, gravel or sand.</td></tr>
<tr><td rowspan="5">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">• Bare ground for nesting
• Open areas for foraging, usually over large insect producing areas such as wetlands but will also use open forested areas.</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (high)
[75-100%]</td><td>• CWHwm Drier forests with:
o SS 1 – 2
o Open forests canopy closure classes 0 – 3
o Openings including cutblocks, roads, natural openings and burnt areas
o Below 600m</td></tr>
<tr><td>2 (moderate)
[25-75%]</td><td>CWHwm and MHmm1
• forested Site series with:
o SS 1- 2 and 3a; or
o canopy closure classes 1 -3 and warm aspects between 600 to 1300m
• Non-forested sites with:
o Open areas including cutblocks, roads, natural openings and burnt areas; or
o Wetlands, bogs, marshes, swamps; or
o Rock outcrops, talus slopes</td></tr>
<tr><td>3 (low)
[1-25%]</td><td>• MHmm1 and mmp
o SS 1 – 2 and 3a; or
o Forested area with structural stages 1- 3a; or
o Canopy closure classes 4 – 5; or
o Cool aspects up to 1300m.</td></tr>
<tr><td>4 (nil)
[0%]</td><td>• CMAun
• MHmm1 and mmp SS 3- 7
• All areas with canopy closure classes 6-9 (56 – 100%)
• All areas with SS 4 – 7
• All areas above 1300m</td></tr>
</table>

1.8 Habitat Ratings Adjustments

No ratings adjustments were conducted at this time.

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MacGillivray's Warbler (*Geothlypis tolmiei*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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LIMITED PARTNERSHIP

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TABLE OF CONTENTS

1.0 MacGillivray's Warbler Species Account....1
1.1 Species Data.... 1
1.2 Species Distribution.... 1
1.2.1 Provincial Distribution.... 1
1.2.2 Study Area Distribution.... 2
1.2.3 Elevation Range.... 2
1.3 Study Area.... 2
1.4 Ecology and Key Habitat Requirements.... 3
1.4.1 Species Description.... 3
1.4.2 Breeding Ecology and Habitat.... 4
1.4.3 Migration.... 5
1.5 Habitat Use – Life Requisites and Seasons.... 5
1.6 Wildlife Habitat Ratings.... 5
1.7 Habitat Ratings Assumptions.... 6
1.8 Habitat Ratings Adjustments.... 7
2.0 References....8

LIST OF TABLES

Table 1. Taxonomic and status information for MacGillivray's Warbler (*Geothlypis tolmiei*) 1
Table 2. Study area administrative boundaries.... 2
Table 3. Study area physiographic setting.... 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with MacGillivray's Warbler Habitat.... 3
Table 5. Seasons and the life requisites for MacGillivray's Warbler being rated in the Project Area.... 5
Table 6. Summary of habitat attributes for McGillivray's Warbler reproduction.... 5
Table 7. Relative suitability classes to be assigned to MacGillivray's Warbler habitat polygons.... 6

1.0 MacGillivray's Warbler Species Account

1.1 Species Data

Table 1. Taxonomic and status information for MacGillivray's Warbler (*Geothlypis tolmiei*)

MacGillivray's Warbler Species Data	
Identifier	***Description***
Common Name	MacGillivray's Warbler
Latin Name	*Geothlypis tolmiei*
Species Code	B-MGWA
Global Status	G5
Provincial Status	S5B
BC List	Yellow
Identified Wildlife	Yes
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 5
	Priority 6 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 6 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 5 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

1.2.1 Provincial Distribution

MacGillivray's Warbler is widely distributed throughout the southern two-thirds of the province, with the highest abundance recorded in the Southern Interior Mountains, Sub-Boreal Interior, and separate patches of the northern and southern Coast and Mountains Ecoprovinces and adjacent Georgia Depression. It is absent from Haida Gwaii and much of exposed coastal areas of western Vancouver Island, southern and northern regions of the Coast and Mountains between Port Hardy and Prince Rupert. The few records north of Vancouver Island are from the heads of deep inlets where valleys cut through the mountains from the Interior (e.g., Kingcome Inlet, Rivers Inlet, and Portland Inlet). The northernmost coastal occurrence is from Stewart, BC (Erskine and Davidson 1976).

The pattern of abundance by elevation is complex, perhaps reflecting a preference for lower elevations in coastal areas and higher elevations in the interior, but there is a clear preference for three biogeoclimatic zones in which the species is most common: Coastal Western Hemlock, Interior Cedar-Hemlock, and Sub-Boreal Spruce (Martell 2015 in Davidson et al. 2015). The MacGillivray's Warbler is not confirmed as breeding in the Taiga

Plains and Boreal Plains ecoprovinces, where the closely related Mourning Warbler (*Geothlypis philadelphia*) occupies similar habitat.

1.2.2 Study Area Distribution

Distribution mapping compiled by E-Fauna BC shows nine occurrences in and near Stewart, BC.

1.2.3 Elevation Range

This species breeds at low to moderate elevations from sea level to about 2,500 m (Martell 2015 in Davidson et al. 2015). Munro (1947) reports that breeding on the coast has been recorded from sea level to at least 1,500 m.

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
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Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with MacGillivray's Warbler Habitat

BEC Zone/Subzone	*Site Series*	*Map Code*	*Site Associations*
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	00	SW	Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	00	Vs	Avalanche Shrub Thicket
	00	Vt	Avalanche Treed
	32	---	Non-forested fen/marsh
	51	---	Avalanche Chutes
MHmm1	01	MB	Mountain Hemlock-Amabilis Fir-Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	Amabilis Fir-Mountain Hemlock-Oak Fern
	04	AB	Mountain Hemlock-Amabilis Fir-Bramble
	05	MT	Amabilis Fir-Mountain Hemlock-Twisted Stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	00	Sc	shrubland
	00	SW	Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	00	Vs	Avalanche Shrub Thicket
	00	Vt	Avalanche Treed
	00	Fl	Low Bench Floodplain
	51	---	Avalanche Chutes
MHmmp	00	Sk	Shrub krummolz
	00	Vs	Avalanche Shrub
	00	Sc	Shrub Carr
	00	Am	Herbaceous Meadows

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

The MacGilivray's Warbler is a small migratory songbird with a slate-gray hood covering its head, nape, and throat, white crescents above and below the eyes, an olive-green back and wings, and a yellow chest and belly. Often referred to as shy, its elusive behaviour makes it difficult to detect on migration and on the breeding grounds (Pitocchelli 2013). MacGillivray's Warbler moves rapidly, taking short flights in and out of shrubs and dense vegetation.

There are two subspecies of MacGillivray's Warbler: *Geothlypis tolmiei tolmiei* and *Geothlypis tolmiei monticola*. The former occupies the Pacific coastal United States and western British Columbia while the latter occurs in the eastern portions of BC (Dunn and Garrett 1997; and Campbell et al. 2007).

1.4.2 Breeding Ecology and Habitat

MacGillivray's Warbler is relatively common in appropriate breeding habitat. It is most often associated with disturbed second growth and riparian vegetation, composed of low, dense undergrowth, shady thickets, shrubs, willows (*Salix* spp.), and saplings of various tree species (Pitochelli 2013). Preferred habitats are often in or near riparian areas in mixed conifer forest, stream bottoms, brushy hillsides along canyons, as well as in open, logged areas with small, remnant forest patches, burned area, and areas recovering from avalanches with dead and fallen trees (Martell 2015 in Davidson et al. 2015). It is found in coniferous-forest clear-cuts with Englemann Spruce (*Picea englemannii*), Subalpine Fir (*Abies lasiocarpa*), Douglas-fir (*Pseudotsuga menziesii*), Lodgepole Pine (*Pinus contorta*), or mixed deciduous forests with Birch (*Betula* spp.), Trembling Aspen (*Populus tremuloides*) and Black Cottonwood (*P. balsamifera*). Preferred species of dense streamside vegetation understory are Sitka Alder (*Alnus sitchensis*), Red-osier Dogwood (*Cornus stolonifera*), willow (*Salix* spp.), huckleberry (*Vaccinium* spp.), Cow Parsnip (*Heracleum maximum*), and Highbush Cranberry (*Viburnum edule*) (Wiebe and Martin 1998).

MacGillivray's Warbler responds to opportunities created by the removal of old-growth coniferous forests in coastal areas. In summer, in coniferous forest of west-central Vancouver Island, Bryant et al. (1993) found this warbler to be consistently present in all age classes of forest except old-growth. It was most numerous in clear-cuts and in regenerating forests between 15 and 35 years old (Campbell et al. 2007).

Nests are an open cup of coarse grass and other plant fibre, placed at or near ground level (under 1.5 m; the majority are 0.3 to 0.6 m above ground), and well hidden under low dense shrub or Bracken Fern (*Pteridium aquilinum*) cover. Nests are often placed in upright forks of tree saplings or shrubs, frequently in shady damp areas. Clutch size is 1 to 5 eggs, with 50% having 4 eggs. Eggs are creamy white with variable tints and speckling. The incubation period is 12 to 13 days in BC (Campbell et al. 2007). On the coast, this warbler breeds from mid to late May to July 25, has a nestling period of 8 to 9 days, in which both parents feed young (Pitocchelli 2013). Young are altricial and nidicolous, born with eyes closed; downy feathers appear on top of the head, back, and wings two days after hatching (Bent 1953).

MacGillivray's Warbler nests are susceptible to Brown-headed Cowbird (*Molothrus ater*) parasitism; Friedmann (1963) regarded this warbler as a regular but infrequent host for the Brown-headed Cowbird.

1.4.3 Migration

MacGillivray's Warbler migrates in fall to central and South America. Migration is entirely over land and does not overlap with the Mourning Warbler. During migration it uses habitats that provide dense cover, including shrub patches, shrubby forest edges, brush piles, willow and Red-osier Dogwood thickets, shrub-grown wetlands, open woodlands, moist gullies choked with deciduous shrubs, and early second growth forests after clearcutting (Campbell et al. 2007). Winter populations from lower latitudes migrate farther north than wintering populations from higher latitudes (Pitocchelli 2013).

1.5 Habitat Use – Life Requisites and Seasons

Two life requisites are rated for the MacGillivray's Warbler in the Project area (Table 5): Reproducing and Growing. Months where this species is not present are not considered.

Table 5. Seasons and the life requisites for MacGillivray's Warbler being rated in the Project Area

Month	*Season**	*Life Requisites*	*Specific Time Period*
April	Growing (Spring)	Living	
May	Growing (Spring)	Reproducing	Nesting mid-May
June	Growing (Summer)	Reproducing	Nesting
July	Growing (Summer)	Reproducing	Nesting/Fledging
August	Growing (Summer)	Reproducing	Fledging/Young
September	Growing (Fall)	Living	
October	Growing (Fall)	Living	

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for MacGillivray's Warbler are summarized in Table 6. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the four-class rating scheme (Table 7).

Table 6. Summary of habitat attributes for McGillivray's Warbler reproduction

Habitat Use	*Attributes of Suitable McGillivray's Warbler Habitat*	*Structural Stage[1]*
Reproducing	Riparian habitat, stream bottoms, brushy hillsides along canyons, or logged-over clear-cuts with second growth, areas recovering from avalanches with dense understory vegetation	3-5
Living	Dense thickets, with insects for forage on low braches and among foliage	3-5

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 7. Relative suitability classes to be assigned to MacGillivray's Warbler habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

1.7 Habitat Ratings Assumptions

Rating assumptions for Living/Reproduction Habitat

- Riparian habitat, stream bottoms, brushy hillsides along canyons, or logged-over clear-cuts with second growth, areas recovering from avalanches with dense understory vegetation (>50% cover) of structural stage 3 are rated Class 1.
- Riparian habitat, stream bottoms, brushy hillsides along canyons, logged-over clear-cuts with second growth and areas recovering from avalanches or other disturbances with <50% but greater than 25% shrub cover in structural stages 4 or 5 are rated Class 2.
- Riparian habitat, stream bottoms, brushy hillsides along canyons, logged-over clear-cuts with second growth and areas recovering from avalanches or other disturbances with <25% understory vegetation in structural stages 6 -7 are rated Class 3.
- Open habitats (structural stage 1, 2), and mature and old growth forest lacking a dense understory, (structural stage 6 and 7) are rated Class 4.
- All other habitats are rated Class 4.

Table 8 Reproducing-Eggs-Growing

<table>
<tr><td colspan="3">MacGillivray's Warbler (B-MACW)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Riparian areas and 2nd Growth, shrub dominated areas recovering from some type of disturbance such as avalanches, cutblocks, land slides etc.</td></tr>
<tr><td rowspan="4">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">• Dense Shrub understory
• Open areas for foraging</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (high)
[75-100%]</td><td>• CWHwm and MHmm1: regenerating forest (structural stages 3a and 3b) including:
o Avalanche chutes
o cutblocks,</td></tr>
</table>

		○ old roads, ○ riparian areas, ○ natural openings and burnt areas • Wetlands in CWHwm and MHmm1 with structural stage 3a and 3b adjacent to the wetland
	2 (moderate) [25-75%]	• CWHwm and MHmm1: regenerating forest (structural stages 4 or 5) including: ○ cutblocks, ○ old roads, ○ riparian areas, ○ natural openings and burnt areas ○ Wetlands in CWHwm and MHmm1 with structural stage 4 or 5 adjacent to the wetland
	3 (low) [1-25%]	• CWHwm and MHmm1 Forested area with structural 6 and > 25% shrub cover • Area with canopy closure class <5
	4 (nil) [0%]	• CWHwm and MHmm1 Forested area with structural 7 • All non-vegetated areas • Vegetated areas in structural stages 1-2 • All other habitats not listed above

1.8 Habitat Ratings Adjustments

No ratings adjustments were conducted at this time.

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Marbled Murrelet (*Brachyramphus marmoratus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Marbled Murrelet Species Account....1
1.1 Species Data.... 1
1.2 Species Distribution.... 1
1.2.1 Provincial Distribution.... 1
1.2.2 Study Area Distribution.... 2
1.2.3 Elevation Range.... 2
1.3 Study Area.... 2
1.4 Ecology and Key Habitat Requirements.... 5
1.4.1 Species Description.... 5
1.4.2 Breeding Habitat.... 5
1.5 Habitat Use – Life Requisites and Seasons.... 7
1.5.1 Existing Habitat Models.... 7
1.6 Wildlife Habitat Ratings.... 8
1.7 Habitat Ratings Assumptions.... 10
1.8 Habitat Ratings Adjustments.... 11
2.0 References....12

LIST OF TABLES

Table 1. Taxonomic and status information for Marbled Murrelet *(Brachyramphus marmoratus)*.... 1
Table 2. Study area administrative boundaries.... 2
Table 3. Study area physiographic setting.... 3
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Marbled Murrelet Habitat.... 3
Table 5. Key microhabitat characteristics of breeding habitat for Marbled Murrelet in BC.... 6
Table 6. Monthly life requisites being rated for Marbled Murrelet in the Project area.... 7
Table 7. Summary of habitat attributes for Marbled Murrelet reproduction.... 8
Table 8. Relative suitability classes to be assigned to Marbled Murrelet habitat polygons.... 8
Table 9 Marbled Murrelet Nesting Habitat Assumptions.... 9

1.0 Marbled Murrelet Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Marbled Murrelet *(Brachyramphus marmoratus)*

Marbled Murrelet Species Data	
Identifier	***Description***
Common Name	Marbled Murrelet
Latin Name	*Brachyramphus marmoratus*
Species Code	B-MAMU
Global Status	G3
Provincial Status	S3B,S3N
BC List	Blue
Identified Wildlife	Y
SARA	Schedule 1 (Threatened)
COSEWIC	Threatened
BC Conservation Framework	CF Highest Priority: 1
	Priority 1 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 1 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 2 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Marbled Murrelet occurs along the west coast of North America from the Aleutian Islands to California (COSEWIC 2012).

1.2.1 Provincial Distribution

The Marbled Murrelet can be found in all coastal areas of BC, except some small sections in the Strait of Georgia (COSEWIC 2012). It is found in all coastal regional districts, with the vast majority of breeding habitat located in the Coastal Western Hemlock (CWH) biogeoclimatic zone, and small amounts in the Coastal Douglas-fir (CDF) and Mountain Hemlock (MH) zones (BC Conservation Data Centre 2013). Nesting habitat is most likely found within 0.5 to 30 km from the ocean, but can be found outside that range as well. Population estimates for BC range from 55,000 to 94,000, with the most recent estimate being 99,100 individuals (COSEWIC 2012). Most population trends indicate a slightly decreasing population size, with a population growth parameter between 0.859 and 0.985 for Marbled Murrelet in Desolation Sound (Cam et al. 2003). There are 7 regions delineated as conservation regions for this species in BC: East Vancouver Island, West and North Vancouver Island, Southern Mainland Coast, Central Mainland Coast, Northern Mainland Coast, Haida Gwaii, and Alaska Border (CMMRT 2003).

1.2.2 Study Area Distribution

Specific occurrences of Marbled Murrelets within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for this species are on the north mainland of British Columbia and Haida Gwaii. These records include observations of birds and nests. Marbled Murrelet is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the Study area. Within this zone, Marbled Murrelets inhabit ocean shorelines within several kilometres off shore from old growth forests (BC Conservation Data Centre 2016).

1.2.3 Elevation Range

Marbled Murrelet nest sites can be found from sea level up to 1,100 m elevation (Hamer and Nelson 1995). Nests are most likely found in locations under 600 m, are moderately likely to be found within 600 to 900 m, and are least likely to be found above 900 m elevation (COSEWIC 2012).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Marbled Murrelet Habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
MHmm1			
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)

BEC Zone/Subzone	Site Series	Map Code	Site Associations
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	32	---	Non-forested fen/marsh
	51	---	Avalanche Chutes
MHmm1	01	MB	Mountain Hemlock-Amabilis Fir-Blueberry
	03	MO	Amabilis Fir-Mountain Hemlock-Oak Fern
	04	AB	Mountain Hemlock-Amabilis Fir-Bramble
	05	MT	Amabilis Fir-Mountain Hemlock-Twisted Stalk
	51	---	Avalanche Chutes
MHmmp	00	AM	Herbaceous Meadows
	00	KC	Krummholz Cliffs
	00	MH	HM-Heather Complex
	00	LM	Lichen-Hm Parkland
CMAun	00	AM	Herbaceous Meadows
	00	CC	Talus Slope and Rock Outcrop Complex
	00	HL	Heather Lichen Meadow
	00	HM	Heather Meadow

BEC Zone/Subzone	Site Series	Map Code	Site Associations
CMAun (cont'd)	00	HP	Mountain Heather-partridge Foot
	00	KC	Krummholz Cliffs
	00	MC	Moss Campion-Coral Lichen Meadows
	00	MH	Mountain Heather
	00	TR	Talus and Rock Outcrop

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

The Marbled Murrelet is a small (approximately 25 cm) seabird that belongs to the Auk family (Alcidae). Its plumage changes from the typical seabird colouring of black and white to a mottled grey/brown during the breeding season. Marbled Murrelet breeds inland and forages at sea. Foraging grounds are typically located in sheltered bays or inlets, but it will forage within 500 m of the coast on the open ocean. It dives for prey, using its muscular wings to propel itself underwater. The Pacific Sand Lance (*Ammodytes hexapterus*) is the most common prey item, but murrelets will also take other epipelagic schooling fish including immature Pacific Herring (*Clupea pallasii*) (Burger 2002; COSEWIC 2012). Emigration of adults and fledglings from breeding grounds to overwintering and/or moulting areas does occur, however the data on this topic are lacking (Burger 2004b, COSEWIC 2012).

The breeding period in BC occurs from late April until September. During this time a single egg is laid by the female and incubated by both sexes. Incubation lasts for approximately 30 days and the chick remains at the nest for 30 to 40 days. Both parents continue to forage at sea during this period, with the hours before sunlight being the preferred time for food delivery to the nest. Nesting success ranges between 0.33 to 0.46 fledglings per nest and 95% of fledglings reach sea after leaving the nest. This, along with adjustments based on nesting attempts and proportion of adult females breeding, results in an at-sea fecundity (number of female offspring which reach the ocean per year per female of breeding age) ranging from 0.16 to 0.22 (Burger 2002). The low recruitment of this species is offset by high adult survival (approximately 85%; COSEWIC 2012).

1.4.2 Breeding Habitat

Marbled Murrelet breeds exclusively in coastal old growth forests, primarily in the CWH biogeoclimatic zone but also in the MH and CDF zones. Nesting habitat is typically found within 30 km of sea water. In BC, the average distance of nest trees from the ocean was 11.5 km (Hamer and Nelson 1995). Typical nest patch tree species include: Yellow Cedar (*Chamaecyparis nootkatensis*), Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*), Coastal Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*), and Western Redcedar (*Thuja plicata*), with few nests found in Amabilis Fir (*Abies amabilis*) and Mountain Hemlock (*Tsuga mertensiana*) (Hamer and Nelson 1995).

Nesting takes place on nest platforms, created by large branches or branches with deformities, located close to the tree trunk. These branches must have a thick covering of moss and other epiphytes to provide substrate for the nest (Burger 2002; COSEWIC 2012). Hull (1999) found that nest patches had a higher density of large diameter trees and a higher number of platforms per tree than in random patches, and Hamer and Nelson (1995) found detection numbers were most accurately predicted by the same variables. A review of Marbled Murrelet habitat associations generated the following stand level structural characteristics that were positively associated with nesting (Burger 2002):

- Density of large trees (diameter at breast height [dbh] >80 cm)
- Tree diameter (dbh)
- Variation in tree size (dbh or height)
- Epiphyte cover on branches
- Epiphyte thickness
- Density of potential platforms per ha
- Density of trees with platforms

These larger features are correlated with a suite of required microhabitat variables which are outlined in Table 5.

Table 5. Key microhabitat characteristics of breeding habitat for Marbled Murrelet in BC

Murrelet Requirements	*Key Habitat Attributes*
Sufficient height to allow stall-landings and jump-off departures	Nest trees are typically >40 m tall (range 15 to 80 m), and nest heights are typically >30 m (range 11 to 54 m); nest trees are often larger than the stand average.
Openings in the canopy for unobstructed flight access	Small gaps in the canopy are typically found next to nest trees, and vertical complexity of the canopy is higher in stands with nests than in other nearby stands.
Sufficient platform diameter to provide a nest site and landing pad	Nests are typically on large branches or branches with deformities, usually with added moss cover; nest limbs range from 15 to 74 cm in diameter; nests typically located within 1 m of the vertical tree trunk.
Soft substrate to provide a nest cup	Moss and other epiphytes provide thick pads at most nest sites, but duff and leaf litter are used in drier areas.
Overhead cover to provide shelter and reduce detection by predators	Most nests are overhung by branches.

Source: Burger (2004a)

Edge effects on nesting success are apparent from various studies throughout the species' range. An increase in predation on edge-associated nests is the main edge

effect observed (Nelson and Hamer 1995; Burger 2002; Malt and Lank 2009). Eggs and chicks are most commonly predated by Steller's Jay (*Cyanocitta stelleri*), followed by other corvids, owls, and birds of prey (Malt and Lank 2009; COSEWIC 2012). The extent of predation varies between studies, although the general consensus is that nest patches further from forest edges have higher success rates than those close to edges (Nelson and Hamer 1995; Manley and Nelson 1999). Malt and Lank (2009) further distinguish between the type of edge and probability of nest predation; they found higher probability of predation on nests closer to hard edges (e.g., roads and recent clearcuts) than on interior nests, lower predation probability on soft edge nests (regenerating forests) than interior nests, and no edge effects on predation for nests near natural edges (e.g., riparian areas).

1.5 Habitat Use – Life Requisites and Seasons

The Life Requisite of Reproducing, represented by nesting habitat, is rated for Marbled Murrelet in the Project area during the Growing season (Table 6).

Table 6. Monthly life requisites being rated for Marbled Murrelet in the Project area

Month	*Season**	*Life Requisites*
April	Growing (Early Spring)	Reproducing–Eggs
May	Growing (Late Spring)	Reproducing–Eggs
June	Growing (Summer)	Reproducing–Eggs
July	Growing (Summer)	Reproducing–Eggs
August	Growing (Summer)	Reproducing–Eggs
September	Growing (Fall)	Reproducing–Eggs

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.5.1 Existing Habitat Models

Numerous habitat suitability models have been created for Marbled Murrelet breeding habitat throughout its range. See Burger (2002) for an in-depth review of these models. Bahn and Newsom (2002a, b) created habitat models using VRI map features after finding that TEM map features did not strongly correlate with Marbled Murrelet activity. Burger (2003) created a system for identifying and ranking nesting habitat using data from air photos and low-level aerial survey features. Mather et al. (2010) provide an overview of a Nesting Habitat Suitability Model for the British Columbia Coast that was developed to predict potential nesting habitat for Marbled Murrelet for 2002. The Canadian Marbled Murrelet Recovery Team (CMMRT) proposed that in order to limit population decline by less than 30%, at least 70% of nesting habitat that existed in 2002 would need to be maintained. The Study Area is within the North Mainland Coast Marbled Murrelet Conservation Region (CMMRT 2003). The model used a two class rating system (suitable/not suitable) based on distance from salt water, biogeoclimatic zones, variants, site series, site index and productivity, elevation, slope, aspect, stand age, tree

height, canopy closure, and moisture regimes, mostly from Burger (2002). The model used tree height, elevation, and distance from salt water as the main variables in the algorithm. The wildlife habitat ratings for Marbled Murrelet in the Project area are based on the habitat features required for nesting and the 6-class ranking scheme created by Burger (2004a).

1.6 Wildlife Habitat Ratings

Marbled Murrelet has been extensively studied and a wide variety of literature outlines the habitat requirements for nesting sites. Key habitat features are summarized in Table 7. While there is no Provincial benchmark habitat for Marbled Murrelet breeding sites, there is a standard method for ranking nesting habitat (Burger 2004a). The 6-class rating scheme presented in Burger (2003) was followed. This rating scheme better facilitates identification of low quality habitats that may be capable of supporting Murrelets (Table 8).

Table 7. Summary of habitat attributes for Marbled Murrelet reproduction

Habitat Use	*Attributes of Suitable Marbled Murrelet Habitat*	*Structural Stage[1]*
Reproducing–Eggs	Old growth forest with multi-layered canopy, canopy gaps and large, tall trees with adequate nest platforms	7

Source: Burger (2003)

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 8. Relative suitability classes to be assigned to Marbled Murrelet habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Habitat Quality and Likelihood of Nesting*
1	Very High	>50 to 100	Key habitat features present in abundance; nesting highly likely
2	High	>25 to 50	Key habitat features common and widespread; nesting likely
3	Moderate	6 to 25	Key habitat features present but uncommon and patchy; nesting likely but at moderate to low densities
4	Low	2 to 5	Key habitat features all evident but patchy and sparse; nesting possible but unlikely or at very low density
5	Very Low	about 1	Key habitat features sparse and might not all be present; nesting highly unlikely
6	Nil	0	All key habitat features absent; nesting impossible (e.g., bogs, bare rock)

Source: Burger (2003)

Table 9 Marbled Murrelet Nesting Habitat Assumptions

<table>
<tr><td colspan="3">Marbled Murrelet (B-MAMU)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Old growth forest with multi-layered canopy, canopy gaps and large, tall trees with adequate nest platforms</td></tr>
<tr><td rowspan="5">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">Mature/old growth forests in close proximity to the ocean that possess nesting platforms with the following characteristics:
• Sufficient height to allow stall landings and jump-off departures
• Openings in the canopy for unobstructed flight access
• Sufficient platform diameter to provide a nest site and landing pad
• Soft substrate to provide a nest cup
• Overhead cover to provide shelter and reduce detection by predators
Note: Habitat within 50 m of edges, specifically roads and clearcuts, will be adjusted downwards by 2 classes.</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (very high)
[50-100%]</td><td>CWHwm and ICHvc:
• Old growth Sitka spruce stands (CWHwm 04 and 05 and ICHvc 06)
• Stands with age class 9 (>250 yrs)
• Structural Stage 7
• Area with site index productivity class I
• Area with tree height class 6-7
• Area with canopy closure class 5-6
• Area with vertical canopy complexity of moderately uniform (21 to 30% height difference, some canopy gaps visible, evidence of past disturbance) and non-uniform (31 to 40% height difference, canopy gaps often visible due to past disturbance)</td></tr>
<tr><td>2 (high)
[25-50%]</td><td>CWHwm 04 and 05; and ICHvc 03 and 04
• Stands with age class 9 (>250 yrs)
• Structural Stage 7
• Area with site index productivity class II
• Area with tree height class 4-5
• Area with canopy closure class 4
• Area with very non-uniform vertical canopy complexity (>40% difference, very irregular canopy)</td></tr>
<tr><td>3 (moderate)
[6-25%]</td><td>CWHwm and ICHvc
• Stands with age class 8 (140 to 250 yrs)
• Structural Stage 6
• Area with site index productivity class I
• Area with tree height class 3
• Area with canopy closure class 3 and 7</td></tr>
</table>

		• Area with uniform vertical canopy complexity (11 to 20% height difference, few canopy gaps visible, little or no evidence of disturbance
	4 (low) [2-5%]	• Stands with age class <8 • Area with site index productivity class IV • Area with tree height class <3 • Area with canopy closure class 2 and 8 • Area with very uniform vertical canopy complexity (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance)
	5 (very low) [~1%]	• Stands with age class <8 • Area with site index productivity class <IV • Area with tree height class <3 • Area with canopy closure class 2 and 8 • Area with very uniform vertical canopy complexity (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance)
	6 (nil) [0%]	• All other habitats not listed above

1.7 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Old growth Sitka spruce stands (ecosystems 04 and 05) are rated Class 1.
- Stands with age class 9 (>250 years) are rated Class 1 or 2, age class 8 (140 to 250 yrs) is rated Class 3, and stands with age class <8 are rated Class 4 or lower.
- Stands within CWHwm and ICHvc are rated Class 1, stands within MHmm1 are rated class 3 or lower and all other BEC zones are rated nil
- Area with site index productivity class I and II are rated Class 1 or 2, class III is rated Class 3, and class IV is rated Class 4 or lower.
- Area with tree height class 4-7 (>27.5 m) is rated Class 1 or 2, tree height class 3 (19.5 to 28.4 m) is rated Class 3, and tree height class <3 (<19.5 m) is rated Class 4 or lower.
- Area with canopy closure class 4-6 is rated Class 1 or 2, classes 3 and 7 is rated Class 3, and classes 2 and 8 are rated Class 4 or lower.
- Stands with height class 6 or greater are rated Class 1, height class 5 is rated Class 2, and height classes 4 and under are rated Class 3 or less.
- Area with vertical canopy complexity of MU, NU, and VNU is rated Class 1 or 2, U is rated Class 3, and VU* is rated Class 4 or lower.

Notes:

- Many of the rating assumptions are based on Table 3 in CMMRT (2003).
- *VU = very uniform (<11% height difference leading trees and average canopy, no evidence of canopy gaps or recent disturbance). U = uniform (11 to 20% height difference, few canopy gaps visible, little or no evidence of disturbance. MU = moderately uniform (21 to 30% height difference, some canopy gaps visible, evidence of past disturbance, stocking may be patchy or irregular. NU = non-uniform (31 to 40% height difference, canopy gaps often visible due to past disturbance, stocking typically patchy or irregular). VNU = very non-uniform (>40% difference, very irregular canopy, stocking very patchy or irregular) (CMMRT 2003).

1.8 Habitat Ratings Adjustments

- Habitat within 50 m of edges, specifically roads and clearcuts, are adjusted downward by 2 classes.

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Northern Goshawk (*Accipiter gentilis*) Draft Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Northern Goshawk Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 2
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 4
1.4.1 Species Description 4
1.4.2 Breeding Ecology and Habitat 5
1.5 Habitat Use – Life Requisites and Seasons 5
1.6 Existing Habitat Models 6
1.7 Wildlife Habitat Ratings 6
1.8 Habitat Ratings Assumptions 6
1.9 Habitat Ratings Adjustments 9
2.0 References 10

LIST OF TABLES

Table 1. Taxonomic and status information for Northern Goshawk (*Accipiter gentilis*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 3
Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with Northern Goshawk habitat 3
Table 5. Monthly life requisites being rated for Queen Charlotte Goshawk in the Project area 5
Table 6. Cross reference for HSI values with respect to wildlife habitat ratings classes 7
Table 7. Nesting habitat variables ratings table for *A. g. laingi* 7

1.0 Northern Goshawk Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Northern Goshawk (*Accipiter gentilis*)

Northern Goshawk Species Data[1]	
Identifier	***Description***
Common Name	Northern Goshawk
Latin Name	*Accipiter gentilis atricapillus, Accipiter gentilis laingi*
Species Code	B-NOGO
Global Status	G5 (*A. gentilis*); G5T2 (*A. g. laingi*)
Provincial Status	S4B,S4N (*A. gentilis*); S2B (*A. g. laingi*)
BC List	Yellow (*A. gentilis*); Red (*A. g. laingi*)
Identified Wildlife	N/A (A. gentilis); Yes (*A. g. laingi*)
SARA	N/A (*A. gentilis*); Schedule 1 (Threatened, *A. g. laingi*)
COSEWIC	N/A (*A. gentilis*); Threatened (*A. g. laingi*)
BC Conservation Framework	CF Highest Priority: 2
	Priority 6 (*A. gentilis*), Priority 1 (*A. g. laingi*) for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 3 (*A. gentilis*), Priority 1 (*A. g. laingi*) for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 4 (*A. gentilis*), Priority 6 (*A. g. laingi*) for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, Northern Goshawk occurs across North America and Eurasia (Cooper and Chytyk 2000). In North America, the species breeds across most of Canada, and western Mexico (COSEWIC 2013).

1.2.1 Provincial Distribution

Two subspecies of Northern Goshawk occur in British Columbia: *A. g. atricapillus* and *A. g. laingi*. The former subspecies breeds throughout the mainland and interior of British Columbia (Campbell et al. 1990). The latter subspecies, or Queen Charlotte Goshawk, occurs only on coastal British Columbia (Campbell et al. 1990), mainly the Queen Charlotte Islands, Vancouver Island, and other large coastal islands (McClaren 2003; Cooper and Chytyk 2000). Although breeding for Queen Charlotte Goshawk has not been confirmed on the coastal mainland of British Columbia (Campbell et al. 1990), it seems likely that the goshawks that breed on the north and central mainland coast are of this subspecies (Cooper and Chytyk 2000; McClaren 2003; Doyle 2003). The distribution map (Northern Goshawk Recovery Team 2008) for *A. g. laingi* includes the entire coastal mainland divided into four distinct conservation regions (South Coast, North Coast, Haida

Gwaii, and Vancouver Island). The Project Study Area is well within the boundaries of the Queen Charlotte Goshawk range. For the purpose of this report "Northern Goshawk" will refer to *A. gentilis* generally whereas "Queen Charlotte Goshawk" will refer specifically to the A. g. *laingi* subspecies.

1.2.2 Study Area Distribution

Specific occurrences of Queen Charlotte Goshawk within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for this species are approximately 140 to 180 km to the southeast near Kitwanga. These records include several nests and although occurring within the transitional area between both subspecies, were assumed to be the *laingi* subspecies. Northern Goshawk is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the Study Area, although MH is considered less suitable than CWH (Mahon et al. 2008). Within this zone, Northern Goshawks prefer mature to old stands of Douglas-fir and Western Hemlock (BC Conservation Data Centre 2016).

1.2.3 Elevation Range

Queen Charlotte Goshawks typically nest from sea level to 900 m although higher elevations may be avoided due to the increased energy expenditure required to access, especially if carrying food for offspring (Northern Goshawk Recovery Team 2008).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with Northern Goshawk habitat

BEC Zone/Subzone	*Site Series*	*Map Code*	*Site Associations*
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	02	HM	Western Hemlock-Sitka Spruce - Step moss
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	09	SC	Sitka Spruce - Skunk cabbage
	32	---	Non-forested fen/marsh
MHmm1	01	MB	Mountain Hemlock-Amabilis Fir-Blueberry
	02	MM	Mountain Hemlock-Aamabilis Fir - Mountain-heather
	03	MO	Amabilis Fir-Mountain Hemlock-Oak Fern
	04	AB	Mountain Hemlock-Amabilis Fir-Bramble
	05	MT	Amabilis Fir-Mountain Hemlock-Twisted Stalk
	06	MD	Mountain Hemlock – Yellow Cedar - Deer Cabbage
	07	YH	Yellow Cedar – Mountain Hemlock - Hellebore
	08	YS	Mountain Hemlock – Yellow cedar - Sphagnum

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Northern Goshawks are considered opportunistic hunters, foraging on a variety of medium-sized birds and mammals throughout the year (Squires and Reynolds 1997). The rounded wings and long tail of goshawks make them well suited for manoeuvring through forested habitats while hunting.

Queen Charlotte Goshawks typically do not breed until they are >2 years, although occasionally they will breed in their second year (McClaren 2003). Individuals return to their breeding sites between early February and late March. Courtship consists of aerial displays, dawn vocalizations, nest building/repair, and frequent copulation, and occurs between February and early April, with peak activity occurring in March (Beebe 1974; Chytyk et al. 1997). Egg laying commences in mid to late April and incubation lasts for 30 to 32 days (Beebe 1974).

The size of Northern Goshawk breeding home ranges varies according to the familiarity of individuals with their home range, differences in hunting efficiency, food requirements (brood size), and food availability (Kennedy et al. 1994). For example, in California, breeding home ranges averaged 1,280 ha (*n*=5) for Northern Goshawk females and 1,880 ha (*n*=5) for males (Keane and Morrison 1994) whereas in southeast Alaska, breeding home ranges for Queen Charlotte Goshawks averaged 19,215 ha (*n*=8) for females and 5,847 ha (*n*=8) for males (Titus et al. 1994). In southeast Alaska, female breeding season home ranges were primarily <1,000 ha; however, two females made large movements away from their breeding areas during the post-fledging period, dramatically increasing estimates of mean breeding season home range size (Titus et al. 1994).

Northern Goshawk breeding ranges consist of three distinct areas: the nest area, post-fledging area (PFA), and foraging area (Reynolds et al. 1992). The nest area usually contains several nest trees used as alternate nesting sites, roost trees, or plucking trees. Most of the courtship behaviour occurs in this area. Nest trees on Vancouver Island were found to be 800 m apart and individual PFAs were estimated at 58 ±11 ha (McClaren and Pendergast 2003). Other estimates for *A. g. atricapillus* PFAs range from 20 ha to 170 ha (Mahon et al. 2008; Kennedy et al. 1994). Although it is recognized that *A. g. laingi* likely needs larger PFAs, a minimum size of 20 ha was used for modelling in this report.

Foraging Habitat

Generally Queen Charlotte Goshawks have a very large foraging territory due to the low density of prey species that usually occur in the northern parts of its range. A brief mention of general foraging habitat characteristics is made here but foraging habitat suitability will not be rated for the Project.

Foraging Habitat Attributes:

- Abundant prey species
- Sufficient cover to hide Goshawk approach
- Sufficiently open understory to provide flight lanes for attack
- Presence of suitable hunting perches

1.4.2 Breeding Ecology and Habitat

Nesting Habitat

Nesting Habitat Attributes:

- Mature and old growth stands (McGrath et al. 2003; Cooper and Stevens 2000; Daw et al. 1998; Squires and Reynolds 1997; McClaren 1998)
- High canopy closure >60% key feature of nesting habitat (Squires and Reynolds 1997; Daw et al. 1998)
- Open understory to provide unobstructed flyways for hunting
- Gentle to moderate slopes <40%
- Lower third or bottom of slope (Chytyk and Dhanwant 1999; Chytyk et al. 1997; Duncan and Kirk 1995)
- Northeast to northwest aspects
- Close to perennial water source
- Abundant prey source (Marshall 1992; Duncan and Kirk 1995)
- Small forest gaps (single or two or three trees falling) (Reynolds et al. 1982)
- Large diameter at breast height (dbh) trees (Daw et al. 1998)

1.5 Habitat Use – Life Requisites and Seasons

Only nesting habitat will be rated for Queen Charlotte Goshawks. The life requisite will be Reproducing-eggs and the season is growing (Table 5).

Table 5. Monthly life requisites being rated for Queen Charlotte Goshawk in the Project area

Month	*Season**	*Life Requisites*
March	Winter	Reproducing-Eggs
April	Spring	Reproducing–Eggs
May	Spring	Reproducing–Eggs
June	Summer	Reproducing–Eggs
July	Summer	Reproducing–Eggs
August	Summer	Reproducing–Eggs

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Existing Habitat Models

Mahon et al. (2008) developed a habitat model for Queen Charlotte Goshawk based on a combination of nesting and foraging habitat suitability models and a Territory Analysis Model. The wildlife habitat ratings for nesting habitat developed for the Project closely follow the nesting habitat suitability model developed by Mahon et al. (2008). For elevation, the Habitat Suitability Index (HSI) remains constant at 1.0 from 0 to 600 m ASL then declines linearly between 600 and 1,200 m. For the Project, the assumption has been made that above 1,200 m HSI is 0 to reflect the upper elevation limit of the MHmm1 subzone, beyond which vegetation is stunted or absent and habitat is unsuitable for Northern Goshawk.

1.7 Wildlife Habitat Ratings

Wildlife habitat ratings will be based on the following habitat suitability model:

Nesting HSI = mean (Age, Height) x CC x StandComp x Elev x Slope pos

Age = Stand age; Height = Stand height; CC = Canopy closure; StandComp = Tree species composition in the stand; Elev = Elevation; Slope pos= Slope position.

1.8 Habitat Ratings Assumptions

A four level rating scheme was used for Queen Charlotte Goshawk habitat ratings (Table 6). The nesting habitat variables rated are outlined in Table 7.

Table 6. Cross reference for HSI values with respect to wildlife habitat ratings classes

HSI Ratings	*Class*	*Value*	*Interpretation*
0 to 0.250	Nil	4	Unsuitable. Habitat fails to provide minimum requirements.
0.251 to 0.500	Low	3	Suitability Unknown. Habitat provides theoretical minimum requirements for supporting a nest, but use by goshawks is rarely observed. Suitability of two or more habitat variables is suboptimal, substantially reducing the overall suitability of the stand. Goshawks are not normally expected to use Low class habitats, but may do so if that is all that available.
0.501 to 0.750	Moderate	2	Suitable. Suitability of one or two habitat variables is slightly lower than optimal conditions but minimum requirements still exceeded. Minority of nest sites expected to occur in Moderate class habitat.
0.751 to 1.000	High	1	Suitable. All habitat variables meet optimal conditions. Majority of nest sites are expected to occur in High class habitat.

Table 7. Nesting habitat variables ratings table for *A. g. laingi*

Mapping Attribute	*FC Class*	*Rating*	*HSI Value*
Stand Age	≥8 (141+yrs)	H (1)	1
	6-7 (101 to 140 yrs)	M (2)	0.75
	5 (81 to 100)	L (3)	0.4
	≤4 (≤80 yrs)	N (4)	0
Stand Height	≥5 (≥37.5 m)	H (1)	1
	4 (28.5 to 37.4 m)	M (2)	0.75
	3 (19.5 to 28.4 m)	L (3)	0.4
	≤2 (≤19.4 m)	N (4)	0.1
Crown Closure	≥7 (≥66%)	H (1)	1
	6 (56 to 65%)	M (2)	0.75
	5 (46 to 55%)	L (3)	0.4
	≤4 (≤45%)	N (4)	0.1
Elevation	≤600 m ASL	H (1)	1.0
	600 – 700 m ASL	H (1)	0.9
	700 – 799 m ASL	H (1)	0.8
	800 – 899 m ASL	M (2)	0.7
	900 – 999 m ASL	M (2)	0.6
	1000 – 1099 m ASL	L (3)	0.5
	1100 – 1199 m ASL	L (3)	0.5
	≥1200 + m ASL	N (4)	0
Slope	0 to 40%	H (1)	0.8
	40 to 60%	M (2)	0.6
	≥60%	L (3)	0.4

Mapping Attribute	*FC Class*	*Rating*	*HSI Value*
Stand Species Composition	Hw leading	H (1)	1
	Ss Leading	H (1)	0.9
	Cw or Ba leading	M (2)	0.6
	Deciduous Act leading	M (2)	0.6
Distance to edge	≥201 m	H (1)	1
	101 to 200 m	M (2)	0.75
	51 to 100 m	L (3)	0.4
	≤50 m	N (4)	0.1

Nesting Habitat Variables:

- Stand Age: Older age classes are rated high. Stands less than 80 years are rated Class 4 (Nil).
- Stand Height: Taller trees (>28.5 m) are rated higher and trees below 20 m are rated low or nil.
- A combined average rating of stand height and stand age is used for rating Goshawk nesting habitat.
- Structural Stage 6 and 7 are rated high (Class 1) except for structural stage 7b where vertical structure complexity reduces potential flyways. Structural stage 7b is rated Class 2.
- Stand species composition stands with Western hemlock (Hw) or Sitka spruce (Ss) leading are rated Class 1. Aamabilis fir (Ba), Western redcedar (Cw), or deciduous black cottonwood (Act) stands are rated Class 2.
- Crown closure code 7 (>66%) is rated Class 1 and crown closure below 45% is rated Class 4.
- Distance to edge ratings listed in the ratings table apply to natural openings and clear-cuts. All habitat within 50 m of an opening is rated Class 4 (Nil).

Table 8 Northern Goshawk Habitat ratings assumptions

Northern Goshawk (B-NOGO-LA)		
General Habitat	Mature or old growth forests with open understories	
Reproducing-Eggs – Growing (RE-G)	Key Habitat Requirements	
	• Mature and old growth stands • High canopy closure >60% key feature of nesting habitat • Open understory to provide unobstructed flyways for hunting • Gentle to moderate slopes <40% • Lower third or bottom of slope • Northeast to northwest aspects • Close to perennial water source • Abundant prey source • Small forest gaps • Large diameter at breast height (dbh) trees	
	Ratings	Assumptions
	1 (high) [0.751-1]	• Stand age ≥ 8 (141+ yrs) —*HSI 1* • Stand height ≥5 (≥37.5m) —*HSI 1* • Crown closure ≥7 (≥66%) —*HSI 1* • Slope 0-40% —*HSI 0.8* • Hw leading —*HSI 1* • Ss leading —*HSI 0.9* • Distance to edge ≥201 m —*HSI 1*
	2 (moderate) [0.501-0.75]	• Stand age 6-7 (101 to 140yrs) —*HSI 0.75* • Stand height 4 (28.5 to 37.4m) —*HSI 0.75* • Crown closure 6 (56 to 65%) —*HSI 0.75* • Slope 40-60% —*HSI 0.6* • Cw or Ba leading —*HSI 0.6* • Deciduous Act leading —*HSI 0.6* • Distance to edge 101 to 200 m —*HSI 0.75*
	3 (low) [0.251-0.50]	• Stand age 5 (81 to 100) —*HSI 0.4* • Stand height 3 (19.5 to 28.4m) —*HSI 0.4* • Crown closure 5 (46 to 55%) —*HSI 0.4* • Slope >60% —*HSI 0.4* • Distance to edge 51 to 100 m —*HSI 0.4*
	4 (nil) [0-0.25]	• Stand age ≤4 (≤80yrs) —*HSI 0* • Stand height ≤2 (≤19.4m) —*HSI 0.1* • Crown closure ≤4 (≤45%) —*HSI 0.1* • Distance to edge ≤50 m—*HSI 0.1*

1.9 Habitat Ratings Adjustments

- All non-forested units are rated 0.

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Olive-sided Flycatcher (*Contopus cooperi*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Olive-sided Flycatcher Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 5
1.4.1 Species Description 5
1.4.2 Breeding Ecology and Habitat 5
1.5 Habitat Use – Life Requisites and Seasons 6
1.6 Wildlife Habitat Ratings 6
1.7 Habitat Ratings Assumptions 7
1.8 Habitat Ratings Adjustments 8
H2.0 References 9

LIST OF TABLES

Table 1. Taxonomic and status information form Olive-sided Flycatcher (*Contopus cooperi*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Olive-sided Flycatcher habitat 3
Table 5. Monthly life requisites being rated for Olive-sided Flycatchers in the Project area 6
Table 6. Summary of habitat attributes for Olive-sided Flycatcher reproduction 6
Table 7. Relative suitability classes to be assigned to Olive-sided Flycatcher habitat polygons 7

1.0 Olive-sided Flycatcher Species Account

1.1 Species Data

Table 1. Taxonomic and status information form Olive-sided Flycatcher (*Contopus cooperi*)

Olive-sided Flycatcher Species Data	
Identifier	***Description***
Common Name	Olive-sided Flycatcher
Latin Name	*Contopus cooperi*
Species Code	B-OSFL
Global Status	G4
Provincial Status	S3/S4B
BC List	Blue
Identified Wildlife	N/A
SARA	Schedule 1 (Threatened)
COSEWIC	Threatened
BC Conservation Framework	CF Highest Priority: 2
	Priority 5 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 3 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, Olive-sided Flycatchers are found across North and South America. In North America, breeding occurs across most of Canada, the northern United States, and the Rocky Mountains. In South America breeding occurs primarily in Bolivia, Peru, Columbia, and Venezuela. Wintering occurs in Central America.

1.2.1 Provincial Distribution

The breeding range of Olive-sided Flycatcher is widely distributed throughout BC. This migrant songbird can be found in all forested areas of the province except for Haida Gwaii and all biogeoclimatic zones except for the Alpine Tundra and Bunchgrass zones (BC Conservation Data Centre 2013). Highest concentrations of Olive-sided Flycatcher are found on southeast Vancouver Island, the Georgia Depression Ecoprovince, and in the southwest portion of the Sub-boreal Interior Ecoprovince (Campbell et al. 1997). Despite its wide distribution, this species has experienced severe population declines in the last half-century; it is estimated that the breeding population has declined by 29% from 1996 to 2006 and by 79% from 1966 to 2006 (COSEWIC 2007).

1.2.2 Study Area Distribution

Specific occurrences of Olive-sided Flycatcher within or near the Project area are not mapped. The closest mapped observation indicated on distribution mapping compiled

by E-Fauna BC for this species is approximately 100 km to the south-southeast, however known breeding range covers all of British Columbia (Altman and Sallabanks 2012). Olive-sided Flycatcher is documented to occur in the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zone, which occurs within the Study Area. Within this zone, Olive-sided Flycatchers are associated with young coniferous or mixed forests, often disturbed by fire or logging and often near water (COSEWIC 2007).

1.2.3 Elevation Range

Olive-sided Flycatcher habitat can range in elevation from 400 to 3,400 m, however typical range is 1,000 to 2,000 m (Environment Canada 2015).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Olive-sided Flycatcher habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

The Olive-sided Flycatcher is a medium-sized (approximately 18 to 20 cm) songbird. Individuals are deep olive green or brown with a white breast and belly. Males have slightly longer wings than females, but both sexes have relatively long wings. It is known for its tendency to perch on the tallest tree tips or snags. This location gives it the best view for detecting flying insects, which are its primary prey. Its song is loud and distinctive; the three-note whistle is commonly described as sounding like 'Quick, THREE BEERS!' (Campbell et al. 1997; COSEWIC 2007).

Olive-sided Flycatchers are Neotropical migrants. Their primary overwintering habitat is located in Panama and in the Andes from Venezuela to Peru, but they can be found in other areas of Central and South America. A large portion of their breeding habitat is located in Canada, with most being west of the Rocky Mountains. Breeding has been reported in Coastal BC from the end of May until early August, although the presence of breeding individuals in the province is thought to range from late April until early September (Campbell et al. 1997).

Males arrive at the breeding ground and select territories, and pair bonds form when females arrive. Nests are created by weaving twigs, sticks, and roots together and are lined with beard lichens, grass, and other vegetation. The number of eggs per nest ranges from 1 to 4 for an average clutch size of 3 (Campbell et al. 1997; COSEWIC 2007). Both parents incubate the eggs for 10 to 17 days and the chicks remain in the nest for 21 to 23 days after hatching (Campbell et al. 1997). Their nesting period is the longest of any passerine in North America (Robertson and Hutto 2007).

1.4.2 Breeding Ecology and Habitat

Breeding habitat is seen in a wide variety of forest types and structural stages, from old growth to young stands (Campbell et al. 1997). Preference is seen for mature forest habitat adjacent to water. Most nests are found in intact forest, although both natural and man-made edge habitat provides the open area favoured by this species (Campbell et al. 1997). Engelmann Spruce (*Picea engelmannii*) and Subalpine Fir (*Abies lasiocarpa* var. *lasiocarpa*) are preferred nesting trees, likely due to their structural characteristics being suitable for the bulky nature of Olive-sided Flycatcher nests (Robertson and Hutto 2007). Nesting is also observed in other conifers including Douglas-fir (*Pseudotsuga menziesii*), Ponderosa Pine (*Pinus ponderosa*), White Spruce (*Picea glauca*), and occasionally in deciduous tree species and shrubs (Campbell et al. 1997; Robertson and Hutto 2007).

There appears to be a relationship between fire-affected forest and occurrence of Olive-sided Flycatcher (Hutto 1995; Hutto and Young 1999; Robertson and Hutto 2007). Hutto (1995) found this species to be most commonly detected in post-fire forest stands than any other cover type in the Northern Rocky Mountains. Burned forests typically contain an abundance of standing dead trees that Flycatchers use as lookouts for prey. Robertson and Hutto (2007) investigated the preference of burned forest versus selectively harvested forest; they showed that Olive-sided Flycatchers were observed in higher densities in selectively harvested forests than in burned plots. However nest success was higher in burned plots even though nest provisioning was higher in harvested plots, suggesting that natural regenerating burned forests offer higher quality habitat than selectively harvested forests that were apparently preferred (Robertson and Hutto 2007). In contrast, Meehan and George (2003) found a negative effect of fire on reproduction of Olive-sided Flycatcher. They found reduced food availability, foraging rates, and nest success in burned areas as compared to adjacent unburned habitat.

1.5 Habitat Use – Life Requisites and Seasons

The Life Requisite of Reproducing, represented by nesting habitat, will be rated for Olive-sided Flycatcher in the Project area (Table 5).

Table 5. Monthly life requisites being rated for Olive-sided Flycatchers in the Project area

Month	*Season**	*Life Requisites*
April	Growing (Early Spring)	Reproducing–Eggs
May	Growing (Late Spring)	Reproducing–Eggs
June	Growing (Summer)	Reproducing–Eggs
July	Growing (Summer)	Reproducing–Eggs
August	Growing (Summer)	Reproducing–Eggs
September	Growing (Fall)	Reproducing–Eggs

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Wildlife Habitat Ratings

There is no provincial benchmark for Olive-sided Flycatcher habitat, therefore habitat ratings will be based on breeding site habitat attributes found in the literature (

Table 6). A four-class rating scheme was used for habitat ratings as there is an intermediate knowledge of species habitat use (

Table 7).

Table 6. Summary of habitat attributes for Olive-sided Flycatcher reproduction

Habitat Use	*Attributes of Olive-sided Flycatcher Habitat*	*Structural Stage[1]*
Reproducing–Eggs	Open forest habitat with numerous tall trees (alive or dead)	**3-7**

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 7. Relative suitability classes to be assigned to Olive-sided Flycatcher habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

1.7 Habitat Ratings Assumptions

Rating Assumptions for Reproduction Habitat

- Old growth conifer forest (structural stages 6 and 7) adjacent to openings (within 100 m) will be rated as Class 1. Openings include cutblocks, roads, wetlands, water bodies, and burnt areas.
- Forested area with structural stage 4-5 will be rated Class 3 or 4, and vegetated areas in structural stages 1-3a will be rated Class 4.
- Wetlands will be rated Class 1 only with age class 6 or 7 forest adjacent (within 100 m) to the wetland.
- Area with canopy closure class 5-6 will be rated Class 3, canopy closure classes 4 and under will be rated Class 1 or 2. Area with canopy closure class 7 or higher will be rated Class 4.
- Area with presence of standing dead trees or snags will be rated Class 1.

Table 8 Reproducing-Eggs-Growing

<table>
<tr><td colspan="3">Olive-sided Flycatcher (B-OSFL)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Open forest habitat with numerous tall trees (alive or dead)</td></tr>
<tr><td rowspan="4">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">• Presence of tall snags for perching while foraging
• Open areas for foraging</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (high)
[75-100%]</td><td>• CWHwm and MHmm1: Mature or old growth conifer forest (structural stages 6 and 7) within 100m of
o cutblocks,</td></tr>
</table>

		○ roads, ○ water bodies, ○ natural openings and burnt areas • Wetlands in CWH and MHmm1 with age class 6 or 7 forest adjacent to the wetland • Area with canopy closure class 1-2 • Area with high presence of standing dead trees or snags
	2 (moderate) [25-75%]	• MHmmp Mature or old growth conifer forest (structural stages 6 and 7) within 100m of: ○ cutblocks, ○ roads, ○ water bodies, ○ natural openings and burnt areas • CWHwm and MHmm1 (SS 4 and 5) areas with: ○ Within 100m of waterbodies ○ only some presence of snags ○ Area with canopy closure class 3-4
	3 (low) [1-25%]	• CWHwm and MHmm1 Forested area with structural stage 4-5 and little or no snags • Area with canopy closure class 5-6
	4 (nil) [0%]	• CMAun • All forested sites >100m from an opening or water body • Vegetated areas in structural stages 1-3a • Area with canopy closure class 7 or greater

1.8 Habitat Ratings Adjustments

No habitat ratings adjustments were made to the Olive-sided Flycatcher model.

2.0 References

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Sooty Grouse (*Dendragapus fuliginosus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Sooty Grouse Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 2
1.2.3 Elevation Range 2
1.3 Study Area 3
1.4 Ecology and Key Habitat Requirements 7
1.4.1 Species Description 7
1.4.2 Breeding Ecology and Habitat 8
1.4.3 Foraging Ecology and Habitat 9
1.5 Habitat Use – Life Requisites and Seasons 9
1.6 Wildlife Habitat Ratings 11
1.7 Habitat Ratings Assumptions 12
1.8 Habitat Ratings Adjustments 13
2.0 References 14

LIST OF TABLES

Table 1. Taxonomic and status information for Sooty Grouse (*Dendragapus fuliginosus*) 1
Table 2. Biogeoclimatic zones and habitat types in British Columbia where Sooty Grouse are known to occur 2
Table 3. Study area administrative boundaries 3
Table 4. Study area physiographic setting 3
Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Sooty Grouse habitat within the LSA and RSA 4
Table 6. Life Requisites of the Sooty Grouse within the Project area rated by month and season 11
Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Sooty Grouse 11
Table 8. Summary of habitat requirements for Sooty Grouse by season and structural stage 12
Table 9 Sooty Grouse Winter living habitat assumptions table 12

1.0 Sooty Grouse Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Sooty Grouse (*Dendragapus fuliginosus*)

Sooty Grouse Species Data	
Identifier	***Description***
Common Name	Sooty Grouse
Common Name Synonym	Blue Grouse
Latin Name	*Dendragapus fuliginosus*
Species Code	B-SOGR
Global Status	G5
Provincial Status	T4
BC List	Yellow
Identified Wildlife	N/A
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 2
	Priority 5 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 3 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, the Sooty Grouse exists within North America and is found along the Pacific coast from southeast Alaska to northern California. It is also found along the Sierra Nevada Mountain Ranges of eastern California (Zwickel and Bendell 2005).

1.2.1 Provincial Distribution

The species, formerly known as the Blue Grouse (*Dendragapus obscurus*). Blue Grouse was reclassified in 2006 based on mitochondrial DNA analysis as well as behavioural and habitat differences to include two species: Dusky Grouse (*D. obscurus*) and Sooty Grouse (*D. fuliginosus*) (Starzomski 2015 in Davidson et al. 2015). There are two subspecies of Sooty Grouse that exist in British Columbia which include *D. f. sitkensis* and *D. f. fuliginosus* (Zwickel and Bendell 2005).

The species is a common resident in British Columbia, and is found in most areas along the coast, including Vancouver Island and Haida Gwaii, however it is less common at lower elevations; its distribution coincides with the mountains throughout its range. Distribution of the species is thought to be rare in the Lower Mainland due to lack of suitable remaining habitat. The species most commonly occurs along the Pacific slopes of the Coast and Cascade Mountains, but is rare to uncommon along the eastern slopes

where the occurrence is replaced by the closely related Dusky Grouse. In northern British Columbia and the Alaskan Panhandle the Sooty Grouse exists in small numbers along the western slopes and valleys of the Coast Mountains (Campbell et al. 1990).

The Sooty Grouse is known to reside within several habitat types and Biogeoclimatic Classification (BEC) Zones within British Columbia (Table 2) (BC Conservation Data Centre 2016), however it is thought that the core of the Sooty Grouse population in BC resides within the Coastal Western Hemlock BEC zone (Starzomski 2015 in Davidson et al. 2015).

Table 2. Biogeoclimatic zones and habitat types in British Columbia where Sooty Grouse are known to occur

Sooty Grouse Habitat	
BEC Zone	***Occurrence Status***
Coastal Douglas-fir (CDF)	Confident or certain
Coastal Mountain-heather Alpine (CMA)	Predicted or probable
Coastal Western Hemlock (CWH)	Confident or certain
Mountain Hemlock (MH)	Confident or certain
Habitat Type(Subtype)	***Dependence***
Agriculture (Cultivated Field / Hedgerow)	Occasional use
Alpine/Tundra (Krummholz)	Occasional use
Forest (Conifer Forest – Dry)	Occasional use
Forest (Conifer Forest – Mesic)	Frequent use
Forest (Conifer Forest – Moist/Wet)	Frequent use
Grassland/Shrub (Meadow/Logged/Natural)	Occasional use
Riparian (Riparian Forest)	Occasional use

Source: BC Conservation Data Centre (2016)

1.2.2 Study Area Distribution

Distribution mapping compiled by E-Fauna BC for *D. fuliginosus* shows four occurrences within the immediate vicinity (2 km) of Stewart, BC. Seventeen additional occurrence observations are mapped along the western border of British Columbia and Alaska within an area which extends 40 km to the north of Stewart, BC.

1.2.3 Elevation Range

Throughout the year the species is known to migrate in altitude, though some individuals remain relatively sedentary. Beginning in late summer, typically in August, and throughout the fall until approximately November, birds breeding in the lowlands as well as those breeding at alpine elevations will begin to migrate to their winter grounds at middle elevations where they will spend the winter alongside other Sooty Grouse that have bred at middle elevations. The birds will begin migrating back to their breeding territories around mid-winter, and most will reach their breeding grounds by late March or early April (Campbell et al. 1990). Point counts suggest that the grouse is most common below 750 m elevation, however the species has been observed up to 2,000 m (Starzomski 2015 in Davidson et al. 2015).

1.3 Study Area

Table 3. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 4. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Sooty Grouse habitat within the LSA and RSA

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFun	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/ ravel Bar
	00	CB	Cutbank
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
ICHvc	00	Ws	Swamp Wetland
	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification

Adult Sooty Grouse are generally 40 to 50 cm in length, with a mass in the range of 835 to 1,280 g.

The adult male Sooty Grouse has sooty-grey upperparts tinged with brown, and fine darker grey vermiculation. The tail is generally black or dark gray with pale grey tips forming a distinct pale grey band on the tail. The breast and underparts are dark grey, darker on the upper breast, and lack brown tinge. Side and flank feathers contain white shafts streaks, and are white-tipped. The head is dark-grey or blackish with the throat area being the darkest, and usually contains white flecking on the chin and throat. Large areas of yellow can be seen on each side of the neck when chambers are inflated upon male displaying behaviour. The yellow patches consist of warty, wrinkly bare skin surrounded by a large circular ruff of dark-tipped white feathers. Another identifying characteristic of the male sooty-grouse when displaying is orange-yellow or bright red combs above the eyes. The grouse has a short blackish bill, dark grey legs, and feet with yellow soles. The legs and toes have a dense covering of grayish-brown feathers.

The adult female has mottle upperparts in shades of brown, reddish-brown, grey, and black, and has narrow white tips and shaft streaks on the shoulders and some wing feathers. The flight feathers are black with brown mottling. The tail is mottled with alternating grey, blackish, and rusty-brown bands, and contains a pale grey terminal band. The breast is also mottled, but slightly paler than the upperparts, as is the belly, however belly feathers contain bold whitish tips, giving the underparts a white-spotted appearance. The head and neck are sooty grey-brown, with brownish mottling on the head and whitish spotting and mottling on the throat and fore-neck. Legs and feet as well as leg feathers are similar in colour to the male birds.

Juveniles appear very similar to the adult females, however many of the body feathers have diagnostic pale shaft areas, and the narrow pointed tail feathers have pale shaft streaks on the outer portions. The crowns generally have varying amounts of rusty-brown.

Distinguishing the Sooty Grouse from other grouse species is relatively simple with their habitat, as the only other grouse species that exists within most of their range is the Ruffed Grouse (*Bonasa umbellus*), which is easily identifiable due to its much smaller size, pronounced crest, and black sub-terminal band on the tail of the females. In some areas along the crest and eastern slopes of the Coast and Cascade Mountains, where the occurrence of Sooty Grouse is less common, the range can overlap with the Spruce Grouse (*Falcipennis canadensis*). The female Spruce Grouse are also much smaller, have a shorter neck, and tail which lacks the pale terminal band which distinguishes the female Sooty Grouse (Zwickel and Bendell 2005).

Vocalizations

The male's song can be heard at distances of 300 to 500 m, and consists of a series of six deep hoots which frequently increase in tempo slightly toward the end of the call. The males will sometimes give a single "whoot" call during courtship, and will produce a low growling sound during antagonistic encounters. The male's call is similar to that of the Dusky Grouse (*D. obscurus*), however the call of the Dusky Grouse consists of five, rather than six hoots, and is not as far-reaching (up to 50 m). Female Sooty Grouse can often be heard producing chicken-like clucking sounds throughout the year, and may produce a whinny during the breeding season (Zwickel and Bendell 2005).

General Habitat

The Sooty Grouse commonly occurs in brushy open areas within forested habitats, such as burns, clear-cuts, mountain meadows, and forest openings. It can also often be found along road sides. The species is closely associated with mature or second-growth coniferous forests throughout its range, including low elevation forests where the dominant tree species include Douglas-fir, Sitka Spruce, Western Hemlock, or Western Redcedar. The grouse can also be found at higher elevations in forests which are dominated by Amabilis Fir, Mountain Hemlock, and Yellow-cedar. During the summer, the grouse is known to inhabit open subalpine areas including parkland or meadows where there is little to no tree cover (Campbell et al. 1990; Zwickel and Bendell 2005).

1.4.2 Breeding Ecology and Habitat

Courtship

Sooty Grouse begin courtship activities in late winter and early spring and continue throughout April and early May. Males are known to mate with multiple females throughout the breeding season, however it is unknown if females mate with more than one male.

Nesting

Nests are constructed by the females in April or May, however this may occur earlier in lowland areas. Sooty Grouse females construct their nests on the ground within small depressions which are generally 17 to 23 cm across and 4 to 5 cm deep, and which are protected by some form of cover above, which may include grasses, shrubs, ferns, small trees, log, stumps, etc. Nest materials are gathered from the immediate vicinity of the nest location; the nest is lined with dry vegetation including grasses, leaves, moss, twigs, conifer needles, or bark, as well as some feathers.

The species generally produces a single brood. A clutch consisting of 4 to 8 eggs is generally laid in April or May, or sometimes earlier in lowland habitats. Occasionally, replacement clutches may be laid into June and July. Smooth, finely speckled pale pinkish or buff coloured eggs are incubated solely by the female, and generally have an incubation period of 25 to 28 days. Though eggs are present in BC between late April

and early August, few clutches are reported later than June (Campbell et al. 1990; Zwickel and Bendell 2005).

Chicks and Juveniles

Young leave the nest within the first day of hatching, and forage in family groups with the female (Starzomski 2015 in Davidson et al. 2015). They are able to feed themselves immediately upon hatching, however they require the protection of the mother for cover, and to provide direction to foraging areas. The young grow quickly, are able to take short flights within 6 to 7 days, and sustained flights at around 14 to 16 days of age. The female travels with the brood until late summer or fall (August or September) at which time the juveniles disperse and become independent (Campbell et al. 1990; Zwickel and Bendell 2005).

1.4.3 Foraging Ecology and Habitat

Most foraging occurs on the ground or in trees. Foraging within trees (arboreal foraging) is most important during the winter months when food on the ground is inaccessible due to the presence of snow.

Sooty Grouse diet consists of conifer needles (particularly *Tsuga heterophylla*) which are consumed most of the year, and form almost 100% of the diet in winter months. Other food sources include plant materials such as berries, fruits, seeds, leaves, buds, and flowers from a wide array of shrubs and forbs, as well as the tips of fern fronds, including Bracken Fern (*Pteridium aquilinum*) and Lady Fern (*Athyrium filix-femina*). During the breeding season, juveniles and some adults are known to consume insects such as ants and grasshoppers. In addition, the species regularly ingests gravel material to aid in digestion (Zwickel and Bendell 2005).

1.5 Habitat Use – Life Requisites and Seasons

Living habitat pertaining to the Life Requisites of the Sooty Grouse which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 6). Life Requisites include Living and Reproducing.

Living

The habitat requirements of the Sooty Grouse vary between seasons. In the winter the Sooty Grouse typically inhabits mature or second-growth coniferous forests, relying on conifer needles as a main food source. During the growing season the Sooty Grouse can be found in open subalpine areas including parkland or meadows where there is little to no tree cover, where their diet consists of forbs, berries, seeds, leaves, and insects.

Reproducing

Eggs are typically laid in April or May, sometimes earlier in lowland habitats. Occasionally, replacement clutches may be laid into June and July. Eggs are present in BC between late April and early August. Eggs hatch after an average 26 day incubation period, with an average fledgling period of 15 days. Breeding occurs in various habitats, though it is

generally within or adjacent to open subalpine areas such as meadows or parkland. Nests are constructed on the ground within small depressions, and are usually hidden by some form of cover.

Table 6. Life Requisites of the Sooty Grouse within the Project area rated by month and season

Sooty Grouse Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Living
February	Winter	Living
March	Winter	Living, Reproducing (eggs)
April	Growing (Early Spring)	Living, Reproducing (eggs)
May	Growing (Late Spring)	Living, Reproducing (eggs)
June	Growing (Summer)	Living, Reproducing (eggs)
July	Growing (Summer)	Living, Reproducing (eggs)
August	Growing (Summer)	Living
September	Growing (Fall)	Living
October	Growing (Fall)	Living
November	Winter	Living
December	Winter	Living

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.6 Wildlife Habitat Ratings

The TEM attributes for suitable Living and Reproducing (eggs) Life Requisites in relation to specific ecosystem attributes are summarized in Table 7.

Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Sooty Grouse

Sooty Grouse Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: site disturbance, structural stage, slope • Vegetation: % cover by layer, plant species, cover for species by layer
Reproducing (eggs) Habitat	• Site: site disturbance, structural stage, slope • Vegetation: % cover by layer, plant species, cover for species by layer

An intermediate level of knowledge exists on the habitat requirements for the Sooty Grouse, therefore a four-class rating scheme will be used.

The habitat requirements for the Sooty Grouse are summarized by season and structural stage in Table 8.

Table 8. Summary of habitat requirements for Sooty Grouse by season and structural stage

Sooty Grouse Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Conifer forests, forest openings, subalpine open areas, krummholz	2-7
Growing	Reproducing	Conifer forests, forest openings, subalpine open areas, krummholz	2-7
Winter	Living	Conifer forests	2-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

1.7 Habitat Ratings Assumptions

Living-Winter

- Alpine and Subalpine meadows during the winter season will be rated Nil (Class 4).
- Riparian areas and deciduous forests during the winter season will be rated Nil (Class 4).
- Mesic, mature, old growth forests on gentle to steep slopes with reasonable understory development rate up to High (Class 1) for living in winter.
- Young to old growth forests will be rated up to High (Class 1) for reproducing if forest has a moderate to high understory cover and canopy closure.

Reproducing-Growing

- Young to old growth forests, alpine and subalpine meadows, and krummholz during the growing season will be rated High (Class 1) for Reproducing.
- Riparian areas and deciduous forests during the growing season will be rated up to Moderate (Class 2) reproducing.
- Mesic, mature, old growth forests on gentle to steep slopes with reasonable understory development rate up to High (Class 1) for living.

Table 9 Sooty Grouse Winter living habitat assumptions table

Sooty Grouse (B-SOGR)	
General Habitat	Mature or old-growth forest with high canopy closure.
Living – Winter (LI-W)	Key Habitat Requirements
	• Mature or Old Growth coniferous forest. • High canopy Closure for snow interception and thermal cover • Some shrub understory development for forage

	Ratings	Assumptions
	1 (high) [75-100%]	• Old growth coniferous stands (Structural stage 7)
	2 (moderate) [25-75%]	• Mature Structural stage 6 coniferous stands
	3 (low) [1-25%]	• Younger coniferous forest (structural stages 4 or 5)
	4 (nil) [0%]	• CMAun • MHmmp • All deciduous forest

Table 9 Sooty Grouse Nesting Habitat Assumptions table

Sooty Grouse (B-SOGR)		
General Habitat	Sub-alpine and alpine habitat with a significant shrub component for hiding cover	
Reproducing -Eggs – Growing (RE-G)	Key Habitat Requirements	
	• Foraging habitat includes open meadows and shrub habitat • Nesting habitat is located within dense patches of shrub or krummholz	
	Ratings	Assumptions
	1 (high) [75-100%]	• CMAun and MHmmp and o Structural stage 2d –3b
	2 (moderate) [25-75%]	• MHmm1 with o Structural stage 2d –3b; or
	3 (low) [1-25%]	• Structural stage 6/7 forest • CWHwm structural stage 2 – 3a
	4 (nil) [0%]	• Structural stage 4 and 5 forests all elevations • All non-vegetated areas • All permanent snow, ice and glaciers

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

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Western Screech-Owl (*Megascops kennicottii kennicottii*) Species Account

Red Mountain Habitat Modelling

IDM Mining

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TABLE OF CONTENTS

1.0 Western Screech-Owl Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 3
1.4.1 Species Description 3
1.4.2 Breeding Ecology and Habitat 4
1.5 Habitat Use – Life Requisites and Seasons 4
1.6 Existing Habitat Models 5
1.7 Wildlife Habitat Ratings 5
1.8 Habitat Ratings Assumptions 6
1.9 Habitat Ratings Adjustments 7
2.0 References 8

LIST OF TABLES

Table 1. Taxonomic and status information for Western Screech-Owl (*Megascops kennicottii kennicottii*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with Western Screech-Owl habitat 3
Table 5. Monthly life requisites being rated for Western Screech-Owl in the Project area 5
Table 6. Summary of habitat attributes for Western Screech-Owl 5
Table 7. Relative suitability classes to be assigned to Western Screech-Owl habitat polygons 6

1.0 Western Screech-Owl Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Western Screech-Owl (*Megascops kennicottii kennicottii*)

Western Screech-Owl Species Data	
Identifier	***Description***
Common Name	Western Screech-Owl
Latin Name	*Megascops kennicottii kennicottii*
Species Code	B-WSOW
Global Status	G5T4
Provincial Status	S3
BC List	Blue
Identified Wildlife	N/A
SARA	1-SC
COSEWIC	Threatened
BC Conservation Framework	CF Highest Priority: 1
	Priority 3 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 1 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 2 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, Western Screech-Owl is non-migratory and occurs in western Canada and United States, and central Mexico. The range of the *kennicottii* subspecies stretches from coastal Alaska, through British Columbia, Washington, and Oregon (COSEWIC 2012).

1.2.1 Provincial Distribution

Two subspecies of Western Screech-Owl are known to Canada, both of which occur in British Columbia. *Megascops kennicottii macfarlanei* occurs entirely in the southern BC interior whereas *M. k. kennicottii* occurs on the coast and Vancouver Island but is notably absent from Haida Gwaii, and the few observations from there are considered unreliable (Campbell et al. 1990). In general, where the range of *M. k. kennicottii* extends inland, it generally follows fjords or river valleys (COSEWIC 2012).

1.2.2 Study Area Distribution

Specific occurrences of Western Screech-Owl within or near the Project area are not mapped. The closest mapped observations indicated on distribution mapping compiled by E-Fauna BC for this species occur on Vancouver Island and the Sunshine Coast. However the range map for Western Screech-Owl includes the Project area (COSEWIC 2012). This report will focus on *M. k. kennicottii* as the Project area is within the range of this subspecies. For the purpose of this report "Western Screech-Owl will refer to the

kennicotti subspecies unless otherwise specified. Western Screech-Owl is known to many forest types including the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic classification (BEC) zones, which occur within the Study area (BC Conservation Data Centre 2016). Within this zone, Western Screech-Owl generally prefers mixed forests near streams with trees large enough for nest cavities (COSEWIC 2012).

1.2.3 Elevation Range

Western Screech-Owl generally prefers low elevations below 600 m however the range map for Western Screech-Owl *kennicottii* in the COSEWIC Status Report (COSEWIC 2012) include only coastal areas below 300 m. Campbell et al. (1990) report no nests observed above 540 m. Observations for *M. k. macfarlanei* suggest they occupy habitat below 1,000 m (Cannings and Davis 2007).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with Western Screech-Owl habitat

BEC Zone/Subzone	Site Series	Map Code	Site Associations
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	Ws51	Ws51	Sitka willow – Pacific willow – Skunk cabbage
	Ws	Ws	Swamp Wetland
	Wb	Wb	Bog Wetland
	32	---	Non-forested fen/marsh

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Western Screech-Owl is a small owl up to 25 cm long (females are generally larger than males). It has ear tufts and yellow eyes. It is usually grey to brown however *M. k. kennicottii* may have a slight red colouration (COSEWIC 2012).

The Western Screech-Owl is nocturnal and feeds on a variety of small animals and insects. It is commonly hunted by other animals, including other owl species (COSEWIC 2012).

Nesting occurs in the spring and clutch size is typically 3 to 7 eggs (COSEWIC 2012) however most commonly 2 to 3 (Campbell et al. 1990). Fledging and dispersal occurs in mid- to late-summer (COSEWIC 2012) after 35 to 42 days (Campbell et al. 1990). Birds are sexually mature after the first year, however survival to adulthood is low (MOE 2013). Birds may live for over a decade, however more commonly less (COSEWIC 2012).

Foraging Habitat

Foraging habitat for *M. k. kennicottii* is not well studied, however *M. k. macfarlanei* forages near permanent water, typically streams, near the edge of its home range (MOE 2013). Urban areas may be used very infrequently for foraging. Home ranges for the interior subspecies vary with season and ranged from 20.4 ha during breeding to 88.6 ha outside of the breeding season (Davis and Weir 2008).

Roosting Habitat

Although roosting may occur in cavities, other roosting habitats are also important for Western Screech-Owl. Roosts mostly occur in large deciduous or coniferous trees, however conifers may be preferred by the coastal subspecies. Mature forests are preferred for roosting however young forests may also be used (COSEWIC 2012).

1.4.2 Breeding Ecology and Habitat

Nesting Habitat

Western Screech-Owl is a secondary cavity nester and prefers to nest in large deciduous trees (although coniferous trees will also be used), generally over 25 cm diameter at breast height (dbh), with either naturally occurring cavities or cavities created by other animals (often woodpeckers or Northern Flickers). Nest boxes will also frequently be used. Cavity nests range from 1.2 to 12.2 m above ground but generally between 3.0 and 4.6 m. Cavity openings are about 15 cm wide (Campbell et al. 1990). Nesting trees are typically located along streambanks (COSEWIC 2012) however nesting will also occur near bodies of standing water including marshes, bogs, and lakes (Campbell et al. 1990).

1.5 Habitat Use – Life Requisites and Seasons

Because Western Screech-Owls are residents, year-round habitat will be assessed for Food/Cover and for Reproducing-eggs (Table 5).

Table 5. Monthly life requisites being rated for Western Screech-Owl in the Project area

Month	*Season**	*Life Requisites*
January	Winter	Food/Cover
February	Winter	Food/Cover
March	Winter	Reproducing–Eggs
April	Spring	Reproducing–Eggs
May	Spring	Reproducing–Eggs
June	Summer	Reproducing–Eggs
July	Summer	Reproducing–Eggs
August	Summer	Reproducing–Eggs
September	Fall	Food/Cover
October	Fall	Food/Cover
November	Winter	Food/Cover
December	Winter	Food/Cover

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Existing Habitat Models

Jacques Whitford (2010) developed a habitat rating model for Western Screech-Owl for a proposed project in northern BC, and the wildlife habitat ratings for Western Screech-Owl developed for the Project closely follows their habitat rating model.

1.7 Wildlife Habitat Ratings

There is no Provincial benchmark for Western Screech-Owl habitat; therefore ratings are based on attributes found in literature. The attributes of suitable habitat for the life requisites Western Screech-Owl are shown in Table 6. A moderate amount of knowledge exists for the habitat requirements of Western Screech-Owl, therefore a four class rating scheme will be used (Table 7).

Table 6. Summary of habitat attributes for Western Screech-Owl

Habitat Use	*Attributes of Suitable Western Screech-Owl Habitat*	*Structural Stage[1]*
Food/Cover Reproducing-eggs	Mature or old-growth riparian forests near streams	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Table 7. Relative suitability classes to be assigned to Western Screech-Owl habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

1.8 Habitat Ratings Assumptions

The model only applies for CWH as the maximum elevation for this BEC zone is 600 m and Western Screech-Owl is unlikely to occur above that elevation. This model assumes a preference for mixed forests or coniferous forests with open canopy. Ratings assumptions for Food/Cover and Reproducing habitat include the following:

- Units with structural stage 1-4 will be rated Nil (Class 4).
- Mixed forest units with structural stage 5 will be rated Low (Class 3).
- Coniferous forests with structural stage 7 will be rated moderate (Class 2).
- Mixed forest units with structural stage 6-7 will be rated High (Class 1).

Table 8 Western Screech-Owl Habitat Assumptions table

<table>
<tr><td colspan="3">Western Screech-Owl (B-WSOW)</td></tr>
<tr><td>General Habitat</td><td colspan="2">Old growth Riparian and mixed forest with multi-layered canopy, canopy gaps and large diameter snags for nesting</td></tr>
<tr><td rowspan="4">Reproducing-Eggs – Growing (RE-G)</td><td colspan="2">Key Habitat Requirements</td></tr>
<tr><td colspan="2">Mature/old growth forests in close proximity to open riparian areas and fields for hunting:
Structural stage 7
Large diameter snags
High component of Black Cottonwood
Adjacent riparian areas or large openings for hunting</td></tr>
<tr><td>Ratings</td><td>Assumptions</td></tr>
<tr><td>1 (high) [76-100%]</td><td>Old growth (structural stage 7) Mixed Forests (>25% Deciduous): and
Within 200m of wetlands, lakes and rivers
Stands with age class 9 (>250 yrs)
Old Growth (Structural Stage 7) Black Cottonwood Riparian areas</td></tr>
</table>

	2 (moderate) [26-75%]	• Mature (structural stage 6) Mixed Forests (>25% Deciduous): and o Within 200m of wetlands, lakes and rivers o Stands with age classes 8 (>140 yrs) • Mature (Structural Stage 6) Black Cottonwood Riparian areas
	3 (Low) [1-25%]	• Mature and Old growth (structural stages 6 or 7) pure coniferous forests: and o Within 200m of wetlands, lakes and rivers o Stands with age class 9 (>250 yrs)
	4 (Nil) [0%]	• All forests in structural stage 5 or less • All non-vegetated areas

1.9 Habitat Ratings Adjustments

- Pure coniferous forest units with a closed canopy will be downgraded by one class.
- Pure deciduous forest units with open or closed canopy will be downgraded by one class.
- Forest units greater than 250 m from permanent water will be adjusted downward by two classes.

2.0 References

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White-tailed Ptarmigan (*Lagopus leucura*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 White-tailed Ptarmigan Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 2
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 4
1.4.1 Species Description 4
1.4.2 Breeding Ecology and Habitat 4
1.4.3 Feeding Ecology and Habitat 5
1.5 Habitat Use – Life Requisites and Seasons 6
1.6 Wildlife Habitat Ratings 6
1.7 Habitat Ratings Assumptions 7
1.8 Habitat Ratings Adjustments 7
2.0 References 8

LIST OF TABLES

Table 1. Taxonomic and status information for White-tailed Ptarmigan (*Lagopus leucura*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 3
Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with White-tailed Ptarmigan habitat. 3
Table 5. Life requisites of the White-tailed Ptarmigan within the Project area rated by month and season 6
Table 6. Summary of habitat attributes for White-tailed Ptarmigan reproduction 6
Table 7. Relative suitability classes to be assigned to White-tailed Ptarmigan habitat polygons 7

1.0 White-tailed Ptarmigan Species Account

1.1 Species Data

Table 1. Taxonomic and status information for White-tailed Ptarmigan (*Lagopus leucura*)

White-tailed Ptarmigan Species Data	
Identifier	***Description***
Common Name	White-tailed Ptarmigan
Latin Name	*Lagopus leucura*
Species Code	B-WTPT
Global Status	G5
Provincial Status	S5?
BC List	Yellow
Identified Wildlife	Yes
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 5
	Priority 5 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 6 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 6 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

1.2.1 Provincial Distribution

White-tailed Ptarmigan (*Lagopus leucura)* is a common year-round resident at high elevation alpine areas throughout the mainland of BC, from the Coast and Cascade Mountains east to the Rocky Mountains. It is uncommon at high elevations on Vancouver Island, and is absent from all other coastal islands (including Haida Gwaii). It is also absent from areas of the province that lack alpine habitats, such as much of the central interior and the northeastern lowlands east of the Rocky Mountains (Peace River area, Fort Nelson lowlands, etc.). Although it occurs year-round within its range, some individuals wander to lower elevations during the winter and can occasionally be found in areas that they would not normally inhabit (exceptionally as low as sea level along the coast) (Campbell et al. 1990 in Fenneman 2014). It occurs almost exclusively in rocky alpine tundra, alpine rockslides, talus, krummholz vegetation, and at the edges of glaciers and snowfields. Most of its habitat is remote from human disturbance, so it is still present in most of its original range.

There are five *Lagopus leucura* subspecies, two of which are found in BC: *Lagopus leucura leucura* (i.e., *Lagopus leucura)* and *Lagopus leucura saxatilis*. The former ranges

throughout the mainland portion of the species' range in BC; the latter is endemic to Vancouver Island (Martin et al. 2015).

1.2.2 Study Area Distribution

White-tailed Ptarmigan is a year-round resident in the northwest of British Colombia, and can be expected to inhabit areas within the Project Area that meet its habitat requirements.

1.2.3 Elevation Range

White-tailed Ptarmigan is found almost exclusively in high elevation alpine habitats (up to 4,054 m), but generally always above the tree line (Martin et al. 2015). It occasionally descends to lower elevations where it can be found in subalpine parkland or, rarely, below the treeline in high elevation coniferous forests, montane meadows, clearcuts, burns, or along lakeshores (especially in winter). While an exception, White-tailed Ptarmigan has been recorded in winter as low as sea level along the coast (Campbell et al. 1990 in Fenneman 2014).

These birds are primarily found at elevations of 1,200 to 2,700 m in British Columbia (lower along the coast and in northern BC where alpine habitats occur at lower elevations), sometimes descending as low as 500 to 900 m during the winter (Campbell et al. 1990; and Braun et al. 1993, in Fenneman 2014).

In BC, alpine tundra begins at elevations above 1,000 m in the northwest of British Columbia, above 1,400 m in the northeastern mountains, above 1,650 m in coastal areas, and above 2,500 m in the southern interior.

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Local Study area Biogeoclimatic Ecosystem Classification associated with White-tailed Ptarmigan habitat.

BEC Zone/Subzone	*Site Series*	*Map Code*	*Site Associations*
MHmmp	00	Am	Herbaceous Meadows
	00	Vs	Avalanche Chute
	00	Ah	Alpine Heath
	00	At	Alpine tundra
	00	Af	Alpine fellfield
	00	Sk	Shrub Krummholz
	00	Sc	Shrubland
	00	Vh	Avalanche Herb
	00	Rc	Rock Cliff
	00	Ro	Rock Outcrop
	00	Rt	Rock Talus
	00	Pk	Parkland Forest
CMAun	00	Am	Herbaceous Meadows
	00	Vs	Avalanche Chute
	00	Ah	Alpine Heath
	00	At	Alpine tundra
	00	Af	Alpine fellfield
	00	Sk	Shrub Krummholz
	00	Sc	Shrubland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Breeding males and females undergo continual moult from spring to fall, therefore "breeding plumage" is merely the stage of moult that corresponds with the breeding season (May to June). Transitional plumage is a patchwork of white and brown in April to May as birds begin to acquire dark-barred brown feathers of summer. Following the peak breeding season, birds gradually acquire white winter plumage between June and October.

White-tailed Ptarmigan is distinguished from the two other ptarmigan species in BC (Willow Ptarmigan and Rock Ptarmigan) as being the smallest of the three, and having white tail feathers (Sibley 2000; Martin et al. 2015). Additionally, White-tailed Ptarmigan generally occupies elevations that are above those that are used by the other two species of ptarmigan, and is particularly fond of rocky or stony substrates.

1.4.2 Breeding Ecology and Habitat

White-tailed Ptarmigan nests in alpine tundra, in rocky areas or sparsely vegetated, grassy slopes, as well as in areas of willow shrubs with subshrub, moss, and boulder cover. Birds tend to search for vacant territory in their natal area, and exhibit a high fidelity to breeding territory in successive years (Frederick and Gutierrez 1992).

Nests are constructed by the female and consists of little more than a shallow scrape on the ground (13 to 15 cm wide and 3 to 4 cm deep) that is lined with dried vegetation, moss, needles, and a few body feathers. The nest is typically situated in open, often rocky terrain or in brushy willow or krummholz vegetation and is usually at least partially concealed by overhead vegetation (Campbell et al. 1990; Martin et al. 2015).

A single clutch of 4 to 7 eggs is laid between mid-May and early July (variable, depending on latitude and local snow conditions) and is incubated by the female alone for 22 to 26 days before hatching. The smooth, slightly glossy eggs are pale buff to pinkish-buff with sparse but regular reddish-brown or dark brown speckling. Eggs are present in BC between mid-May and late July.

The young are downy and fully precocial and leave the nest within 6 to 12 hours of hatching. The chicks are mottled brown on the upperparts and are greyish-white on the underparts. The chicks follow closely behind the parents when young and are regularly brooded by the female, particularly during inclement weather. The young are able to feed themselves within one day of hatching and are not fed by the female (although she does direct them to sources of food). The young are able to fly weakly at approximately 10 days of age, and remain together as a family group throughout the first winter (dispersing the following spring). Family groups that include young chicks have been observed in BC between late June and mid-September (Campbell et al. 1990;

Braun et al. 1993; Baicich and Harrison 1997; and Madge and McGowan 2002, in Fenneman 2014).

Brooding hens in Sierra Nevada show preference to moist meadows, and flocks prefer the artic willow (*Salix anglorum*) vegetation alliance on rocky, north-facing slopes; willow abundance and proximity to water were important habitat factors (Frederick and Gutierrez 1992).

1.4.3 Feeding Ecology and Habitat

This species forages exclusively on the ground, where it picks food from the surface of the soil and rocks, or browses on low shrubs and herbaceous vegetation. It consumes the buds, leaves, stems, seeds, fruits, catkins, and flowers of a wide variety of shrubs, grasses, and forbs, and also consumes insects during the breeding season. White-tailed Ptarmigan shows a particular fondness for willow, and its winter diet is composed largely of willow buds; the buds of birch and alder are also consumed in areas where willow is absent. These buds are often available, even at the highest elevations, in windswept areas where the shrubby vegetation beneath the snow is exposed throughout the winter. Foraging birds occur singly or in pairs during the breeding season, but aggregate into small to medium-sized flocks of up to 35 individuals during the winter. When not foraging, winter flocks sometimes roost in burrows beneath the snow (Braun et al. 1993; Madge and McGowan 2002, in Fenneman 2014; and Martin et al 2015).

1.5 Habitat Use – Life Requisites and Seasons

White-tailed Ptarmigan are year-round residents within the LSA, however, habitat will be assessed for Food/Cover and for Reproducing-Eggs (Table 4-101) during the breeding season.

Table 5. Life requisites of the White-tailed Ptarmigan within the Project area rated by month and season

White-tailed Ptarmigan Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Living
February	Winter	Living
March	Winter	Living
April	Growing (Early Spring)	Living,
May	Growing (Late Spring)	Living, Reproducing (eggs)
June	Growing (Summer)	Living, Reproducing (eggs)
July	Growing (Summer)	Living, Reproducing (eggs)
August	Growing (Summer)	Living, Reproducing (eggs)
September	Growing (Fall)	Living, Reproducing (eggs)
October	Growing (Fall)	Living
November	Winter	Living
December	Winter	Living

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Wildlife Habitat Ratings

The attributes of suitable breeding habitat for White-tailed Ptarmigan are summarized in Table 6. An intermediate level of knowledge exists on the breeding habitat for this species, therefore we will follow the four-class rating scheme (Table 7).

Table 6. Summary of habitat attributes for White-tailed Ptarmigan reproduction

Habitat Use	***Attributes of Suitable Great Blue Heron Habitat***	***Structural Stage1***
Living	Alpine tundra, rocky areas, or sparsely vegetated, grassy slopes, brushy willow, or krummholz vegetation	1-3a,b

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 7. Relative suitability classes to be assigned to White-tailed Ptarmigan habitat polygons

Class	*Suitability*	*% of Polygon Area with Habitat Feature Present*	*Relative Quality*
1	High	76-100	Equivalent
2	Moderate	26-75	Moderately less
3	Low	1-25	Substantially less
4	Nil	0	Habitat or attribute is absent

Source: RIC (1999)

1.7 Habitat Ratings Assumptions

Rating assumptions for Reproduction Habitat

- Alpine habitat with arctic willow vegetation associations is rated Class 1.
- Areas with low shrub and herbaceous vegetation, providing buds, leaves, stems, seeds, fruits, catkins, and flowers of a wide variety of shrubs, grasses, forbs, and also insects during the breeding season are rated Class 1.

1.8 Habitat Ratings Adjustments

No ratings adjustments were conducted at this time.

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Moose (*Alces americanus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Moose Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 5
1.4.1 Species Description 5
1.5 Habitat Use – Life Requisites and Seasons 6
1.6 Wildlife Habitat Ratings 7
1.6.1 Existing Habitat Models 7
1.6.2 Habitat Model for the Project 8
1.7 Habitat Ratings Assumptions 11
1.8 Habitat Ratings Adjustments 11
2.0 References 12

LIST OF TABLES

Table 1. Taxonomic and status information for Moose (*Alces americanus*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Moose habitat 3
Table 5. Life Requisites of the Moose within the Project area rated by month and season 8
Table 6. Provincial Benchmark habitat for Moose 8
Table 7. Summary of general habitat requirements for Moose 9
Table 8. Terrestrial Ecosystem Mapping (TEM) attributes for Moose life requisites 9
Table 9. Relative suitability classes to be assigned to Moose habitat polygons 9
Table 10. Habitat ratings assumptions for Moose Living during growing (LI-G) 10
Table 11. Habitat ratings assumptions for Moose Living during winter (LI-w) 10

1.0 Moose Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Moose (*Alces americanus*)

Moose Species Data[1]	
Identifier	***Description***
Common Name	Moose
Latin Name	*Alces americanus*
Latin Name Synonym	*Alces alces*
Species Code	A-ALAM
Global Status	G5
Provincial Status	S5
BC List	Yellow
Identified Wildlife	N/A
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 6
	Priority 6 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 6 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 6 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

1.2.1 Provincial Distribution

Moose is a Holarctic species and is known to much of Scandinavia, Eurasia, and North America (Rea and Child 2007). In North America it are common across most of Canada and Alaska. In the contiguous United States its range extends south along the Rocky Mountains, and into some northern states near the Great Lakes and east coast (Burt and Grossenheider 1976). The distribution of Moose covers almost all of BC with the exception of only the coast, Vancouver Island, and Haida Gwaii (Eder and Pattie 2001). It is most abundant in the Central Interior and Northern Interior and is generally uncommon or absent in the dry, Southern Interior (MELP 2000).

1.2.2 Study Area Distribution

Specific occurrences of the Moose within or near the Project area are not mapped on distribution mapping compiled by E-Fauna BC, however this species is known to reside throughout most of British Columbia (Eder and Pattie 2001). Within this zone, Moose are associated with forested areas, particularly early seral stages and wetlands which provide abundant browse, however they often move to higher elevations for summer foraging. Moose is known to the Coastal Western Hemlock (CWH) and Mountain Hemlock

(MH) biogeoclimatic classification (BEC) zones, which occur within the Study area, however they are sporadic (Rea and Child 2007).

1.2.3 Elevation Range

Depending on season, Moose can inhabit a range of elevations from low elevation valley bottoms to alpine. A study of Moose in the Nass Valley (near the Project area) observed Moose occupying elevations between 200 and 1,500 m (Demarchi 2003).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Moose habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	Sk	Sk	Shrub krummolz
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1			
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification and General Ecology

The largest members of the deer (Cervidae) family, Moose are identifiable by their overall size, humped shoulders, downturned top lip, and distinctive dewlap under the throat. This species exhibits sexual dimorphism and only males produce antlers which may reach almost 2 m from tip to tip. Antlers are different from other Cervids and are more flattened with less defined prongs, which give antlers more of a scoop shape. Antlers grow during the spring and are shed between late fall and early spring (Rea and Child 2007). Males are also larger than females and may reach over 2 m tall and up to 700 kg (Burt and Grossenheider 1976). Moose of both sexes are shades of brown but may take on a grey appearance in the winter, often the result of rubbing off guard hairs in an effort to reduce

irritation from biting ticks (Eder and Pattie 2001). The tall legs allow for Moose to reach high browse and travel efficiently through deep snow, swamps, and other rough terrain. Moose are also excellent swimmers. Natural predators include Grizzly (*Ursus arctos*) and American Black Bears (*Ursus americanus*), which commonly predate on calves, and Grey Wolves (*Canis lupus*) which more commonly hunt adults (Rea and Child 2007).

Three subspecies of Moose are known to British Columbia which are distinguished through morphology and distribution, however genetic differences are controversial. The Shiras moose (*Alces americanus shirasi*) is found in the southwestern area of the province and is the smallest of the subspecies. The Alaska Moose (*A. a. gigas*) is the largest subspecies and is found in Alaska and the Yukon. The Northwestern Moose (*A. a. andersonii*) is found in the remaining areas of the province (Innes 2010; Shackelton 2013). The Northwestern Moose is the subspecies known to occur in the RSA and may potentially occur within the LSA as well.

Breeding

Males begin growing antlers in the spring which are used during the fall breeding rut to intimidate and spar with other males for mates. Antlers grow back larger over successive seasons. Males are sexually mature at two years but are often incapable of competing with larger males for mates until older (Rea and Child 2007).

Females are sometimes sexually mature as yearlings but will usually breed at two years old and usually produce only one or two calves during their life (average 7 to 8 years). During the rut, females produce a long call that travels several kilometres to attract mates. After a gestation period of about 230 days, cows give birth in the early summer. Normally one calf is produced, although twins are not uncommon in productive areas. Prior to giving birth, females chase away the previous year's calf, if still present. Calves are normally weaned before winter and for the first year are heavily reliant on their mother for protection (Rea and Child 2007).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of Moose which spans all months/seasons has been rated according to RIC Standards (RIC 1999) within the Project area (Table 5). The life requisite for "Living" includes three major components: Food, Security, and Thermal habitat.

Moose Feeding, Security, and Thermal habitat are closely linked to each other. Early seral areas with an abundance of shrubs and grassy vegetation are important sources of forage, however treed areas are also important for security and thermal cover. Forests provide cover from predators as well as thermal protection from summer heat, and winter snow. For this reason, riparian areas, forest edges of cutblocks, linear developments, or burns are commonly exploited as they provide both food from the regenerating shrubs, and the ability to seek thermal cover and protection from predators (Rea and Child 2007).

Seasonally, habitat selection is largely determined by snow which in turn dictates available shrub and grassy forage. Moose are adapted to moving through deep snow and will stay at high elevation summer forage areas later than other ungulates. However heavy snow during winter eventually restricts Moose movement and drives them to low elevation river valleys where snow pack is shallower and temperatures are warmer. Here, Moose select for areas with abundant shrubby vegetation such as wetlands, burns, and avalanche tracks to browse on willows (*Salix* spp.), Red-osier Dogwood (*Cornus stolonifera*), Black Cottonwood (*Populus balsamifera*), and other shrubs. In the summer months, most (particularly pregnant cows) follow the melting snow to higher elevations where they seek out aquatic vegetation in swamps and ponds to replenish minerals, especially sodium (Belovsky and Jordan 1981). Summer forage includes leaves of riparian shrubs and aquatic plants such as Horsetail (*Equisetum* spp.), sedges, and others (MELP 2000; Wall et al. 2011). High elevation summer foraging areas may be less productive than lower elevation areas and Moose appear to trade-off increased security from predators (in the form of tree and shrub cover, and distance to open water) at the expense of reduced quality forage. However some Moose choose to stay at lower elevations where forage abundance and quality is greater, however the risk of predation is higher. Moose at lower elevations will choose habitats that are more open, but the distance to open water is reduced, to increase ability to see predators and use the open water as escape terrain (Rea and Child 2007).

1.6 Wildlife Habitat Ratings

1.6.1 Existing Habitat Models

Several habitat models have been created for projects and research in northern BC. Since there is a detailed level of knowledge on Moose habitat requirements, the models use a 6-class rating system and rate habitat for Food and Security/Thermal life requisites, however they differ in the seasons modelled. EBA (2002) modelled Food and Security/Thermal habitat year-round, grouped into two seasons: Summer (Growing) and Winter. Jacques Whitford AXYS (2010) only modelled winter habitat as it was considered limiting. For a nearby mining project near Stewart, BC, Rescan (2013) considered winter habitat to be the most critical, but divided the season into Early and Late Winter. These seasons did not necessarily correspond to specific dates, instead Early Winter was considered to be the time in winter before snow is deep enough to restrict Moose movement whereas Late Winter was the time when the snow pack has become deep enough to restrict Moose movement and drive them to lower elevations where snow is shallower.

Provincial benchmark habitat for Moose is available and is shown in Table 6. The attributes for suitable Feeding and Security/Thermal Life Requisites in relation to specific ecosystem attributes are summarized in Table 7.

1.6.2 Habitat Model for the Project

For the purposes of the Project, living (forage, security and thermal) habitat will be rated for two seasons: Growing and Winter.

Table 5. Life Requisites of the Moose within the Project area rated by month and season

Moose Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Living (Feeding, Security/Thermal)
February	Winter	Living (Feeding, Security/Thermal)
March	Winter	Living (Feeding, Security/Thermal)
April	Growing (Spring)	Living (Feeding, Security/Thermal)
May	Growing (Spring)	Living (Feeding, Security/Thermal)
June	Growing (Summer)	Living (Feeding, Security/Thermal)
July	Growing (Summer)	Living (Feeding, Security/Thermal)
August	Growing (Summer)	Living (Feeding, Security/Thermal)
September	Growing (Fall)	Living (Feeding, Security/Thermal)
October	Growing (Fall)	Living (Feeding, Security/Thermal)
November	Winter	Living (Feeding, Security/Thermal)
December	Winter	Living (Feeding, Security/Thermal)

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Table 6. Provincial Benchmark habitat for Moose

Season	***Ecoprovince***	***Unit***	***BGC Subzone***	***Rating***
Growing	Boreal Plains	PEL	BWBSmw PR/1 – White Spruce-Balsam Poplar Riparian	B
Winter	Boreal Plains	PEL	BWBSmw BA/1 – Boreal White Spruce-Trembling Aspen	B
Growing	Coast and Mountains	NAB	ICHmc PR/1 – White Spruce-Balsam Poplar Riparian	3
Winter	Coast and Mountains	NAB	ICHmc BA/1 – Boreal White Spruce-Trembling Aspen	3

Source: Appendix H of BC Wildlife Habitat Ratings Standards (RIC 1999). Benchmarks are shown for each season. B = best overall benchmark habitat for the province.

Table 7. Summary of general habitat requirements for Moose

Habitat Use	*Attributes of Suitable Moose Habitat*	*Structural Stage[1]*
Feeding (Growing)	Low to high elevation riparian, herb/shrub-dominated shallow water wetlands that can be temporary or permanent; shrubby burns, or clearcuts in younger age classes	2-3
Thermal (Growing)	Forested areas for thermal protection; more mature forests with denser canopy are preferred	4-7
Security (Growing)	Dense Young to Mature forest providing visual cover. Open water in close proximity to forested areas.	3b-7
Feeding (Winter)	Low elevation riparian, herb-dominated shallow water wetlands that can be temporary or permanent; shrubby burns, clearcuts or avalanche chutes	2-3
Thermal (Winter)	Dense, mature forests for snow interception which provides thermal protection and security	6-7
Security (Winter)	Dense young to mature stands providing visual cover. Broken and varied terrain including ridges and gullies that prevent line of sight.	4-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80 years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

Table 8. Terrestrial Ecosystem Mapping (TEM) attributes for Moose life requisites

Life Requisite	*TEM Attribute*
Food Habitat	• Site: site disturbance, elevation, slope, aspect, structural stage • Vegetation: Percent cover by layer, species list by layer, cover for each species for each layer
Security Habitat	• Site: elevation, slope, aspect, structural stage • Vegetation: total percent cover, percent cover by layer • Mensuration: tree species, diameter at breast height, height
Thermal Habitat	• Site: elevation, slope, aspect, structural stage • Vegetation: total percent cover, percent cover by layer • Mensuration: tree species, diameter at breast height, height

Habitat ratings for the Project LSA will be based on a rating relative to the provincial benchmark (Table 6) for the Coast and Mountains Nass Basin (NAB). Detailed information on Moose habitat requirements is available, therefore a 6-class rating scheme is used (**Error! Not a valid bookmark self-reference.**9).

Table 9. Relative suitability classes to be assigned to Moose habitat polygons

Class	*Suitability*	*Lower Limit (%)*	*Upper Limit (%)*	*Relative Quality*
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

Table 10. Habitat ratings assumptions for Moose Living during growing (LI-G)

Class	*Rating*	*Assumptions*
1	High	• CWHwm, ICHvc and MHmm1 & 2 in structural stages 3 with: o All slopes up to 80% o All aspects • Floodplains, productive benches, and riparian habitat • All wetlands
2	Moderately High	• CWHwm and ICHvc in structural stages 4 to 7 with: o All slopes up to 80% o All aspects
3	Moderate	• MHmm1 and 2 in structural stages 4 to 7 with: o All slopes up to 80% o All aspects
4	Low	• MHmmp tree patches in structural stage 3-7 o All slopes up to 80% o All aspects
5	Very Low	• CMAun structural stage 2 or 3
6	Nil	• All non-vegetated areas • Areas with permanent ice and snow (glaciers)

Table 11. Habitat ratings assumptions for Moose Living during winter (LI-w)

Class	*Rating*	*Assumptions*
1	High	• CWHwm and ICHvc: o <600 m elevation o structural stages 6-7 o Canopy closure classes 6 to 9 (>60%) o All slopes up to 60% o Warm aspect (135°-285°) • Floodplains, productive benches, and riparian habitat below 600 m elevation • Disturbed sites (clearcuts and regenerating burns) within 100 m of structural stage 6-7 (mature and old growth forest)
2	Moderately High	• CWHwm and ICHvc (<600 m) in structural stages 2 to 3 with: o All slopes up to 60% o Warm aspect (135°-285°)
3	Moderate	• CWHwm and ICHvc (< 600 m) with: o All structural stages o Cool aspects (285°-135°)
4	Low	• CWHwm, ICHvc and MHmm1 & 2 (<600 m elevation) o All slopes up to 60% o Warm aspects (135°-285°)
5	Very Low	• CWHwm, ICHvc and MHmm1 & 2 (<600 m elevation) o All slopes up to 60% o Cool aspects (285°-135°)
6	Nil	• All non-vegetated areas • All habitat above 600 m • All slopes >60% • Areas with permanent ice and snow (glaciers)

1.7 Habitat Ratings Assumptions

- Feeding habitat is the dominant representation for habitat suitability ratings for both winter and growing seasons.
- Floodplains, productive benches, and riparian habitat will be rated highest (Class 1).
- Wetlands, avalanche chutes, cutblocks, and regenerating burns with high shrub cover will be rated Class 1.
- Snow interception is the most important vegetation structure characteristic for winter habitat. Structural stages 6 and 7 will be rated highest (Class 1).

1.8 Habitat Ratings Adjustments

Final habitat suitability mapping may require adjustment for:

- Proximity to anthropogenic disturbances (roads, settlements, industrial activities) which may result in a downgrading of the suitability rating by one class.

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Wolverine (*Gulo gulo luscus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Wolverine Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 2
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 7
1.4.1 Species Description 7
1.4.2 Habitat and Feeding 7
1.5 Habitat Use – Life Requisites and Seasons 8
1.5.1 Existing Habitat Models 8
1.6 Wildlife Habitat Ratings 9
1.7 Habitat Ratings Assumptions 9
1.8 Habitat Ratings Adjustments 10
2.0 References 11

LIST OF TABLES

Table 1. Taxonomic and status information for Wolverine (*Gulo gulo luscus*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 3
Table 4. Study area Biogeoclimatic Ecosystem Classification 3
Table 5. Monthly life requisites for Wolverine near Stewart, BC 8
Table 6. Summary of habitat attributes for Wolverine reproduction 9
Table 7. Cross reference for HSI values with respect to habitat ratings classes 9
Table 8. Habitat variables ratings table for Wolverine 9

1.0 Wolverine Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Wolverine (*Gulo gulo luscus*)

Wolverine Species Data	
Identifier	***Description***
Common Name	Wolverine
Latin Name	*Gulo gulo luscus*
Species Code	M-GUGU-LU
Global Status	G4T4
Provincial Status	S3
BC List	Blue
Identified Wildlife	Y
SARA	N/A
COSEWIC	Special concern
BC Conservation Framework	CF Highest Priority: 2
	Priority 3 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 3 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, Wolverines have a Holarctic distribution which spans North America, Eurasia, and Scandinavia. Within North America they have been extirpated from much of their southern range, especially in the northeastern United States although the range extends south along the Rocky Mountains into Colorado and there are isolated populations in Oregon and California. In Canada they are present across almost all of British Columbia, Yukon, Northwest Territories, and Nunavut. They are present in northern Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Labrador. Two subspecies are known to Canada: *Gulo gulo luscus*, which occurs throughout most of the range, and *G. g. vancouverensis* which occurs only on Vancouver Island (COSEWIC 2003).

1.2.1 Provincial Distribution

Wolverines are present in most of British Columbia. Historically they were present in the Lower Mainland and Sunshine Coast but have now been extirpated. There have been no recent observations of *G. g. vancouverensis* on Vancouver Island and this subspecies may be extirpated. They are not found on Haida Gwaii. In British Columbia the highest densities of Wolverines occur in the north and Rocky Mountains (COSEWIC 2003).

1.2.2 Study Area Distribution

No specific occurrences of Wolverine are available through E-Fauna BC (BC Conservation Data Centre 2016). However the range map for Wolverine includes the Project area (COSEWIC 2014). This report will focus on *G. g. luscus* as the Project area is within the range of this subspecies. (For the purpose of this report "Wolverine" will refer to the *luscus* subspecies unless otherwise specified). Wolverines are known to the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and CMA (Coastal Mountain-heather Alpine) biogeoclimatic classification (BEC) zones, which occur within the Study area (BC Conservation Data Centre 2016). Wolverines are habitat generalists and will inhabit most areas where an adequate supply of food, particularly large ungulates, is present (COSEWIC 2003).

1.2.3 Elevation Range

Wolverines are found at all elevations. In general, habitat use varies by season and wolverines are more likely to occupy lower elevations during winter. Adult females occupy higher elevations (potentially to protect young). In some areas where large ungulate populations are present in mountains, wolverines may be very abundant as they follow prey to these higher elevation summer foraging areas (COSEWIC 2003).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield

BEC Zone/Subzone	***Site Series Code***	***Map Code***	***Site Associations***
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood

BEC Zone/Subzone	***Site Series Code***	***Map Code***	***Site Associations***
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern

BEC Zone/Subzone	***Site Series Code***	***Map Code***	***Site Associations***
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	PD	Pond
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Wolverines are the largest terrestrial member of the weasel family in North America. They are stocky and powerfully built which allows them to hunt and scavenge a wide variety of prey items. They have long fur which may be brown to black and a light stripe along the sides often extending across the face and rump. Males are larger (12 to 16 kg) than females (7.5 to 11 kg; COSEWIC 2003).

Wolverines mate in the late summer and kits are normally born in February or March. Due to delayed implantation of embryos, the actual pregnancy is thought to be only 30 to 40 days (Hatler and Beal 2003). Wolverines are sexually mature at about two years. Pregnancy rate and litter size have opposite relationships with age: pregnancy rate is highest in young females, but litter size is highest in those over age 6. Combined these factors contribute to a low overall reproductive rate (COSEWIC 2003; Persson et al. 2006).

Most large mammalian carnivores and also Golden Eagles (*Aquila chrysaetos*) feed on Wolverines, often as Wolverines attempt to scavenge food. However almost half of mortalities are due to human causes (trapping, road mortality). Where trapping occurs, population growth may be negative, indicating the importance of recruitment from surrounding areas to maintain local population viability (COSEWIC 2003).

1.4.2 Habitat and Feeding

Wolverine range and habitat is strongly related to the availability of prey species and they will be in the highest densities where their prey is abundant, although areas used by humans for recreation or resource extraction may be avoided (Krebs et al. 2007). Wolverines are opportunistic feeders and will scavenge or hunt for a wide variety of prey, from rodents to small ungulates. Large ungulates including Mountain Goat (*Oreamnos americanus*), Moose (*Alces americanus*), Caribou (*Rangifer tarandus*), Elk (*Cervus elaphus*) and other species are mostly scavenged. Hoary Marmot (*Marmota caligata*) is also commonly hunted. Cannibalism by other Wolverines also occurs. Hunting is more common in the summer whereas scavenging is more common during winter. Wolverines may also cache food for winter months (COSEWIC 2003).

Aside from the presence of adequate prey, habitat is also determined by suitable reproductive denning sites. Dens are divided into two types: natal dens which are used for birth, and maternal dens which are used after birth has occurred but before kits have weaned. Natal and maternal dens may be associated spatially and may be reused in

subsequent years (Magoun and Copeland 1998). Den characteristics are variable however they may be located in snow drifts, talus slopes, or deadfall (COSEWIC 2003); in general they are located at high elevations under at least 1 m of snow. Natal dens often have a single 25 to 35 cm opening (although some dens may have several) which often drops steeply at first then continues slowly descending to a depth of up to 2.4 m under the snow pack. Dens may be between 14 and 35 m long, often with several side tunnels. Maternal dens may be located from several hundred metres to several kilometres from the natal den. Maternal dens may take advantage of natural crevices or chambers under snow formed by boulders, caves, trees, logs, or meltwater. They may form a complex of several dens hundreds of metres apart or be a single large den with many entrances. Multiple maternal dens may be used in a single season (Magoun and Copeland 1998).

1.5 Habitat Use – Life Requisites and Seasons

Following Tripp et al. (1999) two seasons were rated for the Wolverine: Growing and Winter. Life requisites for each month are outlined in Table 5.

Table 5. Monthly life requisites for Wolverine near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Feeding
February	Winter	Feeding Reproducing (birthing)
March	Winter	Feeding Reproducing (birthing)
April	Growing	Feeding Reproducing (birthing)
May	Growing	Feeding Reproducing (birthing)
June	Growing	Feeding Reproducing (birthing)
July	Growing	Feeding
August	Growing	Feeding
September	Growing	Feeding
October	Growing	Feeding
November	Winter	Feeding
December	Winter	Feeding

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.5.1 Existing Habitat Models

Habitat suitability mapping for Wolverine is difficult due to the variety of terrain and environments they inhabit. Lofroth and Krebs (2007) developed a habitat suitability model to estimate Wolverine population in British Columbia. This model incorporates abundance of dominant prey species (Moose, Caribou, Elk, Mountain Goat, and Hoary Marmot), abundance of denning habitat, and road density to produce a five class rating

scheme to predict Wolverine abundance (nil, rare, low, moderate, high). This model was the basis for Wolverine habitat suitability mapping for the Project.

1.6 Wildlife Habitat Ratings

The attributes of suitable habitat for Wolverine are summarized in Table 6.

Table 6. Summary of habitat attributes for Wolverine reproduction.

Habitat Use	*Attributes of Suitable Wolverine Habitat*	*Structural Stage*[1]
Living	High elevation habitat with abundant prey	**1-7**
Reproducing (birthing)	High elevation with deep snow pack at or just below the tree line	**1-7**

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Wildlife habitat ratings will be based on the following habitat suitability model:

HSI = Food + Den + Road

Where Food = prey availability; Den = denning and rearing habitat; and Road = road density.

1.7 Habitat Ratings Assumptions

A four-class rating scheme was used for Wolverines (Table 7) adapted from the five-class rating scheme by Lofroth and Krebs (2007). Habitat variables are described in Table 8.

Table 7. Cross reference for HSI values with respect to habitat ratings classes

Overall Score	*Class*	*Interpretation*
0	Nil	Unsuitable. Habitat fails to provide minimum requirements and wolverines are not present.
1-6	Low	Wolverines are uncommon or are present but in low abundance. Normally associated with areas that have low ungulate abundance, are disturbed by human activity, and/or have unsuitable denning habitat.
7-12	Moderate	Good wolverine habitat but at least one of the variables (Food, Den, or Road) is suboptimal.
12+	High	Optimal wolverine habitat with abundant prey and den sites with little human disturbance.

Table 8. Habitat variables ratings table for Wolverine

Mapping Attribute	*Variable*	*Value*	*Score*
Food	% of area with moderate or high moose abundance (>10/100 km^2)	0-20	1
		21-40	2
		41-60	3

			61-80	4
			81-100	5
	% of area with moderate or high caribou abundance (>4/100 km^2)		0-5	0
			6-25	2
			26+	4
	% of area with moderate or high elk abundance (>10/100 km^2)		0-5	0
			6-25	2
			26+	4
	% of area with moderate or high goat abundance (>7.7/100 km^2)		0-5	0
			6-25	2
			26+	4
	# of other ungulate species in high abundance in ≥10% of the area: mule and white-tailed deer (>500/100 km^2); bighorn and thinhorn sheep (>7.7/100 km^2)		Tally	0-2
	Hoary marmot abundance habitat (% of alpine tundra)		0-5	0
			6-15	0.33
			16-30	0.66
			30+	1
Den	% of alpine tundra		0-5	0
			6-15	1
			16-30	2
			30+	3
	Maximum % of:	Englemann spruce, subalpine fir, mountain hemlock, spruce will birch in area	0-5	0
			6-15	1
			16-30	2
			30+	3
		Persistent April snow cover	Yes	1.5
Road	Road density (km/km^2)		0	0
			0.1-1	0
			1.1-2	0
			2.1-3	-2
			>3	-5

Reproduced from Lofroth and Krebs (2007).

1.8 Habitat Ratings Adjustments

- Only Mountain Goat sign was observed during ground surveys of Project area therefore other ungulate species will be given an HSI value of 0 or 1 (as applicable).
- Hoary Marmots, White-tailed Ptarmigan and Sooty Grouse are the only other significant prey species within the LSA.
- Aspect is not rated.

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American Marten (*Martes americana*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 American Marten Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 1
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 5
1.4.1 Species Description 5
1.4.2 Habitat and Feeding 6
1.5 Habitat Use – Life Requisites and Seasons 6
1.5.1 Existing Habitat Models 8
1.6 Wildlife Habitat Ratings 9
1.6.1 Provincial Benchmark ("Best" Habitat in the Province) for Winter 9
1.7 Habitat Ratings Assumptions 10
1.8 Habitat Ratings Adjustments 10
2.0 References 11

LIST OF TABLES

Table 1. Taxonomic and status information for American Marten *(Martes americana)* ... 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with American Marten habitat 2
Table 5. Monthly life requisites for Marten near Stewart, BC 8
Table 6. TEM attribute relationships for each winter life requisite for Marten 9
Table 7. Relative suitability classes to be assigned to Marten habitat polygons 9

1.0 American Marten Species Account

1.1 Species Data

Table 1. Taxonomic and status information for American Marten *(Martes americana)*

Marten Species Data	
Identifier	***Description***
Common Name	American Marten
Latin Name	*Martes americana*
Species Code	M-MAAM
Global Status	G5
Provincial Status	S5?
BC List	Yellow
Identified Wildlife	N/A
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	N/A

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

American Martens are found throughout most of Canada and the western United States, with limited distribution in the eastern United States, primarily around the Great Lakes and New England (BC Conservation Data Centre 2016).

1.2.1 Provincial Distribution

American Martens are widely distributed across British Columbia. They are found in every region in the province and in almost every biogeoclimatic classification (BEC) zone. The only notable exception is the open desert ecosystem of the southern interior (Hatler et al. 2008).

1.2.2 Study Area Distribution

American Martens are well documented in BC, through harvest records and reported observations, including within the Study Area, which occurs within the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain-heather Alpine (CMA) biogeoclimatic classification (BEC) zones, all of which are associated with American Marten habitat (BC Conservation Data Centre 2016).

1.2.3 Elevation Range

American Martens inhabit a wide range of elevations, from sea level to high elevation alpine environments (BC Conservation Data Centre 2016).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4 Study area Biogeoclimatic Ecosystem Classification associated with American Marten habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	RZ	Road

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

As of 2012, two species of Marten are recognized and found in British Columbia: American Marten (*Martes americana*) and Pacific Marten (*Martes caurina*) (Dawson and

Cook 2012). The two species have been separated based on molecular and morphological variation, with no notable differences between their ecology (Dawson and Cook 2012). While the Study Area is primarily associated with the Pacific Marten, there is possible range overlap and therefore potential for both species to be present (BC Conservation Data Centre 2016). Given that there was only one species of Marten (American Marten) recognized in BC between 1953 and 2012, the available data and records are all associated with the American Marten (Helgen and Reid 2016).

American Marten, sometimes called "Pine Martens", is a small, primarily carnivorous, mammal in the weasel family. It may be active at any time during the day or night (Eder and Pattie 2001). Home ranges of American Martens are variable by individual and food abundance but are usually less than 10 km² (Slough 1989; Phillips et al. 1998). Male ranges are typically larger than females and often overlap with the home ranges of several females (Slough 1989; Phillips et al. 1998).

Breeding usually occurs between July and August, with delayed implantation of the embryos (Eder and Pattie 2001). Litters of 1 to 6 offspring are born between March and April (Eder and Pattie 2001). When the young are approximately 3 months old the female will re-enter estrus and the family disbands (Eder and Pattie 2001). The young can disperse 40 km or more away from the natal den (BC Conservation Data Centre 2016). Female American Martens have their first litter when they are between 2 to 3 years old (Eder and Pattie 2001).

1.4.2 Habitat and Feeding

American Martens are opportunistic carnivores, though they will supplement their diet with seasonally available insects, eggs, berries, and vegetation (Takats 1996; Eder and Pattie 2001; BC Conservation Data Centre 2016).

American Martens will occupy deciduous or mixed upland or lowland forest habitat year-round, but prefer mature, dominantly coniferous, forests (Eder and Pattie 2001; BC Conservation Data Centre 2016). Habitat selection is based on availability of cover from their predators as well as cover for their rodent prey. While American Martens do not occupy open, recently burned areas or cut-blocks, they will use them for hunting subnivean prey, such as voles (Eder and Pattie 2001; BC Conservation Data Centre 2016). When inactive, American Martens will use a variety of cover such as holes in trees or stumps, conifer canopies, coarse woody debris, and rock or snow cavities (BC Conservation Data Centre 2016). Natal dens are usually in hollow trees or logs, lined with grass and leaves (Eder and Pattie 2001, BC Conservation Data Centre 2016).

1.5 Habitat Use – Life Requisites and Seasons

Martens will use the Project area year-round and two seasons are rated for the Marten: Growing (Spring, Summer, and Fall), and Winter. Life requisites for each month are outlined in Table 5 and are similar to those used in other Marten habitat models (Tripp 1999; EBA 2002; Jacques Whitford AXYS 2010).

Table 5. Monthly life requisites for Marten near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Food Security/Thermal
February	Winter	Food Security/Thermal
March	Winter	Food Security/Thermal Reproducing (birthing)
April	Spring (Growing)	Food Security Reproducing (birthing)
May	Spring (Growing)	Food Security
June	Summer (Growing)	Food Security
July	Summer (Growing)	Food Security
August	Summer (Growing)	Food Security
September	Fall (Growing)	Food Security
October	Fall (Growing)	Food Security
November	Winter	Food Security/Thermal
December	Winter	Food Security/Thermal

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

Winter habitat is considered the most important life requisite for Marten (Watt et al. 1996) and Martens are adaptable to winter conditions. In areas where it is available, deep snow provides important thermal protection and cover during the winter months and where deep snow does not accumulate, other sources of cover, such as squirrel middens, may be used (Baltensperger 2009). Overall, forest structural stage is likely the main predictor of high quality habitat for both Winter and Growing seasons.

1.5.1 Existing Habitat Models

Habitat models for Marten have been produced for other projects in northern BC. The models differ slightly in how seasonal life requisites are assigned. In the model by Rescan (2013), winter was considered the limiting time for Marten and was the only season modelled. In the model by Jacques Whitford AXYS (2010), year-round habitat is modelled. Despite this discrepancy, the models are similar since Marten use similar habitat

throughout the year (Jacques Whitford AXYS 2010). Both models give the highest ratings to closed canopy, low elevation, mature coniferous forests with high complexity and coarse woody debris. Open canopy, young, or deciduous forests, or forests occurring on drier or wetter forests are rated lower. These models form the basis for the Marten habitat model developed for the Project.

1.6 Wildlife Habitat Ratings

A moderate amount of information on Marten habitat requirements is available, therefore a 4-class rating scheme is used (Table 7) similar to other models (Tripp 1999; Rescan 2013). Winter is assumed to be the limiting factor for Martens and therefore only winter habitat will be rated. Winter habitat generally provides the necessary elements for two life requisites: feeding and thermal/security cover (Table 6).

Table 6. TEM attribute relationships for each winter life requisite for Marten

Life Requisite	*TEM Attribute*
Feeding Habitat	• Elevation, slope, aspect, structural stage • Site disturbance • Canopy closure, percent cover by layer, species list by layer, coarse woody debris (CWD)
Thermal/Security Habitat	• Elevation, slope, aspect, structural stage • Site disturbance • Terrain texture • Canopy closure, percent cover by layer, species list by layer, coarse woody debris (CWD) • Individual wildlife tree characteristics (diameter at breast height (dbh), decay classes, cavity characteristics) • Snow cover

1.6.1 Provincial Benchmark ("Best" Habitat in the Province) for Winter

The Englemann Spruce Subalpine Fir dry cool (ESSFdk) subzone within the East Purcell Mountains (EPM) ecosection is considered the best winter habitat in the province. A regional benchmark for the South Boundary Ranges (SBR) has not been formally designated.

Table 7. Relative suitability classes to be assigned to Marten habitat polygons

Class	*Suitability*	*Attributes*
1	High	• Closed canopy, structural stage 6 or 7 coniferous forest on mesic to moist sites (CWH, ICH and MH zones)
2	Moderate	• Open canopy, structural stage 6 or 7 forest on wetter sites • Closed canopy, structural stage 4 or 5 coniferous forest on mesic to moist sites (CWH, ICH and MH zones)
3	Low	• Structural stage 4 or 5 floodplain forests
4	Nil	• BAFAunp and CMAunp zones • Structural stage 1-3 including open water and rivers

1.7 Habitat Ratings Assumptions

- Winter habitat is a limiting factor.
- Mature forests are high quality habitat. Forests with structural stage 6 or 7 are rated highest.
- Coarse woody debris and other ground features that provide complexity are preferred.
- Non-vegetated sites are rated Nil.
- CWH zone is rated higher than MH zone.
- CMAun is rated nil.

1.8 Habitat Ratings Adjustments

- Forests with closed canopies (>40% closure) are rated higher. Forests that are drier or wetter than normal are assumed to have reduced canopy closure and are rated lower.
- Coniferous forests are preferred and deciduous forests are reduced by one class.
- High coarse woody debris is preferred and forests with high CWD (>20%) are increased by one class.

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Hoary Marmot (*Marmota caligata*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Hoary Marmot Species Account....1
1.1 Species Data.... 1
1.2 Species Distribution.... 1
1.2.1 Provincial Distribution.... 1
1.2.2 Study Area Distribution.... 2
1.2.3 Elevation Range.... 2
1.3 Study Area.... 2
1.4 Ecology and Key Habitat Requirements.... 5
1.4.1 Species Description.... 5
1.4.2 Breeding Ecology and Habitat.... 6
1.4.3 Foraging Ecology and Habitat.... 6
1.5 Habitat Use – Life Requisites and Seasons.... 6
1.6 Wildlife Habitat Ratings.... 8
1.7 Habitat Ratings Assumptions.... 9
1.8 Habitat Ratings Adjustments.... 11
2.0 References....12

LIST OF TABLES

Table 1. Taxonomic and status information for Hoary Marmot (*Marmota caligata*) 1
Table 2. Subspecies of Hoary Marmot found in British Columbia and their corresponding ranges 2
Table 3. Study area administrative boundaries.... 2
Table 4. Study area physiographic setting.... 3
Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Hoary Marmot habitat 3
Table 6. Life Requisites of the Hoary Marmot within the Project area (near Stewart, BC) rated by month and season 8
Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Hoary Marmot.... 8
Table 8. Summary of habitat requirements for Hoary Marmots by season and structural stage 9

1.0 Hoary Marmot Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Hoary Marmot (*Marmota caligata*)

Hoary Marmot Species Data	
Identifier	***Description***
Common Name	Hoary Marmot
Common Name Synonyms	*Whistler Marmot, Whistling Marmot*
Latin Name	*Marmot caligata*
Species Code	M-MACA
Global Status	G5
Provincial Status	S5
BC List	Yellow
Identified Wildlife	N/A
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 5
	Priority 6 for Goal 1
	Priority 6 for Goal 2
	Priority 5 for Goal 3

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, the Hoary Marmot exists from Alaska to Yukon and Northwest Territories, south to northeastern Washington, central Idaho, and western Montana (BC Conservation Data Centre 2016).

1.2.1 Provincial Distribution

Marmot caligata can be found within most mountainous, high elevation areas of the British Columbia mainland, aside from lowland boreal forests of the northeast, and low elevation grasslands in the areas of the dry interior (Klinkenberg 2014).

Hoary Marmots can be found in alpine and sub-alpine areas, within meadows, open forests of subalpine fir (*Abies lasiocarpa*) or subalpine larch (*Larix lyalii*), near rock slides, and on talus slopes or within burrows (Nagorsen 2005 in Klinkenberg 2014). They can often be found in habitats containing large boulders which are used for predator observation and basking in the sun (Banfield 1981).

Five subspecies known are to BC and the ranges of each subspecies are shown in Table 2.

Table 2. Subspecies of Hoary Marmot found in British Columbia and their corresponding ranges

Hoary Marmot Subspecies in British Columbia	
Subspecies	***Range***
Marmota caligata (Eschscholtz)	Northern and central interior as far south as Barkerville and Mount Robson
Marmota caligata cascadensis Howell	Coast from Cascade range of Washington north to Garibaldi Provincial Park
Marmota caligata okanagana (King)	Monashee, Selkirk, Purcell, and Rocky Mountains of southeastern BC
Marmota caligata oxytona Hollister	Northeastern BC, Rocky Mountains
Marmota caligata raceyi Anderson	Found only in BC, in mountains of Chilcotin Plateau and in Coast Mountains north to Kitimat

Source: Nagorsen (2005) in Klinkenberg (2014)

1.2.2 Study Area Distribution

Specific occurrences of Hoary Marmot within or near the Project area are not mapped, however this species is known to reside throughout all of British Columbia in the mountains and talus slopes, including that of the Study area.

1.2.3 Elevation Range

Hoary Marmots are found at elevations ranging from 1,250 m to 2,450 m (Nagorsen 2005 in Klinkenberg 2014).

1.3 Study Area

Table 3. Study area administrative boundaries

Administrative Boundary	***Description***
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 4. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Hoary Marmot habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

BEC Zone/Subzone	Site Series	Map Code	Site Associations
CWHvm	01	HB	Western Hemlock-Sitka Spruce-Blueberry
	03	SO	Sitka Spruce-Western Hemlock-Oak Fern
	04	SD	Sitka Spruce-Western Hemlock -Devil's Club
	05	SS	Sitka Spruce-Salmonberry
	06	CD	Black Cottonwood-Red-Osier Dogwood
	07	CW	Black Cottonwood-Willow
	32	---	Non-forested fen/marsh
	51	---	Avalanche Chutes
MHmm1	01	MB	Mountain Hemlock-Amabilis Fir-Blueberry
	03	MO	Amabilis Fir-Mountain Hemlock-Oak Fern
	04	AB	Mountain Hemlock-Amabilis Fir-Bramble

BEC Zone/Subzone	Site Series	Map Code	Site Associations
	05	MT	Amabilis Fir-Mountain Hemlock-Twisted Stalk
	51	---	Avalanche Chutes
MHmmp	00	AM	Herbaceous Meadows
	00	KC	Krummholz Cliffs
	00	---	HM-Lichen Complex
	00	MH	HM-Heather Complex
	00	LM	Lichen-HM Parkland
CMAun	00	AM	Herbaceous Meadows
	00	CC	Talus Slope and Rock Outcrop Complex
	00	HL	Heather Lichen Meadow
	00	HM	Heather Meadow
	00	HP	Mountain Heather-partridge Foot
	00	KC	Krummholz Cliffs
	00	MC	Moss Campion-Coral Lichen Meadows
	00	MH	Mountain Heather
	00	TR	Talus and Rock Outcrop

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification

The Hoary Marmot is the largest species of ground squirrel residing in British Columbia. On average, adults measure roughly 61 cm in length, and have a mass of 4.6 kg (Nagorsen 2005 and University of Alaska 2010 in Klinkenberg 2014). Five subspecies are known to occur throughout the province. Fur colour varies throughout the subspecies however in general, the coat is usually white to grey, with a darker swath around the pale shoulder regions. It has a white nose with a white patch between the eyes on the snout. The head is blackish-brown, and the tail is short and bushy and varies in colour from pale brown to blackish-brown. It has slightly curved thick claws for digging. All-black animals are sometimes found in northern populations (Nagorsen 2005 in Klinkenberg 2014).

Vocalizations

The Hoary Marmot has four calls, ranging from ascending to descending to flat in tone, and also trills, or whistles (Blumstein 2010 in Klinkenberg 2014).

Life History and General Habitat

The Hoary Marmot is a colonial species, living in social groups of up to 36 individuals (Braun et al. 2011). It is a diurnal species which is most active in the early morning or late afternoon (Nagorsen 2005 in Klinkenberg 2014). Individuals have relatively large home ranges (approximately 10 ha) (Blumstein 2009 in Klinkenberg 2014), and generally only travel large distances during the dispersal phase of juvenile offspring (Nagorsen 2005 in Klinkenberg 2014). The average lifespan of the species is approximately 5 years

(Klinkenberg 2014). Social groups have been known to consist of one or two female adults, offspring from previous litters, and one adult male. Two-year-old offspring disperse in the spring if a new litter is born (Nagorsen 2005 in Klinkenberg 2014).

Hoary Marmots hibernate 7 to 8 months of the year, generally from September to April in British Columbia (Whitaker 1980). Hibernation typically occurs in a single burrow shared by all family members. Hibernacula are generally located near a viable spring food source (Nagorsen 2005 in Klinkenberg 2014). In addition to hibernating burrows, Hoary Marmots also construct specialized sleeping burrows, which usually contain several entrances, as well as refuge burrows, which are more simple structures. Refuge burrows are usually most numerous, and generally consist of a single hole which ranges from 1 m to 2 m deep. Sleeping burrows and hibernacula are generally more complex than refuge burrows, may extend to a depth of approximately 3.5 m, and are often lined with plant material. A mature colony may have as many as 100 refuge burrows, 9 regular sleeping burrows, and generally 1 hibernaculum (Holmes 1984).

1.4.2 Breeding Ecology and Habitat

Throughout its range, the *M. caligata* species is known to be both monogamous and polygamous. Adults generally breed every other year (sometimes only every 3 or 4 years), and mate in the spring after hibernation. Breeding may occur within hibernacula before emergence (Kyle et al. 2007), or shortly after emergence (Barash 1981).

The gestation period is typically 25 to 30 days, with one litter of two to four, or sometimes five young born in late May or mid-June. The young emerge from the birth den at about 3 to 4 weeks of age, at which time they are already beginning to be weaned. The young will typically stay with the colony until two years of age, at which time they will disperse, and become fully sexually mature the following year (Braun et al. 2011).

1.4.3 Foraging Ecology and Habitat

The diet of the Hoary Marmot includes grasses, sedges, leaves and forbs, as well as berries, roots, mosses, and lichens (Nagorsen 2005 in Klinkenberg 2014).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Hoary Marmot which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 6). Life Requisites include Living and Hibernating.

Living

The Hoary Marmot resides in open areas with good visibility and available vegetative food resources such as grasses and forbs. It is found in habits with deep soil which is suitable for excavation of burrows as well as boulders and rock ledges used for perches. It feeds in and around den areas and will travel up to 100 m from dens to feed (Banfield 1981).

Hibernating

Hoary Marmot hibernates in deep burrows lined with plant material from September to April in British Columbia. During hibernation it survives on stored body fat.

Table 6. Life Requisites of the Hoary Marmot within the Project area (near Stewart, BC) rated by month and season

Hoary Marmot Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Winter	Hibernating
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Summer)	Living
September	Winter	Hibernating
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.6 Wildlife Habitat Ratings

The attributes for suitable Living and Hibernating Life Requisites in relation to specific ecosystem attributes are summarized in Table 7.

Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Hoary Marmot

Hoary Marmot Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: elevation, slope, aspect, structural stage • Soil/Terrain: terrain texture, deep soils • Vegetation: % cover by layer, plant species • Boulder fields, talus, rock slides
Hibernating Habitat	• Site: elevation, slope, aspect, structural stage • Soil/Terrain: terrain texture, deep soils • Vegetation: % cover by layer, plant species • Boulder fields, talus, rock slides

An intermediate level of knowledge exists on the habitat requirements for the Hoary Marmot, therefore a 4-class rating scheme will be used.

The habitat requirements for the Hoary Marmot are summarized by season and structural stage in Table 8.

Table 8. Summary of habitat requirements for Hoary Marmots by season and structural stage

Hoary Marmot Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Alpine and subalpine meadows with deep soils, talus, boulder fields	2-3
Winter	Hibernating	Alpine and subalpine meadows with deep soils, talus, boulder fields	2-3

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

1.7 Habitat Ratings Assumptions

- Alpine and subalpine meadows (structural stage 2) with deep soils and moderate warm aspects (<30% slope, 135 to 185° aspect), will be rated High (Class 1).
- Large talus and boulder fields will be rated Class 1.
- Cool aspects and shallow soils will be rated downward to Class 2.
- Wet areas will be rated downwards by one class.
- Very shallow soils will rate Nil (Class 4).
- All habitat below 1,200m will be rated Class 4.

Hoary Marmot **Living**	
Ratings	Assumptions
1 (High) [75-100%]	• CMAun and MHmmp: o Above 1200m and o Structural stage 2 o Moderate slope (<30%); and o Warm aspect (135 - 285°) • Large blocky talus (Rt) o Moderate slopes (<30 %); and o warm aspect (135 - 285°)
2 (Moderate) [25—75%]	• CMAun and MHmmp: o Above 1200m and o Structural stage 1 and 3a o Moderate to steep slopes (30 -60%); and o All aspects • Large blocky talus (Rt) o Moderate to steep slopes (30 -60%); and o All aspects
3 (Low) [1-25%]	• CMAun, MHmmp, and MHmm1: o Above 1200m and o Structural stage 3b to 7 • steep slopes (>60%); and o All aspects • Large blocky talus (Rt) o steep slopes (>60%); and o All aspects
4 (nil) [0%]	• All habitats below 1200m

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

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Keen's *Myotis* (*Myotis keenii*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Keen's Myotis Species Account....1
1.1 Species Data....1
1.2 Species Distribution....1
1.2.1 Provincial Distribution....1
1.2.2 Study Area Distribution....2
1.2.3 Elevation Range....2
1.3 Study Area....2
1.4 Ecology and Key Habitat Requirements....5
1.4.1 Species Description....5
1.4.2 Habitat and Feeding....6
1.5 Habitat Use – Life Requisites and Seasons....7
1.6 Wildlife Habitat Ratings....8
1.7 Habitat Ratings Assumptions....9
1.8 Habitat Ratings Adjustments....10
2.0 References....11

LIST OF TABLES

Table 1. Taxonomic and status information for Keen's Myotis (*Myotis keenii*)....1
Table 2. Biogeoclimatic zones in British Columbia where Keen's Myotis is known to occur....2
Table 3. Study area administrative boundaries....2
Table 4. Study area physiographic setting....3
Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Keen's Myotis habitat....3
Table 6. Life Requisites of Keen's Myotis within the Project area rated by month and season....8
Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Keen's Myotis....8
Table 8. Summary of habitat requirements for Keen's Myotis by season and structural stage....9

1.0 Keen's Myotis Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Keen's Myotis (*Myotis keenii*)

Keen's Myotis Species Data	
Identifier	***Description***
Common Name	Keen's Myotis
Common Name Synonym	Keen's Long-eared Myotis
Latin Name	*Myotis keenii*
Species Code	M-MYKE
Global Status	G3
Provincial Status	S3?
BC List	Blue
Identified Wildlife	Y
SARA	Schedule 3 – Special Concern (March 2005)
COSEWIC	Data Deficient (Nov, 2003)
BC Conservation Framework	CF Highest Priority: 1
	Priority for Goal 1: 1
	Priority for Goal 2: 6
	Priority for Goal 3: 1

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, Keen's Myotis (*Myotis keenii*) exists only within North America and is restricted to the Pacific coast, specifically to southeastern Alaska, western British Columbia, and northwestern Washington State (COSEWIC 2003).

1.2.1 Provincial Distribution

In British Columbia, Keen's Myotis is limited to the temperate coastal rainforests, west of the Coast Mountains, including Haida Gwaii and Vancouver Island (COSEWIC 2003).

The species has been confirmed as confident or certain to occur within several habitat types and Biogeoclimatic Classification (BEC) Zones within British Columbia (Table 2) (CDC 2016).

Table 2. Biogeoclimatic zones in British Columbia where Keen's Myotis is known to occur

Keen's Myotis Habitat	
BEC Zone	***Occurrence Status***
BWBS – Boreal White and Black Spruce	Confident or certain
CDF – Coastal Douglas-fir	Confident or certain
CWH – Coastal Western Hemlock	Confident or certain
MH – Mountain Hemlock	Confident or certain

Source: BC Conservation Data Centre (2016)

1.2.2 Study Area Distribution

There are no mapped occurrences of Keen's Myotis in close proximity to the study area, the nearest mapped occurrence being around Hazelton, BC (Ministry of Environment 2008). This species is known to occupy the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) Biogeoclimatic (BEC) zones, both of which occur within the study area (CDC 2016).

1.2.3 Elevation Range

Keen's Myotis has been recorded as occurring in caves between 4 m to 945 m above sea level, with the higher elevation caves being used as hibernacula (COSEWIC 2003).

1.3 Study Area

Table 3. Study area administrative boundaries

Administrative Boundary	***Description***
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 4. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Keen's Myotis habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	CB	Cutbank
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Keen's Myotis is a small, long-eared, dark brown bat with light brown or buff ventral fur, and dark shoulder patches (Eder and Pattie 2001; COSEWIC 2003). Visually, it is very similar to the Long-eared Myotis (*Myotis evotis*), which, given their over-lapping range in southwestern British Columbia, can make identification difficult and often unreliable based on external traits (COSEWIC 2003). Accurate identification requires dental and

cranial analysis of collected specimens in a lab (COWSEIC 2003). However, the range of the Long-eared Myotis is not documented extending as far north as the study area. Home ranges of Keen's Myotis are typically small, with individuals documented only travelling a maximum of one kilometre away from their capture site (CDC 2016).

It is assumed that, like other Myotis species, mating occurs in the autumn, before or during the hibernation period and that after mating females store the sperm until ovulation and subsequent fertilization in the spring (COSEWIC 2003). Pregnant females will leave their hibernacula to move to traditional maternity roosts between April and May to give birth to a single offspring after a 40 to 60 day gestation period (COSEWIC 2003). The young are often capable of flight within 3 weeks of birth, but will continue to nurse until they are approximately 5 weeks old (COSEWIC 2003). It is likely that juveniles won't be ready to reproduce until their second year (COSEWIC 2003). It assumed that Keen's Myotis is capable of using torpor to survive periods of inclement weather and hibernation during the winter months.

1.4.2 Habitat and Feeding

Keen's Myotis is a nocturnal insectivore. It is a slow but maneuverable flyer which catches and consumes flying insects from forests, often near water but seldom over open water (COSEWIC 2003). It is also able to glean insects from surfaces, allowing it to survive periods of inclement weather when insect flight and echolocation are limited (COSEWIC 2003; CDC 2016). Keen's Myotis will usually leave its roost approximately 30 minutes after sunset and forage for insects until about 2 hours before sunrise, when it returns to its roost (COSEWIC 2016). Insects consumed primarily consist of lepidopterans, arachnids, dipterans, and neuropterans (COSEWIC 2003; CDC 2016). While there is little information available on Keen's Myotis's habitat use, it appears to occur in mature/old growth, primarily coniferous, forests where its short broad wings and sensitive hearing allow it to forage for insects in spatially complex habitat (COSEWIC 2003).

During the day, Keen's Myotis roosts in a variety of natural habitats, including caves, tree cavities, bark crevices, and rock crevices, but will also make use of anthropogenic structures, such as houses and bridges (COSEWIC 2003; CDC 2016). These roosts are used by non-reproductive females and males in the spring, while reproducing females use and re-use established maternity roosts (COSEWIC 2003). In British Columbia, only two maternity roosts are documented, both on Haida Gwaii and adjacent to hot springs in geothermally heated rock crevices (COSEWIC 2003). Non-reproductive individuals may use maternity roosts later in the summer, once offspring have become independent (COSEWIC 2003).

While there is currently no data on hibernacula on the mainland, on Vancouver Island and Haida Gwaii Keen's Myotis hibernates during winter deep within (approximately 100 m) mid-elevation caves at 550 to 945 m above sea level (COSEWIC 2003; CDC 2016). These caves remain at a stable temperature between 2.4 and 4.0°C (COSWIC 2003). Keen's Myotis will swarm around the hibernacula around August and September to breed and to build up hibernating populations (COSEWIC 2003; CDC 2016).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of Keen's Myotis which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 6). Life Requisites include Living and Hibernating.

Living

Keen's Myotis is found in mature/old growth coastal rainforests. It forages within forests, consuming insects. During the growing season, reproductive females and young will reside in maternity roosts within structures where temperatures are consistently warm. Males and non-reproductive females will roost alone or in small colonies in roosts outside of the maternity roost until later in the summer, when they may join the maternity colony.

Hibernating

The species hibernates in mid-elevation caves, surviving off of stored body fat from October to May in British Columbia.

Table 6. Life Requisites of Keen's Myotis within the Project area rated by month and season

Keen's Myotis Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Living
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Late Summer)	Living
September	Growing (Fall)	Living
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Wildlife Habitat Ratings

The attributes for suitable Living Life Requisites in relation to specific ecosystem attributes are summarized in Table 7. Hibernating habitat of Keen's Myotis is difficult to fit into the parameters set out by TEM and therefore only Living for the growing season will be rated.

Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Keen's Myotis

Keen's Myotis Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: elevation, slope, structural stage • Vegetation: % cover by layer • Mensuration: tree species, wildlife characteristics • Cliffs, caves • Water body features

A limited level of knowledge exists on the habitat requirements for Keen's Myotis, with many inferences on their ecology based off of similar long-eared Myotis species, therefore a two-class rating scheme will be used.

The habitat requirements for the Keen's Myotis are in Table 8.

Table 8. Summary of habitat requirements for Keen's Myotis by season and structural stage

Keen's Myotis Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Old growth coniferous forests, cliffs, lakes and rivers	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

1.7 Habitat Ratings Assumptions

- Wet forests will be rated High (Class 1) due to the likelihood of high insect concentration.
- Open water, ponds, and wetlands will rate High (Class 1).
- Areas with cliffs and old growth stands with large snags will rate High (Class 1).

Little Brown Myotis **Living**		
Ratings	Code	Assumptions
1 (Useable) [6-100%]	U	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09; and o Below 600m • Low elevation wetlands, and lakes (<600m). • Cliffs below 600m elevation
2 (Likely No Value) [<5%]	X	• All other habitats not listed above

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape, proximity to open areas (burns, clearcuts), and proximity to structures.

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Little Brown Myotis (*Myotis lucifugus*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Little Brown Myotis Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 2
1.2.3 Elevation Range 2
1.3 Study Area 3
1.4 Ecology and Key Habitat Requirements 6
1.4.1 Species Description 6
1.4.2 Breeding Ecology and Habitat 7
1.4.3 Foraging Ecology and Habitat 7
1.5 Habitat Use – Life Requisites and Seasons 7
1.6 Wildlife Habitat Ratings 8
1.7 Habitat Ratings Assumptions 9
1.8 Habitat Ratings Adjustments 10
2.0 References 11

LIST OF TABLES

Table 1. Taxonomic and status information for Little Brown Myotis (*Myotis lucifugus*) 1
Table 2. Biogeoclimatic zones in British Columbia where Little Brown Myotis is known to occur 2
Table 3. Study area administrative boundaries 3
Table 4. Study area physiographic setting 3
Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Little Brown Myotis habitat 4
Table 6. Life Requisites of the Little Brown Myotis within the Project area rated by month and season 8
Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Little Brown Myotis 9
Table 8. Summary of habitat requirements for Little Brown Myotis by season and structural stage 9
Table 9 Habitat ratings assumptions for Little Brown Myotis – Living 10

1.0 Little Brown Myotis Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Little Brown Myotis (*Myotis lucifugus*)

Little Brown Myotis Species Data	
Identifier	***Description***
Common Name	Little Brown Myotis
Common Name Synonyms	Little Brown Bat
Latin Name	*Myotis lucifugus*
Species Code	M-MYLU
Global Status	G3
Provincial Status	S4
BC List	Yellow
Identified Wildlife	N/A
SARA	Schedule 1 (Endangered)
COSEWIC	Endangered
BC Conservation Framework	CF Highest Priority: 5
	Priority 6 for Goal 1
	Priority 6 for Goal 2
	Priority 5 for Goal 3

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Globally, the Little Brown Myotis exists within North America. The wide range of the species includes from the Alaska-Canada boreal forest south through most of the United States. The southwestern boundary of the range is southern California (excluding the extreme southeast) to Nevada, northern Utah and Colorado, and may include parts of northeastern New Mexico. The heart of the range is thought to be the northeastern United States and boreal Canada, with smaller populations occurring in the southern and western United States (BC Conservation Data Centre 2016).

1.2.1 Provincial Distribution

The Little Brown Myotis occurs throughout a various range of habitats, including arid grassland and Ponderosa Pine ecosystems to humid coastal and northern forest ecosystems. The bat's range is thought to extend as far north as the tree-line, and can be found throughout the mainland of British Columbia, as well as on several islands, including Vancouver Island and Haida Gwaii (Nagorsen and Brigham 1993 in Klinkenberg 2014).

The species has been confirmed as confident or certain to occur within several habitat types and Biogeoclimatic Classification (BEC) Zones within British Columbia (Table 2) (BC Conservation Data Centre 2016).

Table 2. Biogeoclimatic zones in British Columbia where Little Brown Myotis is known to occur

Little Brown Myotis Habitat	
BEC Zone	***Occurrence Status***
BG – Bunchgrass	Confident or certain
BWBS – Boreal White and Black Spruce	Confident or certain
CDF – Coastal Douglas-fir	Confident or certain
CWH – Coastal Western Hemlock	Confident or certain
ESSF – Engelmann Spruce – Subalpine Fir	Confident or certain
ICH – Interior Cedar Hemlock	Confident or certain
IDF – Interior Douglas-fir	Confident or certain
MH – Mountain Hemlock	Confident or certain
MS – Montane Spruce	Confident or certain
PP – Ponderosa Pine	Confident or certain
SBPS – Sun-Boral Pine – Spruce	Confident or certain
SBS – Sub-Boreal Spruce	Confident or certain
SWB – Spruce – Willow - Birch	Confident or certain

Source: BC Conservation Data Centre 2016

Three subspecies of *M. lucifugus* are known to occur within the province. *M. lucifugus alascensis* is a dark subspecies which ranges from Alaska to California, and is found throughout most of British Columbia. *M. lucifugus carissima* is thought to exist in British Columbia in the dry southern interior, and *M. lucifugus lucifugus* is a widespread subspecies which is found across eastern and central North America, however it is thought to occur provincially only in the extreme northern region of British Columbia (Nagorsen and Brigham 1993 in Klinkenberg 2014).

1.2.2 Study Area Distribution

Specific occurrences of the Little Brown Myotis within close proximity to the Project area are not mapped, however this species is known to reside throughout most of British Columbia, including within BEC zones located within the Study area. Additionally, presence has been confirmed through field observation within the Study area.

1.2.3 Elevation Range

The bat has been recorded as occurring from sea level on the coast up to 2,288 m in the Rocky Mountains, and is thought to have the greatest altitudinal range of all of the bat species within British Columbia. Males may be more abundant than females at higher elevations (Nagorsen and Brigham 1993 in Klinkenberg 2014).

1.3 Study Area

Table 3. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 4. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Source: Meidinger and Pojar (1991); Banner et al. (1993)

Table 5. Study area Biogeoclimatic Ecosystem Classification associated with Little Brown Myotis habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
CWHwm	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	CB	Cutbank
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification

M. lucifugus is a medium-sized bat species, with an average length of 86 mm, wingspan of 248 mm, and an average weight of 6.2 grams. Fur colour is variable throughout the species, with back fur ranging in colour from yellow or olive (common in individuals within the dry interior) to blackish (coastal populations). Hair on the back has long, glossy tips. The fur on the underside is generally lighter, ranging from light brown to tan. The wing membranes and ears are dark brown. When pushed forward, the ears reach the nostrils. The skull is gradually sloped (Nagorsen and Brigham 1993 in Klinkenberg 2014).

Life History and General Habitat

The Little Brown Myotis can be found in various habitats ranging from dry open forests and riparian areas at low elevations to several higher elevation habitats including forested and riparian areas, and caves and abandoned mines while hibernating. Summer roosts occur in tree cavities, rock crevices, caves, under the bark of trees, and within man-made structures. During the summer, males and females live separately. Females assemble in nursery colonies located in sites with hot (30 to 55°C) temperatures, generally in buildings, or infrequently within hollow trees (BC Conservation Data Centre 2016). Males can be found in the summer roosting alone, or in small sites which are generally cooler that nurseries (Nagorsen and Brigham 1993 in Klinkenberg 2014).

During the winter, the bat hibernates in caves, tunnels, in old abandoned mines, or similar sites (BC Conservation Data Centre 2016), but is not known to hibernate in buildings (Nagorsen and Brigham 1993 in Klinkenberg 2014). Hibernacula usually have stable temperatures that range from 2 to 12°C. In the northeast the Little Brown Myotis may migrate hundreds of kilometres between summer and winter ranges, however in the west, the species is thought to hibernate near their summer range (Schmidly 1991). In late summer or early autumn, adults and young-of-the-year may make nocturnal flights

through caves and mines looking for potential hibernacula. This generally occurs in July as the nursery colonies disband and continues until hibernation begins in September or October depending on local climate conditions. The bats select areas within the hibernaculum which contain high humidity (70 to 95%), and where the temperature remains above freezing (1 to 5°C). Within the interior hibernation may last until April or early May, but bats may arise as early as mid-March in warmer coastal areas (Nagorsen and Brigham 1993 in Klinkenberg 2014).

1.4.2 Breeding Ecology and Habitat

Mating usually occurs in late summer and early autumn, generally in September and October (BC Conservation Data Centre 2016), before entering hibernation. Fertilization occurs after hibernation in the spring. Males do not breed in their first autumn (Nagorsen and Brigham 1993 in Klinkenberg 2014), and in British Columbia females generally do not produce young until their second year (Herd and Fenton 1983). During wet years, individuals may delay or may not reproduce (Grindal et al. 1992).

Annually, reproductive females give birth to one litter containing one young in late spring or early summer. Gestation typically lasts 50 to 60 days (Herd and Fenton 1983; Nagorsen and Brigham 1993 in Klinkenberg 2014). In the southern Okanagan, females are known to give birth between mid-June and mid-July, however birth dates likely occur a little later in coastal areas of higher elevation and latitude (Nagorsen and Brigham 1993 in Klinkenberg 2014). The Little Brown Myotis is thought to have a long lifespan, with some individuals living between 20 and 30 years. Females may remain reproductive up until 12 years of age (Hall et al. 1957; Keen and Hitchcock 1908). Newborn young weigh between 1.0 and 1.5 grams, and are capable of flying and eating solid food by three weeks of age (Nagorsen and Brigham 1993 in Klinkenberg 2014).

1.4.3 Foraging Ecology and Habitat

The Little Brown Myotis emerges from its roost at dusk to feed. The diet consists of a variety of insects, and the bat is able to adjust its hunting techniques to take advantage of insect concentrations. Foraging habitats include areas over water, along lake and stream margins, as well as in woodlands near water. Insects consumed may include, but are not limited to: flying insects including mosquitos, midges, caddisflies, and moths, hoppers, beetles, and sometime spiders. Aquatic insects and mosquitos are the major prey, however diet changes throughout the season based on insect abundance (BC Conservation Data Centre 2016; Nagorsen and Brigham 1993 in Klinkenberg 2014).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Little Brown Myotis which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 6). Life Requisites include Living and Hibernating.

Living

The Little Brown Myotis is found in various habitats including dry open forests, wet riparian areas, as well as mesic and wetter forests and riparian areas at higher elevations. They often forage near bodies of water, consuming insects, and are able to adjust their summer habitats based on insect abundance. Little Brown Myotis has also been found to frequently forage in the forest within close range of its roost. During the growing season, reproductive females and young will reside in nursery colonies within structures where temperatures are hot. Males will roost alone or in small colonies in roosts where the temperatures are cooler.

Hibernating

The species hibernates in caves, tunnels, abandoned mines, or similar structures, surviving off of stored body fat, from October to March on average in British Columbia.

Table 6. Life Requisites of the Little Brown Myotis within the Project area rated by month and season

Little Brown Myotis Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Growing (Early Spring)	Living
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Late Summer)	Living
September	Growing (Fall)	Living
October	Winter	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999)

1.6 Wildlife Habitat Ratings

The attributes for suitable Living Life Requisites in relation to specific ecosystem attributes are summarized in Table 7. Hibernating habitat of the Little Brown Myotis is difficult to fit into the parameters set out by TEM and therefore only Living for the growing season will be rated.

Table 7. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Little Brown Myotis

Little Brown Myotis Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Living Habitat	• Site: site disturbance, elevation, slope, structural stage • Vegetation: % cover by layer • Mensuration: tree species, wildlife characteristics • Cliffs, caves

An intermediate level of knowledge exists on the habitat requirements for the Little Brown Myotis, therefore a four-class rating scheme will be used.

The habitat requirements for the Little Brown Myotis are in Table 8.

Table 8. Summary of habitat requirements for Little Brown Myotis by season and structural stage

Little Brown Myotis Habitat Requirements			
Season	***Life Requisite***	***Requirements***	***Structural Stage[1]***
Growing	Living	Forests, cliffs, lakes and rivers	2-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

1.7 Habitat Ratings Assumptions

- Wet forests will be rated High (Class 1) due to the likelihood of high insect concentration.
- Open water, ponds, and wetlands will rate High (Class 1).
- Areas with cliffs and old growth stands with large snags will rate High (Class 1).

Table 9 Habitat ratings assumptions for Little Brown Myotis – Living.

Little Brown Myotis **Living**	
Ratings	Assumptions
1 (Useable) [6-100%]	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09; and o Below 1200m • Low to mid elevation wetlands, lakes and rivers (<1200m). • Low to mid Elevation (0 - 1200m) Riparian flood plains o CWHwm and MHmm1: 05, 06, & 07 • Cliffs below 1200m elevation
2 (Likely No Value) [<5%]	• All other habitats not listed above

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include landscape heterogeneity and connectivity, and interspersion of differing structural stages within the landscape.

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Mountain Goat (*Oreamnos americanus*) Draft Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Mountain Goat Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 5
1.4.1 Species Description 5
1.5 Habitat Use – Life Requisites and Seasons 7
1.5.1 Existing Habitat Models 8
1.6 Wildlife Habitat Ratings 8
1.7 Habitat Ratings Assumptions 9
1.8 Habitat Ratings Adjustments 12
2.0 References 13

LIST OF TABLES

Table 1. Taxonomic and status information for Mountain Goat (*Oreamnos americanus*) 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Mountain Goat habitat 3
Table 5. Life Requisites of the Mountain Goat within the Project area (near Stewart, BC) rated by month and season 7
Table 6. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Mountain Goat 8
Table 7. Provincial Benchmark habitat for Mountain Goat 8
Table 8. Relative suitability classes to be assigned to Mountain Goat habitat polygons (compared to the provincial best) 9
Table 9. Summary of habitat requirements for Mountain Goat by season and structural stage 9
Table 10. Detailed Rating Assumptions for Living-Growing 10
Table 11. Detailed Rating Assumptions for Living-Winter 11

1.0 Mountain Goat Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Mountain Goat (*Oreamnos americanus*)

Mountain Goat Species Data	
Identifier	***Description***
Common Name	Mountain Goat
Latin Name	*Oreamnos americanus*
Species Code	M-ORAM
Global Status	G5
Provincial Status	S3
BC List	Blue
Identified Wildlife	N/A
SARA	N/A
COSEWIC	N/A
BC Conservation Framework	CF Highest Priority: 1
	Priority 4 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 1 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 3 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

1.2.1 Provincial Distribution

Mountain Goats are known to most mountainous regions of British Columbia except Vancouver Island and Haida Gwaii. They are generally absent from the Interior Plateau and Peace River (Shackleton 2013).

1.2.2 Study Area Distribution

Specific occurrences of the Mountain Goat within or near the Project area are not mapped on distribution mapping compiled by E-Fauna BC (BC Conservation Data Centre 2016). , however other distribution maps indicate that they are present in the Study Area at moderate densities (Shackleton 2013). Mountain Goats are documented to occur in the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain-heather Alpine biogeoclimatic classification (BEC) zones, which occur within the Study area. Within these zones, Mountain Goats are strongly associated with steep alpine and subalpine meadows and cliffs (Shackleton 2013).

1.2.3 Elevation Range

Elevational range of Mountain Goats varies by location, however Mountain Goats in BC can generally inhabit areas over 2000 m (Innes 2011). Coastal Mountain Goats occupy lower elevations than interior populations (Hebert and Turnbull 1977). Foster (1982) documented Mountain Goats between 250 and 2250 m in the Nass Range, with the majority of observations above the treeline. On the south coast of BC, Taylor et al. (2006) observed goats between 300 and 1800 m depending on season, however most observations were between 600 and 1200 m. Smith et al. (1983) observed goats between 150 and 760 m in coastal Alaska.

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Mountain Goat habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	Ro	RO	Rock Outcrop
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
ICHvc	10	LS	Pl - Sphagnum
	00	SW	Shrubland (Willow/Alder Thicket)
	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	Ro	RO	Rock Outcrop
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank
	00	RI	River
	Ro	Ro	Rock Outcrop
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	WA	Alpine Wetland

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Identification and General Ecology

Mountain Goats are medium-sized ungulates with long, shaggy white to cream coloured fur and 20 to 30 cm long, pointed horns which are present in both males and females.

Males may weigh up to 144 kg and females up to 70. Lifespans is typically 10 to 11 years although one 18 year-old individual has been observed (Shackleton 2013).

Mountain Goats inhabit steep, mountainous terrain and have many adaptions for this environment. A stocky body with powerful shoulders and short legs allows for easy movement on mountainsides and specially adapted soft pads on the base of the hoof provide excellent grip on rocks and ledges. The long fur provides excellent insulation during winter conditions (Shackleton 2013).

Females are capable of breeding after two years however older females are more successful. Rutting occurs in November or December, during which time males intimidate other males, and will dig urine pits in which they will roll to attract females. Gestation is approximately 6 months, after which females will seek out an isolated location for birth (MOELP 2000). Birth occurs within a short time period which is synchronized with optimal forage (Côté and Festa-Bianchet 2001). Kids weigh approximately 3 kg and are usually born singly, although twins do occur. Kids suffer from high mortality and over half may die in their first year (MOELP 2000).

Habitat

Mountain Goats inhabit two ecotypes in British Columbia. In the interior, goats experience dry conditions which produce lighter, more mobile snow which allows Mountain Goats to occupy higher winter ranges whereas coastal goats (such as those potentially found in the Project Area) experience a wetter coastal climate with dense snow and are generally found at lower elevations (Hebert and Turnbull 1977).

Mountain Goats generally occupy open alpine environments where escape terrain is present (Gilnber and Raedeke 1992). Escape terrain is important for protection from predators such as Grey Wolves (*Canis lupus*), Cougars (*Puma concolor*), and Grizzly Bears (*Ursus arctos*) which are likely the main predators in the LSA (MGMT 2010). Mountain Goats prefer to forage near steep cliffs which allow them to access escape terrain quickly (Foster 1982; Nietfeld et al. 1985; Gilbert and Raedeke 1992; MOELP 2000; Taylor et al. 2006). In a study in Ketchikan in south-coastal Alaska, Smith (1983) found goats were most active between 51 and 65°. Steep terrain may only have sparse vegetation therefore Mountain Goats have adapted to consume a variety of forage (Shackleton 2013). Graminoids (grasses, sedges, and rushes), forbs, shrubs such as Snowberry (*Symphoricarpos albus*), and tree leaves and twigs from alder (*Alnus* spp.) and conifers may form part of the diet (Nietfeld et al. 1985; Smith 1983). Mountain Goats may seek out mineral licks at mid- to high elevations, but avoid those at low elevations (Poole and Heard 2003).

Winter Habitat is considered the critical habitat for Mountain Goats. Although adapted to cold environments, goats still favor south-facing slopes which accumulate less snow due to their warmer aspect (MOELP 2000). Mountain Goats often make extensive use of mature or old growth forest areas with high canopy cover (50-60%) for snow interception (Smith 1983) but generally stay within 500 m of escape terrain (Poole and Heard 2003). Conversely, some research has shown that open areas such as burns or clearcuts may

also be used in the winters with a low snowpack (Taylor et al. 2006). Winter forage includes Bunchberry (*Cornus canadensis*), Blueberries and Black Huckleberries (*Vaccinium* spp.), ferns (*Polypodium* spp.), Yellow Cedar (*Xanthocyparis nootkatensis*), Five-leaved Bramble (*Rubus pedatus*), Salmonberry (*Rubus spectabilis*), Hemlock (*Tsuga* spp.), lichens (*Lobaria* spp.) and mosses (Smith 1983). Gilbert and Raedeke (1992) reported coastal Mountain Goats in Washington State relied strongly on conifers for their winter diet when lower vegetation becomes inaccessible.

Summer habitat is less important than winter habitat. Warmer temperatures and absence of snow allow Mountain Goats to access higher elevation summer feeding areas where they aggregate to forage on short herbaceous vegetation (Nietfeld et al. 1985). Mountain Goats may be at risk of heat stress during high temperatures and goats may use areas with dirt or gravel substrates (Foster 1982) or other cool areas such as overhangs, caves, or canyons to avoid overheating (MOELP 2000; MGMT 2010). Summer and winter habitats are usually located in the same area and Mountain Goats simply change their elevation, however migrations of up to 13 km have been reported (Poole and Heard 2003).

1.5 Habitat Use – Life Requisites and Seasons

Habitat use pertaining to the Life Requisites of the Mountain Goat which spans all months/seasons has been rated according to RIC Standards (RIC 1999) for the species within the Project area (Table 5). Life Requisites include Feeding, Security and Thermal.

Table 5. Life Requisites of the Mountain Goat within the Project area (near Stewart, BC) rated by month and season

Mountain Goat Life Requisites		
Month	***Season****	***Life Requisites***
January	Winter	Feeding/Security & Thermal
February	Winter	Feeding/Security & Thermal
March	Winter	Feeding/Security & Thermal
April	Growing (Early Spring)	Feeding/Security & Thermal
May	Growing (Late Spring)	Feeding/Security & Thermal
June	Growing (Summer)	Feeding/Security & Thermal
July	Growing (Summer)	Feeding/Security & Thermal
August	Growing (Summer)	Feeding/Security & Thermal
September	Growing (Early Fall)	Feeding/Security & Thermal
October	Growing (Late Fall)	Feeding/Security & Thermal
November	Winter	Feeding/Security & Thermal
December	Winter	Feeding/Security & Thermal

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC 1999).

1.5.1 Existing Habitat Models

Several habitat models have been developed for Mountain Goat. For a project approximately 65 north-northwest of Stewart, Rescan (2013) performed habitat suitability modelling for Mountain Goat winter range. The model parameters included distance to escape terrain, aspect, elevation, and vegetation with the highest ratings for habitats that were on warm (southerly) aspects below 1630 m that are within 75 m of escape terrain (barren areas with 40° to 70° slope). For another project approximately 125 km northwest of Stewart, RTEC (2010) modelled habitat using similar parameters to model both winter and summer habitat. Reid et al. (2004) incorporated similar parameters for modelling habitat in the Kispiox Forest District, but also included structural stage with the highest ratings for early seral (1 to 20 year old) forests which provide abundant herbaceous and coniferous forage, and old growth (>120 year old) forests which also provide snow interception.

1.6 Wildlife Habitat Ratings

The attributes for suitable Feeding, Security and Thermal Life Requisites in relation to specific ecosystem attributes are summarized in Table 6.

Table 6. Terrestrial Ecosystem Mapping (TEM) relationships for each Life Requisite of the Mountain Goat

Mountain Goat Ecosystem Attributes	
Life Requisite	***TEM Attribute***
Feeding	• Site: site series, slope, aspect, site disturbance, elevation,; • Vegetation: % cover by layer, structural stage, and canopy closure
Security/Thermal	• Site: site series, slope, aspect, site disturbance, and elevation; • Vegetation: % cover by layer, structural stage, and canopy closure

Habitat ratings for the Project LSA will be based on a rating relative to the provincial benchmark (Table 7) for the Coast and Mountains Nass Basin (NAB). Detailed information on Mountain Goat habitat requirements is available, therefore a 6-class rating scheme is used (Table 8).

Table 7. Provincial Benchmark habitat for Mountain Goat

Season	***Ecoprovince***	***Unit***	***BGC Subzone***	***Rating***
Growing	Coast and Mountains	NAR	AT AM - Alpine Meadow	B
Winter	Coast and Mountains	NAR	MHmm MF/6 - Mountain Hemlock-Amabilis Fir/RO - Rock	B

Source: Appendix H of BC Wildlife Habitat Ratings Standards (RIC 1999). Benchmarks are shown for each season. Benchmark for Southern Interior Mountains not shown. B = best overall benchmark habitat for the province.

Table 8. Relative suitability classes to be assigned to Mountain Goat habitat polygons (compared to the provincial best)

Class	Suitability	Lower Limit (%)	Upper Limit (%)	Relative Quality
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

The habitat requirements for the Mountain Goat are summarized by season and structural stage in Table 9.

Table 9. Summary of habitat requirements for Mountain Goat by season and structural stage

Mountain Goat Habitat Requirements				
Season	**Food/Cover Life Requisite**	**Specific Life Requisite**	**Requirements**	**Structural Stage[1]**
Growing	Feeding (FD)	Living (Li)	High elevation, open alpine or subalpine meadows	1-3
Growing	Security (SH)		Steep, rocky slopes (40° - 70°) which provide escape terrain	1-3
Growing	Thermal (TH)		Topographic features (caves, overhangs, canyons) or old growth forest cover, snow fields	1-3, 6-7
Winter	Feeding (FD)	Living (Li)	Forested areas with adequate forage	6-7
Winter	Security SH)		Steep, rocky slopes (40° - 70°) which provide escape terrain	1-3
Winter	Thermal (TH)		South facing slopes at lower elevation than during Growing season, mature forest with moderate to high canopy cover (50-60%)	6-7

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998)

1.7 Habitat Ratings Assumptions

During summer, security habitat is the most important feature for mountain goat habitat, followed by feeding habitat. Security habitat is escape terrain that has a slope of 40° to 70° with structural stage 1-3. Habitat quality decreases with distance from escape terrain

and is Nil greater than 400 m away. Thermal cover is the least important habitat requisite during the summer season during which time foraging occurs above the treeline. Access to food becomes much more important during the winter season and is equally as important as escape terrain. Thermal habitat is also more important but still secondary to food and security cover in winter. Winter thermal/security habitat includes areas with structural stage 6-7 with 50 to 60% canopy cover. Detailed ratings assumptions are provided in Tables 10 and 11.

Table 10. Detailed Rating Assumptions for Living-Growing

General Habitat	Steep mountainous terrain year round.	
Living – Growing (Li-G)	Key Habitat Requirements	
	Summer feeding areas are at high elevations and generally occur within 400m of security habitat although the prime habitat is usually within 50m. Summer diets of goats are more varied than in winter with a higher proportion of forbs, grasses and sedges and less browse. Security habitat: mountain goats need steep (>80%) rugged terrain with cliffs, rock ledges, and talus slopes. Escape terrain should be within at least 400 metres of forage sites (Schoen and Kirchoff, 1981; Fox and Taber, 1981) and most goats are found within 50m of escape terrain.	
	Ratings	Assumptions
	1 (High) [75-100%]	CMAUN and MHmmp SS 2 – 3 All aspects with slopes > 80% and; > 10% vegetation cover
	2 (Mod. high) [50—75%]	CMAUN and MHmmp SS 1 – 3 All slopes and aspects within 50 - 400m of escape terrain (> 80%) Units with > 10% vegetation cover
	3 (moderate) [25-50%]	MHmm1 & 2 SS 1 – 3b All slopes and aspects within 100m of escape terrain (> 80%)
	4 (low) [5-25%]	MHmm1 & 2 ss 1 – 3b All slopes and aspects within 100 - 400m of escape terrain (> 80%)
	5 (very low) [1-5%]	MHmm1 & 2 ss 4 - 7 All slopes and aspects within 400m of escape terrain (> 80%)
	6 (nil) [0%]	All units below 800m All slopes and aspects > 400m from escape terrain

Table 11. Detailed Rating Assumptions for Living-Winter

General Habitat	Steep mountainous terrain year round.	
Living – Winter (Li-W)	Key Habitat Requirements	
	Winter feeding areas include wind-swept ridges (interior populations), steep cliffs, and high elevation, Mature and old growth forests providing snow interception and adequate browse adjacent to escape terrain are key to coastal Mountain Goat winter ranges. Security habitat: Mountain Goats need steep (>80%) rugged terrain with cliffs, rock ledges, and talus slopes. Escape terrain should be within at least 400 m of forage sites (Schoen and Kirchoff 1981; Fox and Taber 1981) and most goats are found within 50 m of escape terrain.	
	Ratings	Assumptions
	1 (High) [75-100%]	MHmm1 and 2, CWHwm and ICHvc with: Structural stage (SS) 6-7 and; escape terrain (> 80%) and: all slopes within 100m of escape terrain; and Warm aspects (135 – 285°)
	2 (Mod. High) [50—75%]	MHmmp, MHmm1 & 2, CWHwm and ICHvc with: SS 6 – 7 and; Within 100 - 400m of escape terrain (> 80%) and: Warm aspects (135 – 285°)
	3 (moderate) [25-50%]	MHmmp MHmm1 & 2, CWHwm and ICHvc with: SS 6 – 7 and Within 400m of escape terrain (> 80%) and Cool aspects (285 - 135°)
	4 (low) [5-25%]	MHmm1 & 2, CWHwm and ICHvc SS 4 – 5 All slopes within 400m of escape terrain (> 80%) and warm aspects (135 – 285°)
	5 (very low) [1-5%]	MHmm1 & 2, CWHwm and ICHvc SS 1 to 3 Cool aspects (285 - 135°)
	6 (nil) [0%]	CMAun and BAFun all units MHmmp in SS 1 - 3 All units greater than 400m from escape terrain Permanent snow, ice field and glaciers

1.8 Habitat Ratings Adjustments

Final ratings adjustment considerations may include downward adjustments for less suitable structural stage, elevation, aspect, and distance to escape terrain.

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Grizzly Bear (*Ursus arctos*) Species Account

Red Mountain Habitat Modelling

IDM Mining

Prepared February 2017

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TABLE OF CONTENTS

1.0 Grizzly Bear Species Account 1
1.1 Species Data 1
1.2 Species Distribution 1
1.2.1 Provincial Distribution 1
1.2.2 Study Area Distribution 1
1.2.3 Elevation Range 2
1.3 Study Area 2
1.4 Ecology and Key Habitat Requirements 6
1.4.1 Species Description 6
1.4.2 Habitat and Feeding 7
1.5 Habitat Use – Life Requisites and Seasons 7
1.6 Wildlife Habitat Ratings 9
2.0 References 20

LIST OF TABLES

Table 1. Taxonomic and status information for Grizzly Bear *(Ursus arctos)* 1
Table 2. Study area administrative boundaries 2
Table 3. Study area physiographic setting 2
Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Grizzly Bear habitat 3
Table 5. Important habitat features for coastal Grizzly Bears used for each season 7
Table 6. Monthly life requisites for Grizzly Bear near Stewart, BC 8
Table 7. Summary of general habitat attributes for Grizzly Bears 11
Table 8. Relative suitability classes to be assigned to Grizzly Bear habitat polygons 11

1.0 Grizzly Bear Species Account

1.1 Species Data

Table 1. Taxonomic and status information for Grizzly Bear *(Ursus arctos)*

Grizzly Bear Species Data[1]	
Identifier	***Description***
Common Name	Grizzly Bear
Latin Name	*Ursus arctos*
Species Code	M-URAR
Global Status	G4
Provincial Status	S3?
BC List	Blue
Identified Wildlife	Y
SARA	N/A
COSEWIC	Special concern
BC Conservation Framework	CF Highest Priority: 2
	Priority 3 for Goal 1: Contribute to global efforts for species and ecosystem conservation
	Priority 2 for Goal 2: Prevent species and ecosystems from becoming at risk
	Priority 3 for Goal 3: Maintain the diversity of native species and ecosystems

Source: BC Conservation Data Centre (2016)

1.2 Species Distribution

Grizzly Bears were previously known to occupy large areas of North America, Asia, Europe, and even North Africa. Today they have been extirpated from much of their historical range and are primarily found in North America, as well as Russia (where they are more commonly known as Brown Bears). Smaller, mostly isolated populations occur throughout Asia, Europe, and Scandinavia (COSEWIC 2012; McLellan et al. 2008).

1.2.1 Provincial Distribution

There are approximately 15,000 Grizzly Bears in BC that occupy an estimated 84% of the province (Mccrory et al. 1990, MFLNRO 2012). Grizzly Bears are found in every forest region and every biogeoclimatic unit except for Bunchgrass (BG) and Coastal Douglas-Fir (CDF). They are not found on Vancouver Island or the Queen Charlotte Islands and are considered extirpated in southern and south-central areas of the province (Gyug et al. 2004).

1.2.2 Study Area Distribution

Grizzly Bears are well documented in BC through observations and harvest records (BC Conservation Data Centre 2016). There are an estimated 358 individuals in the Stewart Population Unit which is considered viable (MFLNRO 2012). Grizzly Bears are known to the Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Coastal Mountain Heather Alpine (CMA) biogeoclimatic classification (BEC) zones, which occur within the

Study area (BC Conservation Data Centre 2016). As habitat generalists they may be found in many different habitat types within these zones depending on the season (COSEWIC 2012).

1.2.3 Elevation Range

Grizzly Bears inhabit a wide range of elevations, from sea level to high elevation alpine environments (Gyug et al. 2004). Interior populations tend to occupy high elevational ranges; McLellan and Hovey (2001) found Flathead River Valley grizzlies in the southern interior to span elevations from 1,000 to 2,400 m. Individuals from the North Coast often remain within 500 m of sea level and spend the majority of their time under 100 m elevation (MacHutchon et al. 1993).

1.3 Study Area

Table 2. Study area administrative boundaries

Administrative Boundary	*Description*
Forest Region	Skeena
Forest District	Kalum
MFLNRO Resource District	Coast Mountains
Watershed Group	Kshwan River
Regional District	Kitimat-Stikine
Municipality	Stewart

Table 3. Study area physiographic setting

Ecosystem Classification	*Description*
Ecodomain	Humid Temperate
Ecodivision	Cool Hyper Maritime and Highlands
Ecoprovince	Coast and Mountains
Ecoregion	Boundary Ranges
Ecosection	South Boundary Ranges
Biogeoclimatic (BEC) Zones Sub-zones Variants	BEC Label: CWHwm Zone: Coastal Western Hemlock (CWH) Sub-zone: Wet Maritime (wm)
	BEC Label: MHmm1 Zone: Mountain Hemlock (MH) Sub-zone: Moist maritime (mm) Variant: Windward (1)
	BEC Label: MHmmp Zone: Mountain Hemlock (MH) Sub-zone: Moist Maritime Parkland (mmp)
	BEC Label: CMAun Zone: Coastal Mountain-heather Alpine (CMA) Subzone: Undifferentiated (un)
Elevation Range (m)	100 m to 2,130 m ASL

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

Table 4. Study area Biogeoclimatic Ecosystem Classification associated with Grizzly Bear habitat

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
BAFAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	AH	Alpine Heath
	00	AF	Alpine Fellfield
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	Ro	Rock Outcrop
	00	AT	Alpine Tundra
CMAun	00	LA	Lake
	00	PD	Pond
	00	RI	River
	00	GL	Glacier
	00	AM	Alpine Herb Meadow
	00	Ah	Alpine Heath
	00	Af	Alpine Fellfield
	00	AT	Alpine Tundra
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Sk	Sk	Shrub krummolz
	Ro	RO	Rock Outcrop
CWHwm	00	AC	Avalanche Chute
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vs	Avalanche Shrub Thicket
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	LA	Lake
	00	Water	Water (Includes ponds and ocean)
	00	GB	Gravel Bar
	00	FL/GB	Low Bench Floodplain/Gravel Bar
	00	CB	Cutbank
	00	ES	Exposed Soil
	01	HB	HwSs - Blueberry
	02	HM	HwSs - Step moss

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	03	SO	SsHw - Oak fern
	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club
	04	SD	SsHw - Devil's club
	05	SS	Ss - Salmonberry
	06	CD	Act - Red-osier dogwood
	08	HS	Hw - Sphagnum
	09	SC	Ss - Skunk cabbage
	10	LS	Pl - Sphagnum
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	UR	Urban Residential
ICHvc	01	HD	HwBl - Devil's club
	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss
	02	HM	Hw - Step moss
	03	SD	Sx - Devil's club
	04	DD	Sx - Devil's club - Dogwood
	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood
	05	CD	ActSx - Dogwood
	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)
	00	ES	Exposed Soil
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	RI	River
	00	PD	Pond
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
MHmm1	00	ES	Exposed Soil
	00	GL	Glacier
	00	CB	Cutbank

BEC Zone/Subzone	Site Series Code	Map Code	Site Associations
	00	RI	River
	00	PD	Pond
	Ro	Ro	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)
	00	Vh	Avalanche Herb Meadow
	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak Fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twisted stalk
	06	MD	HmYc - Deer Cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage
MHmm2	01	MB	HmBa - Blueberry
	02	MM	HmBa - Mountain-heather
	03	MO	BaHm - Oak fern
	04	AB	HmBa - Bramble
	05	MT	BaHm - Twistedstalk
	06	MD	HmYc - Deer cabbage
	07	YH	YcHm - Hellebore
	08	YS	HmYc - Sphagnum
	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)
	00	GL	Glacier
	00	ES	Exposed Soil
	00	RI	River
	00	PD	Pond
	00	RZ	Road
	Ro	RO	Rock Outcrop
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wb	Bog Wetland
	00	Wh	Herb Wetlands
	00	SW	Shrubland (Willow/Alder Thicket)
	00	WE	Shrub Wetland (Swamp and/or Fen)
	00	Ws	Swamp Wetland
	00	Vh	Avalanche Herb Meadow
	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)

BEC Zone/Subzone	*Site Series Code*	*Map Code*	*Site Associations*
MHmmp	00	WA	Alpine Wetland
	00	AT	Alpine Tundra
	Sk	Sk	Shrub krummolz
	00	Sc	shrubland
	Vs	Vs	Avalanche Shrub
	Vs	VsSc	Avalanche Shrub/shrub thicket
	00	GL	Glacier
	00	PS	Permanent Snow
	00	PN/GL	Permanent Snow
	Rc	Rc	Rock Cliff
	Ro	Ro	Rock Outcrop
	Rt	Rt	Rock talus
	00	RZ	Road
	00	Sc	Shrub Carr
	00	PK	Parkland Forest
	00	PK/Sc	Parkland Forest/Shrubland
	00	AM	Alpine Herb Meadow
	00	ES	Exposed Soil
	00	LA	Lake
	00	PD	Pond
	00	WA	Alpine Wetland

Sources: Meidinger and Pojar (1991); Banner et al. (1993)

1.4 Ecology and Key Habitat Requirements

1.4.1 Species Description

Grizzly Bears are large, omnivorous mammals. They are predominantly crepuscular, although may be active at any time during the day or night (BC Conservation Data Centre 2016). In the Khutzymateen Valley just north of the Project area, Grizzlies were found to be mainly diurnal in areas of low human use (MacHutchon et al. 1998). Home ranges of Grizzly Bears vary individually and geographically, however they follow a general rule that home range size is negatively correlated with habitat quality (Ross 2002). The abundance of high quality food and habitat results in coastal Grizzly Bears having smaller home ranges than interior bears (Hamilton and Bunnell 1987, MacHutchon et al. 1993). Male home ranges are larger than females and often overlap with the home ranges of many females (MacHutchon et al. 1993; McLoughlin et al. 1999; Gyug et al. 2004).

Breeding can occur quite soon after emergence from the dens, usually between late April and late June, and cubs are born between January and March during the denning period. Female Grizzly Bears have their first offspring when they are 5 to 7 years old and average litter size in the Project area is 2.4 cubs (MacHutchon et al. 1993). Grizzly Bears

are mainly solitary animals aside from the social interaction within sibling groups and between mother and offspring, who stay together for multiple years (approximately 2.5) (Gyug et al. 2004).

1.4.2 Habitat and Feeding

Grizzly Bears are opportunistic omnivores whose diet varies spatially and seasonally. In general, herbivory is the main feeding, with bears consuming a variety of plant types including roots, green vegetation, and berries (Gyug et al. 2004). The percent of meat in the diet is dependent on season, location, and availability, and it is generally preferred over readily available plant foods (Hilderbrand et al. 1999).

Grizzly Bear habitat selection and movements are reflective of food availability (Hamilton 1987). While some similarities exist, coastal and interior bears can be very different in terms of habitats used and foods consumed (Ross 2002, Gyug et al. 2004). For interior populations, plant roots and ungulate meat are important diet components in the early spring and late in the fall, while green vegetation is eaten throughout the summer and berries compose a key component in late summer (McLellan and Hovey 1995). Coastal bears feed on early season green vegetation after den emergence until early summer when berries begin to ripen and become the main food source. In fall, salmon becomes the primary food source (MacHutchon et al. 1993, Gyug et al. 2004). Coinciding with the location of preferred foods, coastal bears spend the majority of their active periods on forested low elevation mountain slopes, south facing avalanche slopes, and valley bottoms (Hamilton 1987, MacHutchon et al. 1993, Schoen et al. 1994). See Table 5 for an overview of important Grizzly Bear habitat features.

Table 5. Important habitat features for coastal Grizzly Bears used for each season

Season	*Habitat Features*[1]
Winter	Steep slopes, mid-high elevations, soil that stays frozen in winter, open canopy old growth forest, large root masses or other vegetation that stabilizes the den's roof
Spring	Avalanche tracks, estuaries, non-forested wetlands, and mature to old growth forest
Summer	Early seral to old growth floodplains, climax (mature and old growth) Hemlock dominated forests
Fall	Salmon streams, young seral to old growth floodplains, and climax (mature and old growth) Hemlock dominated forests

Sources: Hamilton (1987), MacHutchon et al. (1993) , Schoen et al. (1994)

1.5 Habitat Use – Life Requisites and Seasons

Five seasons are rated for Grizzly Bear: early spring, late spring, summer, fall, and winter. Life requisites for each month are outlined in Table 6.

Table 6. Monthly life requisites for Grizzly Bear near Stewart, BC

Month	*Season (Code)**	*Life Requisites*
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Early Spring	Feeding/Security & Thermal
May	Late Spring	Feeding/Security & Thermal
June	Summer	Feeding/Security & Thermal
July	Summer	Feeding/Security & Thermal
August	Summer	Feeding/Security & Thermal
September	Fall	Feeding/Security & Thermal
October	Fall	Feeding/Security & Thermal
November	Winter	Hibernating
December	Winter	Hibernating

*Seasons as per Appendix B of BC Wildlife Habitat Ratings Standards for the Coast and Mountains Ecoprovince (RIC, 1999).

Grizzly Bear feeding habitat is considered the most important life requisite considering that habitat selection in the growing season (spring, summer, and fall) is reflective of food availability. For this reason, habitat ratings primarily depend on feeding habitat.

Grizzly Bear emergence from hibernation occurs from mid to late April. Southerly and west facing slopes and openings including meadows and low elevation avalanche chutes provide the most abundant early season green-up of vegetation (MacHutchon 2010). After emergence, individuals move down avalanche chutes and feed on emerging herbaceous vegetation and then on emerging herbs, sedges, and Skunk Cabbage (*Lysichiton americanum*) in valley bottoms (MacHutchon et al., 1993). Feeding in late spring is similar to early spring, with sedges still dominating the diet and herbaceous vegetation becoming a larger part of the diet as vegetation begins to grow. MacHutchon et al. (1993) defines three seasons of activity for Grizzly Bears on the North Coast; the first combines early and late spring and lasts from den emergence until berries are the predominant food item.

During summer, the main food types for Grizzly Bear are berries; therefore bears are associated with the floodplain and low elevation slopes that support these fruiting shrubs. Most commonly consumed species include Red Elderberry (*Sambucus raacemosa)*, Devil's Club (*Oplopanex horridis)*, and Stink Current (*Ribes bracteosum)* (MacHutchon et al., 1993). At higher elevations huckleberries and blueberries (*Vaccinium* spp.) are important all the way up the slope to the alpine as the season progresses. Important berry producing species in the high alpine include Crowberry (*Empetrum nigrum*) and Lingonberry (*Vaccinium vitis-idaea*). Additional plants consumed during summer include *Umbelliferae* spp., Hedge Nettle (*Stachys* spp.), Stinging Nettle (*Urtica dioica)*, Common Touch-me-not (*Impatiens noli-tangere)*, horsetail (*Equisetum* spp.), Skunk Cabbage, and

Lady Fern (*Athyrium filix-femina*). Grizzlies can be found within 0 to 150 m of class 1 streams during this time (MacHutchon et al., 1993).

Salmon species are the main component of diets in the fall and, like in summer, bears are concentrated in the area near salmon bearing streams. Bears consume both fresh and dead salmon when available. Additional foods eaten in the fall include Skunk Cabbage, Cow Parsnip (*Heracleum maximum*), and various berries.

Alpine and subalpine habitats with deep soils are considered important for hibernation. Dens are generally located at high elevations in areas of high snowfall and low snowmelt. Most excavated dens tend to be located on slopes from 55 to 90% (Harding 1976, Ciarnello et al. 2005). Most dens are situated in specific areas to ensure an early and long lasting snow cover to provide adequate insulation. MacHutchon (2007) speculates that snow cover for insulation may not be as important on the coast. Instead, colder aspect slopes at elevation where freezing remains constant and snow melt seepage is minimized may be more important. Excavated den sites generally consist of steep well drained slopes with high density matted vegetation such as Mountain Heather and various herbs and shrubs that provide dense root structure to support the den roof.

Existing Habitat Models

Numerous Grizzly Bear habitat mapping projects have been completed in BC along the coast and coast interior transition since 1999. MacHutchon (2007) lists 15 different projects mapping Grizzly Bear habitat and rating habitat polygons between 1999 and 2007. These projects developed a range of mapping products including Standard TEM mapping to Grizzly Bear habitat polygons with buffers. In 2007, MacHutchon developed the draft Mapping Methods for Important Coastal Grizzly Bear Habitat. These mapping methods form the basis for the Grizzly Bear habitat model development for the Project.

1.6 Wildlife Habitat Ratings

Habitat features present in the Khutzymateen Valley as outlined by MacHutchon (2007) were used as the benchmark for Grizzly Bear habitat ratings (

Table 7). Detailed information on Grizzly Bear habitat requirements is available, therefore a 6-class rating scheme is used (Table 8).

Table 7. Summary of general habitat attributes for Grizzly Bears

Habitat Use	*Attributes of Suitable Grizzly Bear Habitat*	*Structural Stage[1]*
Early Spring (PE) Feeding	• High forage plant diversity in lush herb layer with an abundance of skunk cabbage, grasses, sedges, horsetails, cow parsnip, angelica, stinging nettle, etc. • Floodplains, estuaries, valley bottoms, and warm aspect lower slopes of avalanche chutes with moist to wet soil moisture regimes and rich soil nutrient regimes	2-3, 6-7
Late Spring (PL) Feeding	• Similar to PE with additional shrubs and herbs greening up; salmonberry, thimbleberry, and devil's club new shoots • Warm sites as snow recedes up the hillside, mesic to hygric wetlands, floodplains, avalanche chutes	2-3, 6-7
Summer (S) Feeding	• Fruit producing shrubs and herbaceous plants are the main source of food. • High use habitats are submesic to hygric sites with medium to rich soil moisture regimes. • Young seral, mature seral, and old growth floodplain forests, avalanche chutes with berry-producing shrubs, and open forest alluvial fans	3, 6-7
Fall (F) Feeding	• Salmon spawning areas and adjacent forests • Berry-producing forests close to salmon streams, e.g., floodplain forests, and avalanche chutes with berry-producing shrubs • Moist or wet forests with skunk cabbage • Some bears will move into sub alpine areas with berry production.	3, 6-7
Security/ Thermal Cover	• Mixed young seral >2 m • Mixed conifer/deciduous older forest (5-7) • Mature to old conifer • Shrub cover >50%	3b, 5-7
Hibernating Habitat	• Dry, moisture-shedding site • Higher elevation (at or above treeline) • Steep slopes (30°-40°) • Cool aspects (285° - 135°) • Heavy matted vegetation layer providing support to den roof	6, 7

Source: Adapted from MacHutchon (2007)

[1] Structural Stage: 1 = sparse/non-vegetated, 2 = herb, 3 = shrub/herb (<20 years), 3a = low shrub, 3b = tall shrub, 4 = pole/sapling (20-40 years), 5 = young forest (40-80years), 6 = mature forest (80-240 years), 7= old forest (>250 years) (RIC 1998).

Table 8. Relative suitability classes to be assigned to Grizzly Bear habitat polygons

Class	*Suitability*	*Lower Limit (%)*	*Upper Limit (%)*	*Relative Quality*
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

Source: RIC (1999)

Habitat Ratings Assumptions

General Rating Assumptions:

- Feeding habitat is the most important limiting factor for Grizzly Bear in the study area.
- Disease, intra/inter-specific competition, hunting, and predation all affect Grizzly Bear population growth, viability, and distribution. This suitability model does not include these factors.
- Intra-specific competition/interactions and potential for human conflict greatly influence Grizzly Bear habitat use.

Detailed Rating Assumptions Early Spring Feeding Habitat (P_E-FD)

- Estuaries, low elevation (<600m) wetlands, and low elevation (<600m) avalanche chutes are rated as class 1.
- Low elevation riparian flood plains are rated class 2.
- Wet Forest Units with the presence of skunk cabbage, horsetails, cow parsnip, and other important forage species are rated class 3 for structural stages 2 or 3, class 5 for structural stages 4 and 5, and class 4 for structural stages 6 and 7.
- Dry to mesic forest units are rated class 4 for structural stages 6 and 7 and class 5 for structural stages 4 and 5.
- Roads, landings, or other grass covered openings are rated class 3 for early vegetation green-up but are adjusted down due to lack of security cover (see ratings adjustments).
- Openings in structural stage 2 or 3 are rated class 3.
- All areas above 600m rated class 6.
- All other areas are rated class 6.

Detailed Rating Assumption for Late Spring Feeding Habitat (P_L-FD):

- Similar to Early spring but assume slight shift to use of forage plant green-up from openings to underneath more mature forest canopy.
- Also slight shift in elevation up to 900m
- Estuaries, wetlands, and warm aspect avalanche chutes are rated class 1.
- Wet (subhydric) swamp forests with presence of skunk cabbage, horsetails, cow parsnip, or other forage plant species are rated class 2.
- Dry to mesic forest units are rated class 4 for structural stages 6 and 7 and class 5 for structural stages 4 and 5.

- Roads, landings, or other grass covered openings are rated class 3 for early vegetation green-up but are adjusted down due to lack of security cover (see ratings adjustments).
- Cutblocks in structural stage 2 or 3 are rated class 3.
- All other areas are rated class 6.

Detailed Ratings Assumptions for Summer Feeding Habitat (S-FD)

- Polygons in the MHmm1, MHmmp, and CMAun with large openings and berry producing shrubs are rated class 1.
- Dry to wet forest units (CWH and MH) with berry producing shrubs in structural stages 2 and 3 are rated class 2. Similar units in structural stage 6 or 7 are rated class 3.
- Floodplain forest units are rated class 2 if they are in structural stage 3 and class 3 if they are in structural stage 6 or 7. Structural stage 4 and 5 are rated class 5.
- Wet meadows/fens are rated class 4.
- Cutblocks in structural stage 2 or 3 are rated class 2.
- All other areas are rated class 6.

Detailed Rating Assumptions for Fall Feeding Habitat

- Salmon spawning streams are rated class 1.
- Floodplain forests (all structural stages) within 100 m of salmon spawning streams are rated class 1.
- All other habitat within 100 m of salmon spawning stream are adjusted up by a maximum of 2 rating classes.
- Floodplain forests in structural stages 2/3 and 6/7 are rated class 2.
- Openings (structural stages 2-3) and mature forests (Structural stages 6-7) with berry producing shrubs are rated class 2
- Wet (subhydric) swamp forests in Structural stage 6 and 7, with presence of skunk cabbage, horsetails, cow parsnip, or other forage plant species, are rated class 2.
- Openings in structural stage 2 or 3 are rated class 4.
- Openings in structural stage 4 or 5 are rated class 5.
- All other areas are rated class 6.

Table 9 Detailed Early Spring habitat assumptions

GRIZZLY BEAR **EARLY SPRING**	
Ratings	Assumptions
1 (High) [75-100%]	• CWHwm and ICHvc Structural stages 1 -3a (<600m elevation) • Avalanche chutes with warm aspect (135 - 285°) • Low elevation wetlands (<600m).
2 (Mod. high) [50—75%]	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09 o ICHvc 03, 04, 05, & 06 • Low elevation (<600m) meadows, fields, right of ways, landings and other grass covered openings
3 (moderate) [25-50%]	• Low Elevation (<600m) Riparian flood plains o CWHwm 05, 06, & 07 • Cutblocks and other openings in structural stage 2 or 3
4 (low) [5-25%]	• Wet forest units in structural stages 4 or 5 that have skunk cabbage, horsetails, cow parsnip, and other important forage species:
5 (very low) [1-5%]	• Dry to mesic forest units (Site series 01 – 04 in all BEC zones) in structural stages 4 to 7
6 (nil) [0%]	• All other habitats not listed above • All habitat above 600m elevation

Table 10 Late Spring habitat ratings assumptions

GRIZZLY BEAR **LATE SPRING**	
Ratings	Assumptions
1 (High) [75-100%]	• CWHwm Structural Stage 2-3 o 04, 05, 06, 07, 08, 09 • ICHvc Structural Stages 2-3 o 01, 01/02, 03, 04, 04/05, • Avalanche Chutes with warm aspect (135 - 285°) • Low elevation (<1000m) meadows, fields, right of ways, landings and other grass covered openings, • Meadows

	• Wetlands
2 (Mod. high) [50—75%]	• Wet forest units in structural stages 5/6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 08 & 09 o ICHvc 03, 04, 05, 06, & Fm03 • Wet forest units in structural stages 2-3 and 5-7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o MHmm1 03, 05, 06, 07 & 09 o MHmm2 05, 06, 07, & 09
3 (moderate) [25-50%]	• Mid Elevation (<1000m) Riparian flood plains o CWHwm 05, 06, & 07 o ICHvc Fl02 • Cutblocks in structural stage 2 or 3 • Roads, landings, or other grass covered openings • Avalanche chutes with cool aspect (285° to 135°)
4 (low) [5-25%]	• Wet forest units in structural stages 4 or 5 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09 o ICHvc 03, 04, 05, 06, & Fm03 o MHmm1 03, 05, 06, 07 & 09 o MHmm2 05, 06, 07, & 09
5 (very low) [1-5%]	• Dry to mesic forest units in structural stages 4 and 5 (Site series 01 – 04 in all BEC zones)
6 (nil) [0%]	• All other habitats not listed above • All habitat above 1000m

Table 11 Summer Habitat Ratings Assumptions

GRIZZLY BEAR **SUMMER**	
Ratings	Assumptions

1 (High) [75-100%]	• Polygons with large openings (SS 2 & 3) and berry producing shrubs: o CWHwm 01, 03, 04 and 08 o ICHvc 01, 02 o MHmm1 & 2 and mmp 01, 02, 05, and 06 • Salmon spawning streams
2 (Mod. high) [50—75%]	• Dry to Wet Forest units with berry producing shrubs in structural stages 2 – 3 and 6-7: o CWHwm: 01, 03, 04 and 08 o ICHvc: 01, 02, 04, 06 o MHmm1 & 2: 01, 02, 04 and 06 o MHmmp • Riparian forest units in structural stage 3 within 100m of water
3 (moderate) [25-50%]	• Wet meadows: o CMAun 00-Ah, 00-Am, , 00-Sk o MHmmp 00-Hm, 00-Sk, 00-Sc, 00-Vh, and 00-Vs o MHmm1 Wf50 and Fm50 • Wetlands Ws51 • Avalanche Chutes
4 (low) [5-25%]	• Wet forest units in structural stage 4 -7 o CWHwm 05 to 09 o MHmm1 05 - 07
5 (very low) [1-5%]	o Drier Forested Sites Structural Stage 4 o CWHwm 01 to 04 o MHmm1 01 to 04
6 (nil) [0%]	• All other habitats not listed above

Table 12 Fall Habitat Ratings Assumptions

GRIZZLY BEAR **FALL**	
Ratings	Assumptions
1 (High) [75-100%]	• Salmon spawning streams • Floodplain forests (all structural stages) within 100 m of salmon spawning streams
2 (Mod. high) [50—75%]	• CWHwm, ICHvc and MHmm1 & 2 with: o Floodplain forests in structural stages 2, 3, 6 OR 7; or o Cutblocks and structural stage 3 natural openings with high percentage cover (> 50%) of berry producing shrubs (SS 3) in: ▪ CWHwm 01, 03, 04 and 08 ▪ MHmm1 and • Dry to Wet Forest units with berry producing shrubs in structural stages 6 and 7 o CWHwm 01, 03, 04 and 08 o ICHvc 01, 02, 04, 06 o MHmm1 & 2: 01, 02, 04 and 06
3 (moderate) [25-50%]	• Wet forest units in structural stages 2/3 or 6/7 that have skunk cabbage, horsetails, cow parsnip, and other important forage species: o CWHwm 04, 08 & 09 o ICHvc 04, 05, & 06 o MHmm1 03, 05, 06, 07 & 09 o MHmmp 01, 02, 05, and 06 • Wet meadows: o CMAun 00-Ah, 00-Am, , 00-Sk o MHmmp 00-Hm, 00-Sk, 00-Sc, 00-Vh, and 00-Vs o MHmm1 Wf50 and Fm50 • Wetlands • Avalanche Chutes • MHmmp

4 (low) [5-25%]	• Dry to mesic forest units (Site series 01 – 04 in all BEC zones) in structural stages 6 and 7
5 (very low) [1-5%]	• Dry to mesic forest units(Site series 01 – 04 in all BEC zones) in structural stages 4 and 5 • Cutblocks in structural stage 4 or 5
6 (nil) [0%]	• All other habitats not listed above

Table 13. Detailed Rating Assumption for Winter Denning (Wi-DE)

Rating	***Assumptions***
1 - High	• CMAun, BAFun, and MHmmp with 55 – 90% slopes on cool aspects (285°-135°) with deep soils (site modifiers d and m) and good vegetative cover (structural stages 2 and 3 with herb/shrub cover >50%) • Structural stage 6 to7 in upper MHmm1 and 2 (>1,100 m) and transition to MHmmp with cool aspect (285°-135°) • Rock caves in CMA BAFun, MHmmp and MHmm1 & 2
2 –Mod. High	• CMAun and BAFun where vegetation cover not as dense (structural stage 2-3 with 20-50% herb/shrub cover) with: • Cool aspect (285°-135°) and • Slopes are 35 – 55% or 85 – 120% • MHmm1 & 2 and MHmmp with structural stage 5 and 55 – 90% slopes
3 - Moderate	• CMAun, BAFun and MHmmp with warm aspect (135° -285°) • MHmm1 and 2 (>1000m) in structural stages 3 or 4 with slopes 55 – 90%, cool aspect (285°-135°) with good soils (site modifiers d and m) and vegetation cover (>50% cover)
4 - Low	• As class 3 above but shallow unstable soils (site modifiers s and v) • Structural stage 5 to 7 (<600 m) at MHmm1/CWHwm transition or MHmm2/ICHvc transition
5 - Very Low	• Structural stage 3 to 4 (<1,000 m) MHmm1 & 2
6 - Nil	• Scree, talus, or other unstable slopes • Wet seepages • Glaciers, Permanent Snow • Boulder fields or bedrock o Slopes with <50% vegetation cover

Habitat Ratings Adjustments

- No downward adjustments will be made to fall feeding habitat suitability within 100 m of salmon spawning streams regardless of human activity.
- Habitat suitability is adjusted downward by 2 classes for all habitat within 500 m of human activity.

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APPENDIX 3

FIELD VERIFICATION AND HABITAT RATINGS WITHIN THE LSA

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
MEM	BAFAun	00	AC	Avalanche Chute	Alder - fern avalanche chute; steep slopes	2/3	6	1	6	6	1	5	6	6	6	N	M	H
MEM	BAFAun	00	AF	Alpine Fellfield	Non-forested	1a	6	2	6	6	6	6	6	6	6	N	N	M
MEM	BAFAun	00	AH	Alpine Heath	Non-forested	2d	6	2	6	6	1	4	1	6	5	N	N	M
MEM	BAFAun	00	AM	Alpine Herb Meadow	Non-forested	2	6	2	6	6	1	4	5	6	4	N	N	M
MEM	BAFAun	00	AS	Alpine Nivation	Non-forested	N/A	6	3	6	6	5	6	6	6	6	N	N	N
MEM	BAFAun	00	AT	Alpine Tundra	herbaceous cover	2b	6	2	6	6	1	4	2	6	4	N	N	H
MEM	BAFAun	00	CB	Cutbank	Non Vegetated	1	6	3	6	6	5	6	6	6	6	N	N	N
MEM	BAFAun	00	ET	Escape Terrain	Sparsley Vegetated	1	6	1	6	6	3	4	2	6	5	N	N	H
MEM	BAFAun	00	GB	Gravel Bar	Unvegetated	1	6	6	6	6	5	6	6	6	6	N	N	N
MEM	BAFAun	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	BAFAun	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	5	5	6	6	4	N	N	N
MEM	BAFAun	00	MI	Mine	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	BAFAun	00	PD	Pond	Non-vegetated	N/A	6	6	6	6	5	5	6	6	4	N	N	N
MEM	BAFAun	00	PN/GL	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	BAFAun	00	PS	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	BAFAun	Rc	Rc	Rock Cliff	Non Forested	N/A	6	1	6	6	5	6	5	6	6	N	N	H
MEM	BAFAun	00	RI	River	Non-vegetated	N/A	6	6	6	6	5	6	6	6	6	N	N	N
MEM	BAFAun	Ro	Ro	Rock Outcrop	Non-forested	N/A	6	1	6	6	6	6	5	6	6	N	N	H
MEM	BAFAun	Sk	Sk	Shrub krummolz	Non Forested	2/3	6	1	6	6	3	5	2	6	6	L	L	H
SBR	CMAun	00	AC	Avalanche Chute	Alder - fern avalanche chute; steep slopes	2/3	6	1	6	3	1	2	1	6	3	N	L	M
SBR	CMAun	00	Af	Alpine Fellfield	Non-forested	1	6	3	6	6	5	6	6	6	6	N	N	N
SBR	CMAun	00	Ah	Alpine Heath	Non-forested	2d	6	2	6	4	2	4	1	6	4	L	L	M
SBR	CMAun	00	AM	Alpine Herb Meadow	Non-forested	2	6	1	6	3	1	4	3	6	3	N	N	M
SBR	CMAun	00	AS	Alpine Nivation	Non-forested	N/A	6	2	6	6	4	6	6	6	6	N	N	L
SBR	CMAun	00	AT	Alpine Tundra	Non-forested	2b	6	1	6	3	1	4	3	6	3	N	N	M
SBR	CMAun	00	CB	Cutbank	Non Vegetated	1	6	3	6	6	6	6	5	6	4	L	N	L
SBR	CMAun	00	ET	Escape Terrain	Sparsley Vegetated	1	6	1	6	6	6	6	6	6	6	N	N	H
SBR	CMAun	00	GB	Gravel Bar	Unvegetated	1	6	5	6	6	4	5	6	6	5	N	N	L
SBR	CMAun	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	CMAun	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	6	6	6	6	2	N	N	N
SBR	CMAun	00	MI	Mine	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CMAun	00	PD	Pond	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	N
SBR	CMAun	00	PN/GL	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	CMAun	00	PS	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	CMAun	Rc	Rc	Rock Cliff	Non Forested	N/A	6	1	6	6	6	6	5	6	6	N	N	M
SBR	CMAun	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	6	6	6	5	N	N	L
SBR	CMAun	Ro	RO	Rock Outcrop	Non-forested	N/A	6	1	6	6	6	6	6	6	6	N	N	M
SBR	CMAun	Sk	Sk	Shrub krummolz	Non Forested	2/3	6	1	6	6	2	4	2	6	4	N	N	L
SBR	CMAun	00	VS	Avalanche Chute	Alder - fern avalanche chute; steep slopes	2/3	6	1	6	3	1	2	1	6	3	N	L	M
SBR	CWHwm	51	51	Generic Avalanche Code	Non-forested	2/3	6	3	1	1	3	3	6	5	2	N	N	H
SBR	CWHwm	00	AC	Avalanche Chute	Alder - fern avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	CWHwm	00	AD	Alder - Devils Club	Very Steep Slopes	3a/3b	4	5	1	1	3	3	6	5	3	N	L	M
SBR	CWHwm	00	CB	Cutbank	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench	1	6	6	3	3	2	3	6	5	4	L	L	L
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench	2	6	6	1	1	3	3	6	1	2	L	L	M
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench	3	6	6	3	3	1	1	6	1	2	L	L	M
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench	4	6	6	4	4	3	3	6	1	2	L	L	M
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench	5/6/7	3	6	2	2	1	1	6	1	1	H	H	H
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, middle bench	1	6	6	3	3	2	3	6	5	4	L	L	L
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench	2	6	6	1	1	3	3	6	1	2	L	L	M
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench	3	6	6	3	3	1	1	6	1	2	L	L	M
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench	4	6	6	4	4	3	3	6	1	2	L	L	M

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench	5/6/7	3	6	2	2	1	1	6	1	1	H	H	H
SBR	CWHwm	00	ES	Exposed Soil	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CWHwm	00	ET	Escape Terrain	Sparsley Vegetated	1	3	3	6	6	6	6	6	6	6	N	N	M
SBR	CWHwm	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	5/6/7	1	4	5	5	5	5	6	6	6	M	M	L
SBR	CWHwm	00	FL/GB	Low Bench Floodplain/ ravel Bar	Unvegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CWHwm	00	GB	Gravel Bar	Unvegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	1	6	6	3	3	1	2	6	4	4	L	L	L
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	2	6	6	2	3	1	2	6	4	4	L	L	L
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	3	6	6	2	3	1	2	6	4	4	L	L	L
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	4	6	6	2	3	1	2	6	4	4	L	L	L
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	5/6/7	3	6	2	2	1	2	6	3	3	L	L	L
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position	1	6	6	3	3	2	3	6	4	4	L	L	L
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position	2	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position,	3	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position,	4	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position,	5/6/7	4	6	2	2	2	3	6	3	3	L	L	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions	1	6	6	2	2	4	4	6	5	4	L	L	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions	2	6	6	1	1	3	3	6	5	4	L	L	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions	3	6	6	2	2	1	3	6	4	4	L	L	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions	4	6	6	3	3	3	3	6	3	4	L	L	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions	5/6/7	3	6	3	3	3	3	6	1	3	H	H	M
SBR	CWHwm	00	IF	Indian Hellabore - Fern	gentle to moderate colluvial slopes at the toe of avalanche tracts	2/3	4	5	1	1	3	3	6	5	1	N	L	M
SBR	CWHwm	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	6	6	6	6	2	N	N	N
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	1	6	6	6	6	6	6	6	5	4	L	L	L
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	2	6	6	3	3	6	6	6	5	4	L	L	L
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	3	6	6	3	3	6	6	6	4	4	L	L	L
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	4	6	6	6	6	6	6	6	3	4	L	L	L
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	5/6/7	5	6	3	3	6	6	6	1	3	H	H	L
SBR	CWHwm	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	1	6	6	2	N	N	M
SBR	CWHwm	Ro	RO	Rock Outcrop	Non-forested	N/A	1	1	6	6	6	6	6	6	6	N	N	H
SBR	CWHwm	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site	1	6	6	2	2	4	4	6	5	4	L	L	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site;	2	6	6	1	1	3	3	6	5	4	L	L	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site	3	6	6	2	2	1	3	6	4	4	L	L	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site	4	6	6	3	3	3	3	6	3	4	L	L	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site	5/6/7	3	6	2	2	3	3	6	1	3	H	H	M
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites	1	6	6	3	3	4	3	6	5	4	L	L	L
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites	2	6	6	1	1	2	3	6	5	4	L	L	L
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites	3	6	6	1	1	2	2	6	4	4	L	L	L
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving site	4	6	6	1	3	3	3	6	4	4	L	L	L
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites	5/6/7	3	6	2	2	1	1	6	1	3	H	H	M
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	1	6	6	3	3	2	3	6	6	4	L	L	L
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	2	6	6	2	3	2	3	6	6	4	L	L	L
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	3	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	4	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	5/6/7	3	6	2	2	2	3	6	1	3	H	H	M
SBR	CWHwm	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club	Mesic Forest	1	6	6	3	3	2	3	6	6	4	L	L	L
SBR	CWHwm	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club	Mesic Forest	2	6	6	2	3	2	3	6	6	4	L	L	L
SBR	CWHwm	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club	Mesic Forest	3	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club	Mesic Forest	4	6	6	2	3	2	3	6	4	4	L	L	L
SBR	CWHwm	03/04	SO/SD	SsHw - Oak fern/SsHw - Devil's club	Mesic Forest	5/6/7	3	6	2	2	2	3	6	1	3	H	H	M
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench	1	6	6	3	3	2	3	6	5	4	L	L	L

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench	2	6	6	1	1	3	3	6	1	2	L	L	M
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench	3	6	6	3	3	1	1	6	1	2	L	L	M
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench	4	6	6	4	4	3	3	6	1	2	L	L	M
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench	5/6/7	3	6	2	2	1	1	6	1	1	H	H	H
SBR	CWHwm	00	SW	Shrubland (Willow/Alder Thicket)	Shrub complex	3a/3b	4	5	1	1	3	3	6	5	3	N	L	M
SBR	CWHwm	00	UR	Urban Residential	Non-vegetated	N/A	6	6	6	6	6	6	6	6	4	N	N	N
SBR	CWHwm	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	CWHwm	00	Vs	Avalanche Shrub Thicket	avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	CWHwm	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)	Alder - fern avalanche chute	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	CWHwm	00	Water	Water (Includes ponds and ocean)	Non-vegetated	N/A	6	6	6	6	6	6	6	6	2	N	N	N
SBR	CWHwm	00	Wb	Bog Wetland	Wetland	3	6	6	3	3	6	6	6	4	4	L	L	L
SBR	CWHwm	00	Wb	Bog Wetland	Wetland	4	6	6	6	6	6	6	6	3	4	L	L	L
SBR	CWHwm	00	Wb	Bog Wetland	Wetland	5/6/7	5	6	3	3	6	6	6	1	3	H	H	M
SBR	CWHwm	00	WE	Shrub Wetland (Swamp and/or Fen)	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	M
SBR	CWHwm	00	Wh	Herb Wetlands	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	M
SBR	CWHwm	00	Ws	Swamp Wetland	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	M
SBR	CWHwm	Ws51	Ws51	Stika willow – Pacific willow – Skunk cabbage	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	L
MEM	ICHvc	07	--	Hw - Cloudberry - Peat-moss (Wb04 - Hw - Cloudberry - Peat-moss)		1	6	6	4	4	5	3	6	6	2	N	N	M
MEM	ICHvc	07	--	Hw - Cloudberry - Peat-moss (Wb04 - Hw - Cloudberry - Peat-moss)		2	6	6	3	2	5	3	6	6	2	N	N	M
MEM	ICHvc	07	--	Hw - Cloudberry - Peat-moss (Wb04 - Hw - Cloudberry - Peat-moss)		3	6	6	3	2	5	3	6	6	2	N	N	M
MEM	ICHvc	07	--	Hw - Cloudberry - Peat-moss (Wb04 - Hw - Cloudberry - Peat-moss)		4	6	6	3	2	5	3	6	6	2	L	N	M
MEM	ICHvc	07	--	Hw - Cloudberry - Peat-moss (Wb04 - Hw - Cloudberry - Peat-moss)		5/6/7	5	6	3	2	5	3	6	6	2	M	N	M
MEM	ICHvc	31	31	Non-forested fen/marsh		2	6	6	1	1	3	3	6	6	2	N	N	M
MEM	ICHvc	05	CD	ActSx - Dogwood	active floodplains, medium to low bench	1	6	6	3	3	4	4	6	6	4	N	N	N
MEM	ICHvc	05	CD	ActSx - Dogwood	active floodplains, medium to low bench	2	6	6	1	1	3	3	6	5	3	N	N	L
MEM	ICHvc	05	CD	ActSx - Dogwood	active floodplains, medium to low bench	3	6	6	1	1	4	2	6	4	1	L	N	H
MEM	ICHvc	05	CD	ActSx - Dogwood	active floodplains, medium to low bench	4	5	6	2	2	4	2	6	3	1	M	H	H
MEM	ICHvc	05	CD	ActSx - Dogwood	active floodplains, medium to low bench	5/6/7	3	6	2	2	4	3	6	1	1	H	H	H
MEM	ICHvc	04	DD	Sx - Devil's club - Dogwood	active floodplains, gentle slope to level; high bench	1	6	6	2	2	4	4	6	6	4	N	N	N
MEM	ICHvc	04	DD	Sx - Devil's club - Dogwood	active floodplains, gentle slope to level; high bench	2	6	6	1	1	2	3	6	5	3	N	N	L
MEM	ICHvc	04	DD	Sx - Devil's club - Dogwood	active floodplains, gentle slope to level; high bench	3	6	6	1	1	2	2	6	4	1	L	H	H
MEM	ICHvc	04	DD	Sx - Devil's club - Dogwood	active floodplains, gentle slope to level; high bench	4	5	6	1	2	4	2	6	3	1	M	H	H
MEM	ICHvc	04	DD	Sx - Devil's club - Dogwood	active floodplains, gentle slope to level; high bench	5/6/7	3	6	1	2	4	3	6	1	1	H	H	H
MEM	ICHvc	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood	active floodplains, gentle slope to level; high bench	1	6	6	2	2	4	4	6	6	4	N	N	N
MEM	ICHvc	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood	active floodplains, gentle slope to level; high bench	2	6	6	1	1	2	3	6	5	3	N	L	L
MEM	ICHvc	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood	active floodplains, gentle slope to level; high bench	3	6	6	1	1	2	2	6	4	1	L	H	H
MEM	ICHvc	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood	active floodplains, gentle slope to level; high bench	4	5	6	1	1	4	2	6	3	1	M	H	H
MEM	ICHvc	04/05	DD/CD	Sx - Devil's club - Dogwood/ActSx - Dogwood	active floodplains, gentle slope to level; high bench	5/6/7	3	6	1	1	4	3	6	1	1	H	H	H
MEM	ICHvc	00	ES	Exposed Soil	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	ICHvc	Fl01	Fl01	Mountain alder - Common horsetail		2/3	6	6	1	1	3	3	6	6	1	N	N	H
MEM	ICHvc	01	HD	HwBl - Devil's club	gentle slope; deep, medium - textured soil	1	6	6	3	3	3	4	6	6	6	N	N	L
MEM	ICHvc	01	HD	HwBl - Devil's club	gentle slope; deep, medium - textured soil	2	6	6	1	1	3	3	6	5	1	N	N	H
MEM	ICHvc	01	HD	HwBl - Devil's club	gentle slope; deep, medium - textured soil	3	6	6	1	1	1	2	6	4	1	N	N	H
MEM	ICHvc	01	HD	HwBl - Devil's club	gentle slope; deep, medium - textured soil	4	3	6	3	3	3	2	6	4	2	L	N	M
MEM	ICHvc	01	HD	HwBl - Devil's club	gentle slope; deep, medium - textured soil	5/6/7	2	6	2	2	3	3	6	1	2	H	H	M
MEM	ICHvc	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss	gentle slope; deep, medium - textured soil	1	6	6	3	3	3	4	6	6	6	N	N	N
MEM	ICHvc	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss	gentle slope; deep, medium - textured soil	2	6	6	1	1	3	3	6	5	1	N	N	H
MEM	ICHvc	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss	gentle slope; deep, medium - textured soil	3	6	6	1	1	1	2	6	4	1	N	N	H
MEM	ICHvc	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss	gentle slope; deep, medium - textured soil	4	3	6	3	3	3	2	6	4	2	L	N	M
MEM	ICHvc	01/02	HD/HM	HwBl - Devil's club/Hw - Step moss	gentle slope; deep, medium - textured soil	5/6/7	2	6	3	3	3	3	6	1	2	H	H	M
MEM	ICHvc	02	HM	Hw - Step moss	gentle slope; deep, coarse - textured soil	1	6	6	4	4	3	4	6	6	6	N	N	N
MEM	ICHvc	02	HM	Hw - Step moss	gentle slope; deep, coarse - textured soil	2	6	6	3	3	2	4	6	5	4	N	N	N

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
MEM	ICHvc	02	HM	Hw - Step moss	gentle slope; deep, coarse - textured soil	3	6	6	3	4	1	4	6	4	4	N	N	N
MEM	ICHvc	02	HM	Hw - Step moss	gentle slope; deep, coarse - textured soil	4	3	6	4	4	1	4	6	4	4	L	N	N
MEM	ICHvc	02	HM	Hw - Step moss	gentle slope; deep, coarse - textured soil	5/6/7	2	6	4	3	4	4	6	1	4	H	H	N
MEM	ICHvc	00	PD	Pond	Non-vegetated	N/A	6	6	6	1	1	6	6	3	1	N	L	N
MEM	ICHvc	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	1	6	6	2	N	N	M
MEM	ICHvc	Ro	RO	Rock Outcrop	Non-forested	N/A	1	1	6	6	6	6	6	6	6	N	N	H
MEM	ICHvc	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	ICHvc	03	SD	Sx - Devil's club	lower slope; receiving site; deep, medium - textured soils	1	6	6	2	3	4	4	6	6	4	N	N	N
MEM	ICHvc	03	SD	Sx - Devil's club	lower slope; receiving site	2	6	6	1	1	4	3	6	5	1	N	N	H
MEM	ICHvc	03	SD	Sx - Devil's club	lower slope; receiving site; deep, medium - textured soils	3	6	6	1	1	4	2	6	4	1	N	N	H
MEM	ICHvc	03	SD	Sx - Devil's club	lower slope; receiving site; deep, medium - textured soils	4	4	6	2	2	4	2	6	3	2	L	N	M
MEM	ICHvc	03	SD	Sx - Devil's club	lower slope; receiving site	5/6/7	2	6	2	2	4	3	6	1	2	H	M	M
MEM	ICHvc	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)	level to depression	1	6	6	3	3	5	4	6	6	2	N	N	M
MEM	ICHvc	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)	level to depression	2	6	6	1	1	4	2	6	5	2	N	N	M
MEM	ICHvc	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)	level to depression;	3	6	6	1	1	4	3	6	5	2	L	N	M
MEM	ICHvc	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)	level to depression;	4	6	6	2	2	4	3	6	5	2	M	N	M
MEM	ICHvc	06	SH	Sx - Horsetail (Ws07 - Sxw - Common horsetail - Leafy moss)	level to depression;	5/6/7	5	6	2	2	4	3	6	5	2	H	N	M
MEM	ICHvc	00	SW	Shrubland (Willow/Alder Thicket)	Shrub complex	3a/3b	4	5	1	1	3	3	6	5	3	N	L	M
MEM	ICHvc	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	5	4	N	N	H
MEM	ICHvc	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)	Alder - fern avalanche chute	2/3	6	3	1	1	3	3	6	5	4	N	N	H
MEM	ICHvc	00	Wb	Bog Wetland	Wetland	3	6	6	3	3	6	6	6	4	4	L	M	L
MEM	ICHvc	00	Wb	Bog Wetland	Wetland	4	6	6	6	6	6	6	6	3	4	L	M	L
MEM	ICHvc	00	Wb	Bog Wetland	Wetland	5/6/7	5	6	3	3	6	6	6	1	3	H	H	M
MEM	ICHvc	Wb13	Wb13	Shore sedge - Buckbean - Peat-moss		2	6	6	1	1	3	3	6	6	1	N	N	H
MEM	ICHvc	00	WE	Shrub Wetland (Swamp and/or Fen)	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	L
MEM	ICHvc	Wf01	Wf01	Water sedge - Beaked sedge		2	6	6	1	1	3	3	6	6	1	N	N	H
MEM	ICHvc	Wf51	Wf51	Sitka sedge - Peat-moss		2	6	6	1	1	3	3	6	6	1	N	N	H
MEM	ICHvc	00	Wh	Herb Wetlands	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	L
MEM	ICHvc	WM09	WM09	Inflated sedge		2	6	6	1	1	3	3	6	6	1	N	N	H
MEM	ICHvc	00	Ws	Swamp Wetland	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	L
MEM	ICHvc	WS02	WS02	Mountain alder - Pink spirea - Sitka		2/3	6	6	3	3	3	3	6	6	1	N	N	H
MEM	ICHvc	WS04	WS04	Drummond's willow - Beaked sedge		2/3	6	6	1	1	3	3	6	6	1	N	N	H
SBR	MHmm1	51	51	Generic Avalanche Code	Non-forested	2/3	6	3	2	1	1	3	4	6	3	N	M	M
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	3	6	6	3	2	1	3	4	6	6	N	N	L
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	4	5	6	4	3	3	5	6	6	6	N	N	L
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	5/6/7	1	6	3	2	1	5	6	6	4	M	M	M
SBR	MHmm1	00	CB	Cutbank	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	MHmm1	00	ES	Exposed Soil	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	MHmm1	00	ET	Escape Terrain	Sparsley Vegetated	1	4	1	5	5	5	5	3	6	6	L	M	L
SBR	MHmm1	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	5/6/7	1	1	5	5	3	3	2	6	6	L	M	L
SBR	MHmm1	Fm50	Fm50	Black Cottonwood - Red Alder - Salmonberry	Wetland Mid-Bench floodplain	3a/3b	5	4	3	2	2	3	6	6	2	M	L	M
SBR	MHmm1	00	GB	Gravel Bar	Unvegetated	N/A	6	6	6	6	6	6	6	4	4	N	N	N
SBR	MHmm1	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	MHmm1	00	HM	Heather Meadow	gently sloping ridgecrests and mountain tops	2	4	2	3	2	1	2	4	6	3	N	L	M
SBR	MHmm1	00	IF	Indian Hellabore - Fern	gentle to moderate colluvial slopes at the toe of avalanche tracts	2/3	6	3	4	3	1	1	5	6	1	L	L	L
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	3	6	6	3	2	1	3	4	6	6	N	N	L
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	4	6	6	4	3	3	5	6	6	6	N	N	L
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	5/6/7	2	6	3	2	2	5	6	6	5	L	L	L

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites;	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites;	3	6	6	3	2	1	3	4	6	3	N	N	L
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	4	6	6	4	3	3	5	6	6	5	N	N	L
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	5/6/7	4	6	3	2	1	5	6	6	3	M	M	M
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	3	6	6	3	2	1	3	4	6	6	N	N	L
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	4	6	6	4	3	3	5	6	6	6	N	N	L
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	5/6/7	2	6	3	2	2	5	6	6	5	L	L	L
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	3	6	6	3	2	1	3	4	6	6	N	N	L
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	4	6	6	4	3	3	5	6	6	6	N	N	L
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	5/6/7	1	6	3	2	1	5	6	6	4	M	M	M
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	3	6	6	3	2	1	3	4	6	3	N	N	L
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	4	5	6	4	3	3	5	6	6	5	N	N	L
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	5/6/7	1	6	3	2	1	5	6	6	3	M	M	M
SBR	MHmm1	00	PD	Pond	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	N
SBR	MHmm1	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	MHmm1	Ro	Ro	Rock Outcrop	Non-forested	N/A	5	1	6	6	6	6	6	6	6	N	N	M
SBR	MHmm1	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	MHmm1	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)	Alder - fern avalanche chute	2/3	6	3	1	1	3	3	6	5	4	N	N	H
SBR	MHmm1	00	Wb	Bog Wetland	Wetland	4	6	6	6	6	6	6	6	3	4	L	L	L
SBR	MHmm1	00	Wb	Bog Wetland	Wetland	5/6/7	5	6	3	3	6	6	6	1	3	H	H	M
SBR	MHmm1	Wf50	Wf50	Narrow-leaved Cottongrass-Peat Moss	Wetland	2	6	3	3	1	2	3	6	6	1	N	N	M
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp,	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp,	3	6	6	3	2	1	3	4	6	3	N	N	L
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	4	6	6	4	3	3	5	6	6	5	N	N	L
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	5/6/7	6	6	3	2	2	5	6	6	3	M	M	M
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes;	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes;	3	6	6	3	2	1	3	4	6	3	N	N	L
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes	4	6	6	4	3	3	5	6	6	5	N	N	L
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes	5/6/7	4	6	3	2	2	5	6	6	3	M	M	M
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	1	6	6	3	2	2	4	5	6	6	N	N	N
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	2	6	6	3	2	1	3	4	6	6	N	N	N
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	3	6	6	3	2	1	3	4	6	3	N	N	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	4	6	6	4	3	3	5	6	6	5	N	N	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	5/6/7	5	6	3	2	2	5	6	6	3	M	M	M
MEM	MHmm2	00	AA	Ba - Alaskan blueberry	infrequent aval. Unit		6	3	6	4	1	4	5	6	4	N	N	N
MEM	MHmm2	04	AB	HmBa - Bramble	significant slopes	1	6	3	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	04	AB	HmBa - Bramble	significant slopes	2	6	3	6	5	2	3	4	6	6	N	N	N
MEM	MHmm2	04	AB	HmBa - Bramble	significant slopes	3	6	3	6	5	1	3	4	6	6	N	N	L
MEM	MHmm2	04	AB	HmBa - Bramble	significant slopes	4	3	3	6	5	1	5	6	6	6	N	N	L
MEM	MHmm2	04	AB	HmBa - Bramble	significant slopes	5/6/7	1	3	6	4	2	5	6	6	4	M	M	M
MEM	MHmm2	00	AC	Avalanche chute	significant slope		6	2	6	3	1	3	5	6	3	N	N	L
MEM	MHmm2	00	AF	Alder - Lady fern	seepage, gentle slope, deep soils	2/3	6	6	6	4	3	3	5	6	3	N	N	L
MEM	MHmm2	00	AH	Sitka alder - Black huckleberry avalanche track	avalanche chute; steep slopes	2/3	6	2	6	3	1	3	5	6	3	N	N	L

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G
MEM	MHmm2	00	AM	Herb meadow	gentle slopes; deep, medium-textured soil	2	6	6	6	3	1	3	4	6	3	N	N	L
MEM	MHmm2	00	AV	Sitka alder - Sitka valerian avalanche track	active avalanche tracks	2/3	6	2	6	3	1	3	5	6	3	N	N	L
MEM	MHmm2	51	AV	Avalanche track	GENERIC MAP UNIT		6	2	6	3	1	3	5	6	3	N	N	L
MEM	MHmm2	00	BA	Ba - Valerian	forested parkland unit		6	5	6	4	1	3	4	6	3	L	N	L
MEM	MHmm2	00	BD	Bluejoint - subalpine daisy moist meadow	moist to wet meadows	2	6	3	6	3	1	3	5	6	4	N	N	L
MEM	MHmm2	00	BT	Brushy Talus	non-forested	2/3	6	4	6	6	3	5	6	6	6	M	N	L
MEM	MHmm2	00	CA	Crowberry - Bog blueberry - Alpine azalea or (Dry Lichen)	crest; shallow, coarse-textured soil	2	6	5	6	4	2	3	6	6	5	L	N	L
MEM	MHmm2	00	DH	Ds - Herb - grass	Alder thickets interspersed with herb and grass meadows,	2	6	6	6	3	1	3	6	6	3	N	N	L
MEM	MHmm2	00	ES	Exposed Soil	Non Vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	MHmm2	00	FH	BaBl - Mountain heather	typically on gently sloping Mb in cirque basins;	2d/6/7	3	2	6	5	3	3	3	6	3	M	N	L
MEM	MHmm2	00	FP	Open Balsam Forest	open shrubby balsam forest, on rock, with		4	3	6	5	3	3	4	6	3	M	N	L
MEM	MHmm2	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
MEM	MHmm2	00	GW	Herb Wetlands	all non-forested sedge fens and herb wetlands	2	6	5	6	3	1	3	6	6	2	N	N	M
MEM	MHmm2	00	HM	Heath meadow	gentle slopes, crest; shallow, coarse-textured soils	2	6	5	6	4	2	3	2	6	4	N	N	L
MEM	MHmm2	00	LB	Liverwort - Brachythecium talus	blocky talus slopes subject to rapid mass movement.	N/A	6	5	6	6	5	3	6	6	6	H	L	L
MEM	MHmm2	01	MB	HmBa - Blueberry	significant slope	1	6	3	6	6	4	6	6	6	6	N	N	N
MEM	MHmm2	01	MB	HmBa - Blueberry	significant slopes;	2	6	3	6	6	1	3	2	6	4	N	N	N
MEM	MHmm2	01	MB	HmBa - Blueberry	significant slopes;	3	6	3	6	6	1	3	3	6	4	N	N	N
MEM	MHmm2	01	MB	HmBa - Blueberry	significant slopes;	4	3	3	6	5	2	3	3	6	4	L	L	N
MEM	MHmm2	01	MB	HmBa - Blueberry	significant slopes	5/6/7	1	3	6	5	2	4	3	6	4	M	M	N
MEM	MHmm2	06	MD	HmYc - Deer cabbage	lower slope receiving position	1	6	6	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	06	MD	HmYc - Deer cabbage	lower slope receiving position	2	6	6	6	5	1	3	4	6	6	N	N	N
MEM	MHmm2	06	MD	HmYc - Deer cabbage	lower slope receiving position	3	6	6	6	5	1	3	4	6	3	N	N	L
MEM	MHmm2	06	MD	HmYc - Deer cabbage	lower slope receiving position	4	4	6	6	4	1	5	6	6	5	N	N	L
MEM	MHmm2	06	MD	HmYc - Deer cabbage	lower slope receiving position	5/6/7	2	6	6	3	2	5	6	6	3	M	M	M
MEM	MHmm2	00	MH	Mountain hemlock - Indian hellebore	wet, nutrient-rich sites on gentle toe slopes		6	6	6	3	2	2	3	6	3	L	N	L
MEM	MHmm2	00	MK	Mountain hemlock krummholz	gentle slopes, very shallow soils	2/3	6	4	6	5	2	4	2	6	5	N	L	L
MEM	MHmm2	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	1	6	6	6	6	4	6	6	6	6	N	N	N
MEM	MHmm2	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	2	6	6	6	5	3	4	3	6	4	N	N	N
MEM	MHmm2	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	3	6	6	6	5	1	4	3	6	4	N	N	N
MEM	MHmm2	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	4	5	6	6	5	1	5	3	6	4	L	L	N
MEM	MHmm2	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	5/6/7	1	6	6	4	3	5	3	6	4	H	M	N
MEM	MHmm2	03	MO	BaHm - Oak fern	significant slopes	1	6	3	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	03	MO	BaHm - Oak fern	significant slopes;	2	6	3	6	5	3	3	4	6	6	N	N	N
MEM	MHmm2	03	MO	BaHm - Oak fern	significant slopes	3	6	3	6	5	3	3	4	6	6	N	N	L
MEM	MHmm2	03	MO	BaHm - Oak fern	significant slopes	4	3	3	6	4	3	5	6	6	6	N	N	L
MEM	MHmm2	03	MO	BaHm - Oak fern	significant slopes	5/6/7	1	3	6	3	3	5	6	6	4	M	M	M
MEM	MHmm2	00	MR	Mountain-heather - Racomitrium scrub	mtn-heather dominated ecosystems on gentle slope	2/3	6	4	6	4	2	4	1	6	4	L	L	L
MEM	MHmm2	05	MT	BaHm - Twistedstalk	significant slopes	1	6	3	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	05	MT	BaHm - Twistedstalk	significant slopes; middle to lower slope postion	2	6	3	6	5	3	3	4	6	6	N	N	N
MEM	MHmm2	05	MT	BaHm - Twistedstalk	significant slopes; middle to lower slope postion	3	6	3	6	5	3	3	4	6	3	N	N	L
MEM	MHmm2	05	MT	BaHm - Twistedstalk	significant slopes; middle to lower slope postion	4	3	3	6	4	3	5	6	6	5	N	N	L
MEM	MHmm2	05	MT	BaHm - Twistedstalk	significant slopes; middle to lower slope postion	5/6/7	1	3	6	3	3	5	6	6	3	M	M	M
MEM	MHmm2	00	NH	Alpine Heath	non-forested heath, dominated by grasses and forbs	2/3	6	3	6	4	1	4	1	6	4	N	N	L
MEM	MHmm2	00	OS	Organic shrub fen	non-treed unit, shrub dominated fen on organic soils		6	4	6	4	3	4	6	6	4	N	N	L
MEM	MHmm2	00	PD	Pond	Non-vegetated	N/A	6	6	6	1	1	6	6	6	1	N	N	N
MEM	MHmm2	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	1	6	6	2	N	N	M
MEM	MHmm2	Ro	RO	Rock Outcrop	Non-forested	N/A	1	1	6	6	6	6	6	6	6	N	N	H
MEM	MHmm2	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
MEM	MHmm2	00	SA	Sitka alder - Salmonberry Avalanche chute	subject to periodic snow avalanching; submesic - subhygric	2/3	6	4	6	3	1	3	5	6	3	N	M	M
MEM	MHmm2	00	SM	Sedge - Mountain hairgrass meadow	typically occurs on gently sloping Mb and LGb.	2	6	4	6	3	1	3	6	6	3	N	N	M
MEM	MHmm2	00	SV	Sitka alder Vanilla leaf	deep soil; submesic - subhygric		5	4	6	5	2	3	6	6	2	M	N	M

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MEM	MHmm2	00	SW	Shrubland (Willow/Alder Thicket)	Shrub complex	3a/3b	4	5	1	1	3	3	6	4	3	N	L	M
MEM	MHmm2	00	US	Hm Yc - Sphagnum	treed bog, occurs on level ground and in depressions		5	6	6	5	5	2	6	6	3	N	N	M
MEM	MHmm2	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes	2/3	6	3	1	1	3	3	6	6	4	N	N	H
MEM	MHmm2	00	Vs/SW	Avalanche Shrub Thicket/Shrubland (Willow/Alder Thicket)	Alder - fern avalanche chute	2/3	6	3	1	1	3	3	6	5	4	N	N	H
MEM	MHmm2	00	Wb	Bog Wetland	Wetland	3	6	6	3	3	6	6	6	6	4	L	L	L
MEM	MHmm2	00	Wb	Bog Wetland	Wetland	4	6	6	6	6	6	6	6	6	4	L	L	L
MEM	MHmm2	00	Wb	Bog Wetland	Wetland	5/6/7	5	6	3	3	6	6	6	3	3	H	H	M
MEM	MHmm2	00	WE	Shrub Wetland (Swamp and/or Fen)	Wetland	2/3	6	6	1	1	3	3	6	6	1	N	N	L
MEM	MHmm2	31	WE	Non-forested wetland	GENERIC MAP UNIT	2/3	6	6	6	4	3	3	6	6	2	N	N	M
MEM	MHmm2	00	WE	Shrub Wetlands	all non-forested shrub wetlands	2/3	6	6	6	4	3	3	6	6	1	N	N	H
MEM	MHmm2	00	Wh	Herb Wetlands	Wetland	2/3	6	6	1	1	3	3	6	5	1	N	N	L
MEM	MHmm2	00	WL	Subalpine wetland	level site; deep, medium-textured soils	2/3	6	6	6	4	2	3	6	6	1	N	N	H
MEM	MHmm2	00	WM	Wet seepage meadow	gentle slopes		6	5	6	4	2	3	6	6	1	N	N	H
MEM	MHmm2	00	Ws	Swamp Wetland	Wetland	2/3	6	6	1	1	3	3	6	6	1	N	N	L
MEM	MHmm2	00	WS	Willow - sedge wetland	shrub - sedge dominated wet meadows and fens	2/3	6	6	6	4	1	3	6	6	1	L	L	H
MEM	MHmm2	00	YB	HmYc - Blueberry - Mountain heather	open canopy forests		6	6	6	6	1	2	4	6	4	N	L	L
MEM	MHmm2	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)	treed swamp	1	6	6	6	5	5	4	5	6	6	N	N	N
MEM	MHmm2	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)	treed swamp,	2	6	6	6	5	2	3	4	6	6	N	N	N
MEM	MHmm2	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)	treed swamp,	3	6	6	6	5	2	3	4	6	3	N	N	L
MEM	MHmm2	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)	treed swamp	4	5	6	6	4	4	5	6	6	5	N	N	L
MEM	MHmm2	09	YC	YcHm - Skunk cabbage (Ws55 - YcHm - Skunkcabbage)	treed swamp	5/6/7	3	6	6	4	4	5	6	6	3	M	M	M
MEM	MHmm2	07	YH	YcHm - Hellebore	lower slope receiving position; gentle slopes	1	6	6	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	07	YH	YcHm - Hellebore	lower slope receiving position; gentle slopes	2	6	6	6	5	1	3	4	6	6	N	N	N
MEM	MHmm2	07	YH	YcHm - Hellebore	lower slope receiving position; gentle slopes	3	6	6	6	5	1	3	4	6	3	N	N	L
MEM	MHmm2	07	YH	YcHm - Hellebore	lower slope receiving position; gentle slopes;	4	5	6	6	4	1	5	6	6	5	N	N	L
MEM	MHmm2	07	YH	YcHm - Hellebore	lower slope receiving position; gentle slope	5/6/7	3	6	6	3	2	5	6	6	3	M	M	M
MEM	MHmm2	00	YR	Yc - Rhacomitrium bluffs	scrubby forested bluffs, cliffs		4	1	6	6	4	4	5	6	6	L	L	M
MEM	MHmm2	08	YS	HmYc - Sphagnum	treed bog; organic	1	6	6	6	6	4	4	5	6	6	N	N	N
MEM	MHmm2	08	YS	HmYc - Sphagnum	treed bog; organic	2	6	6	6	6	1	3	4	6	6	N	N	N
MEM	MHmm2	08	YS	HmYc - Sphagnum	treed bog; organic	3	6	6	6	6	1	3	4	6	3	N	N	L
MEM	MHmm2	08	YS	HmYc - Sphagnum	treed bog; organic	4	5	6	6	6	1	5	6	6	5	N	N	L
MEM	MHmm2	08	YS	HmYc - Sphagnum	treed bog; organic	5/6/7	3	6	6	6	2	5	6	6	3	M	M	M
MEM	MHmm2	Wf01		Water sedge - Beaked sedge		2	6	6	5	2	3	4	6	6	4	N	N	N
SBR	MHmmp	00	AM	Alpine Herb Meadow	Non-forested	2	6	1	5	2	1	1	3	6	4	N	N	M
SBR	MHmmp	00	AT	Alpine Tundra	Non-forested	2b	6	1	6	3	1	4	3	6	3	N	N	M
SBR	MHmmp	00	ES	Exposed Soil	Non-vegetated	N/A	6	2	6	6	4	6	6	6	6	N	N	L
SBR	MHmmp	00	ET	Escape Terrain	Sparsley Vegetated	1	4	1	5	5	5	5	5	6	6	N	N	M
SBR	MHmmp	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	5/6/7	3	1	5	5	5	5	2	6	6	N	M	M
SBR	MHmmp	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	MHmmp	00	KC	Krummholz Cliffs	scrubby krummholz on cliffs and hypersteep rock	3	3	1	6	6	6	6	3	6	6	N	N	L
SBR	MHmmp	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	6	6	6	6	2	N	N	N
SBR	MHmmp	00	MH	Hm-Mountain heather Parkland	mosaic of heather and tree islands	2/3	3	2	5	3	2	4	3	6	4	N	L	M
SBR	MHmmp	00	PD	Pond	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	N
SBR	MHmmp	00	PK	Parkland Forest	mosaic of heather and tree islands	2/3	3	2	5	3	2	4	3	6	4	N	L	M
SBR	MHmmp	00	PK/Sc	Parkland Forest/Shrubland	mosaic of heather and tree islands	2/3	3	2	5	3	2	4	3	6	4	N	L	M
SBR	MHmmp	00	PN/GL	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	MHmmp	00	PS	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	3	6	6	6	6	6	6	6	N	N	L
SBR	MHmmp	Rc	Rc	Rock Cliff	Non Forested	N/A	5	1	6	6	6	6	6	6	6	N	N	N
SBR	MHmmp	Ro	Ro	Rock Outcrop	Non-forested	N/A	5	1	6	6	6	6	6	6	6	N	N	M
SBR	MHmmp	Rt	Rt	Rock talus	Non-forested	N/A	6	3	6	6	6	6	6	6	6	M	M	M
SBR	MHmmp	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N
SBR	MHmmp	00	Sc	shrubland	Non Forested	3a/3b	5	2	5	2	1	1	1	6	2	L	L	M

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SBR	MHmmp	00	Sc	Shrub Carr	Non-forested	3a/3b	6	3	4	2	1	2	1	6	3	N	N	M
SBR	MHmmp	Sk	Sk	Shrub krummolz	Non Forested	3a/3b	6	1	5	3	2	2	2	6	3	M	M	M
SBR	MHmmp	Vh	Vh	Avalanche Herb	Non Forested	2	5	1	5	2	1	1	2	6	3	L	L	M
SBR	MHmmp	Vs	Vs	Avalanche Shrub	Non Forested	3a/3b	5	2	5	2	1	1	1	6	2	L	L	M
SBR	MHmmp	Vs	VsSc	Avalanche Shrub/shrub thicket	Non Forested	3a/3b	5	2	5	2	1	1	1	6	2	L	L	M
SBR	MHmmp	Vt	Vt	Avalanche Treed	Non Forested	5/6/7	1	2	5	2	2	2	1	6	3	M	M	M
SBR	MHmmp	00	WA	Alpine Wetland	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	M
SBR	MHmmp	00	WA	Alpine Wetland	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	N

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFL-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
SBR	CMAun	00	AC	Avalanche Chute	Alder - fern avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) so	2/3	6	1	6	4	1	2	1	6	3	N	L	M	N	X	X	N	N	N	N	N	L	M	N	6	N
SBR	CMAun	00	Af	Alpine Fellfield	Non-forested	1a	6	3	6	6	5	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	N	M	N	6	N
SBR	CMAun	00	Ah	Alpine Heath	Non-forested	2d	6	2	6	4	2	4	1	6	4	L	L	M	H	X	X	L	N	N	N	N	H	M	N	6	N
SBR	CMAun	00	Am	Alpine Herb Meadow	Non-forested	2a	6	1	6	4	1	3	2	6	3	N	N	M	H	X	X	L	N	N	N	N	H	M	N	6	N
SBR	CMAun	00	As	Alpine Nivation	Non-forested	1a	6	2	6	6	4	6	6	6	6	N	N	M	L	X	X	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	At	Alpine tundra	Non-forested	2d	6	2	6	4	2	4	1	6	4	L	L	M	M	X	X	L	N	N	N	N	H	M	N	6	N
SBR	CMAun	00	CB	Cutbank	Non Vegetated	1a	6	3	6	6	6	6	5	6	6	L	N	N	L	X	X	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	ES	Exposed Soil	Non-vegetated	1	6	2	6	6	4	6	6	6	6	N	N	L	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	ET	Escape Terrain	Sparsley Vegetated	1	6	1	6	6	6	6	6	6	6	N	N	H	H	U	U	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	GB	Gravel Bar	Unvegetated	1	6	5	6	6	4	5	6	6	6	N	N	L	L	X	X	L	N	N	N	N	L	N	N	6	N
SBR	CMAun	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	6	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	6	6	6	6	4	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	H
SBR	CMAun	00	MI	Mine	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	L	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	MN	Morraine	non-vegetated	1a	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	NC	Not Classified	No Air photo coverage	N/A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SBR	CMAun	00	PN	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	5	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	PS	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	5	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	Rc	Rock Cliff	Non Forested	1	6	1	6	6	6	6	5	6	6	N	N	H	H	U	U	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	6	6	6	5	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	L
SBR	CMAun	00	Ro	Rock Outcrop	Non-forested	1	6	1	6	6	6	6	6	6	6	N	N	H	H	U	U	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	Rt	Rock Talus	Non-forested	1	6	1	6	6	6	6	6	6	6	N	N	H	H	U	U	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	RU	Rubble	Rubble is common on the ground surface in and adjacent to alpine areas, on ridgetop	1a	6	6	6	6	6	6	6	6	6	N	L	L	L	X	X	L	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CMAun	00	Sc	shrubland	Non Forested	3a	5	2	5	4	1	1	1	6	2	L	L	M	M	X	X	N	N	N	N	N	M	H	N	6	N
SBR	CMAun	00	Sk	Shrub krummolz	Non Forested	2/3	6	1	6	6	2	3	2	6	4	N	N	H	M	X	X	N	N	N	N	N	M	M	N	6	N
SBR	CMAun	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) so	2/3	6	1	5	4	1	3	1	5	4	N	N	H	N	X	X	N	N	N	N	N	N	M	N	6	N
SBR	CMAun	00	Vs	Avalanche Shrub	Non Forested	3a	5	2	5	4	1	1	1	6	2	L	L	M	L	X	X	N	N	N	N	N	M	H	N	6	N
SBR	CWHwm	51	51	Generic Avalanche Code	Non-forested	2/3	6	5	1	1	3	3	6	5	2	N	N	H	N	X	X	N	N	L	N	N	N	M	N	6	N
SBR	CWHwm	00	AC	Avalanche Chute	Alder - fern avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) so	2/3	6	5	1	1	3	3	6	5	4	N	N	H	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	CWHwm	00	AD	Alder - Devils Club	Very Steep Slopes	3a/3b	4	6	1	1	3	3	6	5	3	N	L	M	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	CWHwm	00	CB	Cutbank	Non Vegetated	1	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	M	N	N	N	N	N	N	N	6	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	1	6	6	3	4	4	3	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	2	6	6	1	1	2	3	6	1	2	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	3	6	6	3	3	2	1	6	1	2	L	L	L	N	X	X	L	N	H	N	N	N	M	N	6	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	4/5	5	6	4	4	3	3	6	1	2	L	L	L	N	X	X	N	M	N	N	N	N	L	M	6	N
SBR	CWHwm	06	CD	Act - Red-osier dogwood	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	6/7	3	6	2	2	2	1	6	1	1	H	H	M	N	U	U	N	H	N	M	H	N	N	H	5	N
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	1	6	6	3	4	4	3	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	3	N
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench; deep coarse - textured soil	2	6	6	1	1	2	3	6	1	2	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	L
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench; deep coarse - textured soil	3	6	6	3	3	2	1	6	1	2	L	L	L	N	X	X	L	N	H	N	N	N	M	N	6	L
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench; deep coarse - textured soil	4/5	5	6	4	4	3	3	6	1	2	L	L	L	N	X	X	N	M	N	N	N	N	L	M	5	L
SBR	CWHwm	07	CW	Act - Willow	Floodplain Forest; active floodplain, low bench; deep coarse - textured soil	6/7	3	6	2	2	2	1	6	1	1	H	H	M	N	U	U	N	H	N	M	H	N	N	H	3	L
SBR	CWHwm	00	ES	Exposed Soil	Non Vegetated	1	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	M	N	N	N	N	N	N	N	6	N
SBR	CWHwm	00	ET	Escape Terrain	Sparsley Vegetated	1	3	5	6	6	6	6	6	6	6	N	N	H	M	U	U	H	N	N	N	N	L	N	N	6	N
SBR	CWHwm	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	6/7	2	5	5	5	5	5	6	6	6	M	M	L	N	U	U	N	H	L	L	N	N	M	H	4	N
SBR	CWHwm	00	GB	Gravel Bar	Unvegetated	1	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	00	GP	Gravel Pit	Unvegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	1	6	6	3	4	2	2	6	4	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	2	6	6	2	3	2	2	6	4	4	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	3	6	6	2	3	3	2	6	4	4	L	L	L	N	X	X	L	N	M	N	N	N	M	N	6	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	4/5	4	6	2	3	4	2	6	4	4	L	L	L	N	X	X	N	M	N	N	N	N	N	L	6	N
SBR	CWHwm	01	HB	HwSs - Blueberry	Mesic Forest	6/7	2	6	2	2	2	2	6	3	3	L	L	L	N	U	U	N	H	N	M	L	N	N	L	6	N
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position, medium textured shallow soils over bedrock	1	6	6	3	4	4	3	6	4	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position, medium textured shallow soils over bedrock	2	6	6	2	3	2	3	6	4	4	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	N

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFL-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position, medium textured shallow soils over bedrock	3	6	6	2	3	2	3	6	4	4	L	L	L	N	X	X	L	N	M	N	N	N	M	N	6	N
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position, medium textured shallow soils over bedrock	4/5	4	6	2	3	3	3	6	4	4	L	L	L	N	X	X	N	M	N	N	N	N	L	6	N
SBR	CWHwm	02	HM	HwSs - Step moss	gentle slope; crest position, medium textured shallow soils over bedrock	6/7	2	6	2	2	2	3	6	3	3	L	L	L	N	U	U	N	H	N	M	L	N	N	L	6	N
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions; deep coarse - textured soils; imperfectly dra	1	6	6	2	4	4	4	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions; deep coarse - textured soils; imperfectly dra	2	6	6	1	1	3	3	6	5	4	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions; deep coarse - textured soils; imperfectly dra	3	6	6	2	2	3	3	6	4	4	L	L	L	N	X	X	L	N	M	N	N	N	M	N	6	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions; deep coarse - textured soils; imperfectly dra	4/5	6	6	3	3	4	3	6	3	4	L	L	L	N	X	X	N	M	N	N	N	L	M	5	L
SBR	CWHwm	08	HS	Hw - Sphagnum	Wet Forest: lower slope to toe positions; deep coarse - textured soils; imperfectly dra	6/7	4	6	1	1	3	3	6	1	3	H	H	M	N	U	U	N	H	N	H	H	N	N	H	4	L
SBR	CWHwm	00	IF	Indian Hellabore - Fern	gentle to moderate colluvial slopes at the toe of avalanche tracts	2/3	4	6	1	1	3	3	6	5	1	N	L	M	N	X	X	N	N	L	N	N	N	M	N	6	N
SBR	CWHwm	00	LA	Lake	Non-vegetated	N/A	6	6	6	6	6	6	6	6	2	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	H
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	1	6	6	6	6	6	6	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	L
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	2	6	6	3	3	6	6	6	5	4	L	L	L	N	X	X	M	N	N	N	N	N	N	N	6	M
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	3	6	6	3	3	6	6	6	4	4	L	L	L	N	X	X	L	N	H	N	N	N	L	N	6	M
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	4/5	6	6	6	6	6	6	6	3	4	L	L	L	N	X	X	N	M	N	N	N	N	N	L	6	M
SBR	CWHwm	10	LS	Pl - Sphagnum	organic bog wetland	6/7	5	6	3	3	6	6	6	1	3	H	H	M	N	U	U	N	H	N	M	L	N	N	M	6	M
SBR	CWHwm	00	MN	Morraine	non-vegetated	1	6	6	6	6	6	6	6	6	6	N	N	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	00	PD	Pond	Non-vegetated	N/A	6	6	6	1	3	6	6	3	1	N	L	M	N	X	X	N	N	N	N	N	N	N	N	6	H
SBR	CWHwm	00	Rc	Rock Cliff	Non Forested	1	3	6	6	6	6	6	6	6	6	N	N	N	L	U	U	L	N	N	N	N	N	N	N	6	N
SBR	CWHwm	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	1	6	6	2	N	N	M	N	X	X	N	N	N	N	N	N	N	N	6	L
SBR	CWHwm	00	RW	Rural		N/A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SBR	CWHwm	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site; deep, medium- textured soil; wet gleyed soil;	1	6	6	2	4	4	4	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site; deep, medium- textured soil; wet gleyed soil;	2	6	6	1	1	2	3	6	5	4	L	L	L	N	X	X	L	N	N	N	N	N	L	N	6	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site; deep, medium- textured soil; wet gleyed soil;	3	6	6	2	2	2	3	6	4	4	L	L	L	N	X	X	N	N	M	N	N	N	M	N	6	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site; deep, medium- textured soil; wet gleyed soil;	4/5	5	6	3	3	4	3	6	3	4	L	L	L	N	X	X	N	M	N	N	N	N	L	M	4	L
SBR	CWHwm	09	SC	Ss - Skunk cabbage	Wet Forest; lower slope, receiving site; deep, medium- textured soil; wet gleyed soil;	6/7	3	6	1	1	3	3	6	2	3	H	H	M	N	U	U	N	H	N	H	H	N	N	H	1	L
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites; deep, medium- textured soils,	1	6	6	3	4	4	3	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites; deep, medium- textured soils,	2	6	6	1	1	2	3	6	5	4	L	L	L	N	X	X	L	N	N	N	N	N	L	N	6	N
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites; deep, medium- textured soils,	3	6	6	1	1	2	2	6	4	4	L	L	L	N	X	X	N	N	M	N	N	N	M	N	6	N
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites; deep, medium- textured soils,	4/5	5	6	1	3	3	3	6	4	4	L	L	L	N	X	X	N	M	N	N	N	N	L	M	5	N
SBR	CWHwm	04	SD	SsHw - Devil's club	Moist Forest; gentle slope; lower slope receiving sites; deep, medium- textured soils,	6/7	2	6	1	1	2	1	6	1	3	H	H	M	N	U	U	N	H	N	H	H	N	N	H	2	N
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	1	6	6	3	4	4	3	6	6	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	2	6	6	2	3	2	3	6	6	4	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	N
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	3	6	6	2	3	3	3	6	4	4	L	L	L	N	X	X	L	N	M	N	N	N	M	N	6	N
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	4/5	4	6	2	3	3	3	6	4	4	L	L	L	N	X	X	N	M	N	N	N	N	L	M	5	N
SBR	CWHwm	03	SO	SsHw - Oak fern	Mesic Forest	6/7	2	6	2	2	2	3	6	2	3	H	H	M	N	U	U	N	H	N	H	L	N	N	H	3	N
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench ; deep, medium -textured soil	1	6	6	3	4	4	3	6	5	4	L	L	L	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench ; deep, medium -textured soil	2	6	6	1	1	2	3	6	1	2	L	L	L	N	X	X	M	N	N	N	N	N	L	N	6	N
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench ; deep, medium -textured soil	3	6	6	3	3	2	1	6	1	2	L	L	L	N	X	X	L	N	H	N	N	N	M	N	6	N
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench ; deep, medium -textured soil	4/5	3	6	4	4	4	3	6	1	2	L	L	L	N	X	X	N	M	N	N	N	N	L	M	5	N
SBR	CWHwm	05	SS	Ss - Salmonberry	Floodplain Forest;active floodplain, high bench ; deep, medium -textured soil	6/7	1	6	2	2	2	1	6	1	1	H	H	M	N	U	U	N	H	N	H	H	N	N	H	1	N
SBR	CWHwm	00	SW	Shrubland (Willow/Alder Thicket)	Shrub complex	3b	4	6	1	1	3	3	6	5	3	N	L	M	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	CWHwm	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) so	2/3	6	6	1	1	3	3	6	5	4	N	N	H	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	CWHwm	00	Vs	Avalanche Shrub Thicket	avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) soils	3a/3b	6	6	1	1	3	3	6	5	4	N	N	H	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	CWHwm	Vt	Vt	Avalanche Treed	Non Forested	3b	3	6	1	2	4	4	6	3	3	M	M	M	N	X	X	N	L	H	N	N	N	M	M	6	N
SBR	CWHwm	Wf50	Wf50	Narrow-leaved Cottongrass-Peat Moss	Wetland	2	6	6	3	1	3	3	6	6	1	N	N	M	N	X	X	M	N	L	N	N	N	L	N	6	H
SBR	CWHwm	Wm00	Wm00	Wet Meadow	Wetland	2	6	6	1	1	3	4	6	4	1	L	L	L	N	U	U	M	L	N	N	N	N	N	L	6	H
SBR	CWHwm	00	Ws	Swamp Wetland	Wetland	2	6	6	1	1	3	3	6	5	1	N	N	M	N	U	U	H	H	M	N	N	N	N	N	6	M
SBR	CWHwm	Ws51	Ws51	Stika willow – Pacific willow – Skunk cabbage	Wetland	2/3	6	6	1	1	4	3	6	5	1	N	N	L	N	U	U	H	H	M	N	N	N	N	N	6	M
SBR	MHmm1	51	51	Generic Avalanche Code	Non-forested	2/3	6	5	5	1	1	3	4	6	3	N	M	M	N	X	X	L	N	M	N	N	N	L	N	6	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	H	N	6	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	3	6	6	3	2	1	3	4	6	1	N	N	L	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	4/5	4	6	4	3	3	5	6	6	3	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	04	AB	HmBa - Bramble	Forested	6/7	1	6	3	2	1	5	6	6	4	M	M	M	N	U	U	N	H	N	H	N	N	L	H	6	N
SBR	MHmm1	00	As	Alpine Nivation	Non-forested	1a	6	3	6	6	4	6	6	6	6	N	N	L	N	X	X	L	N	N	N	N	N	N	N	6	N

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFL-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
SBR	MHmm1	00	BF	Blockfield	Level or gently sloping areas that are covered with moderately sized or large, angular	1	6	6	6	6	6	6	6	6	6	M	H	H	H	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	CB	Cutbank	Non Vegetated	1	6	6	6	6	6	6	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	ES	Exposed Soil	Non Vegetated	1	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	M	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	ET	Escape Terrain	Sparsley Vegetated	1	4	2	6	5	5	5	3	6	6	L	M	L	N	U	U	H	N	N	N	N	N	N	N	6	H
SBR	MHmm1	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	6/7	2	2	6	5	3	3	2	6	6	L	M	L	N	U	U	N	H	N	L	N	N	L	L	6	N
SBR	MHmm1	00	Fl	Low Bench Floodplain	Floodplain Forest; active floodplain, low bench; deep coarse - textured soil	3	6	6	6	3	1	1	6	2	2	L	L	L	N	X	X	N	N	H	N	N	N	M	N	6	L
SBR	MHmm1	00	Fm	Mid Bench Floodplain	Floodplain Forest; active floodplain, middle bench; deep coarse - textured soil	4	6	6	6	3	3	3	6	2	2	L	L	L	N	X	X	N	N	N	N	N	N	L	M	6	N
SBR	MHmm1	Fm50	Fm50	Black Cottonwood - Red Alder - Salmonberry	Wetland Mid-Bench floodplain	3a/3b	5	6	5	2	2	3	6	6	2	M	L	M	N	U	U	N	M	H	N	N	N	L	N	6	N
SBR	MHmm1	00	GB	Gravel Bar	Unvegetated	1	6	6	6	6	6	6	6	4	4	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	HM	Heather Meadow	gently sloping ridgecrests and mountain tops with very shallow soils. ; sites are slightly	2	4	5	6	2	1	2	4	6	3	N	L	M	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	00	IF	Indian Hellabore - Fern	gentle to moderate colluvial slopes at the toe of avalanche tracts	2/3	6	5	6	3	1	1	5	6	1	L	L	L	N	X	X	N	N	M	N	N	L	M	N	6	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	3	6	6	3	2	1	3	4	6	2	N	N	L	N	X	X	L	N	H	N	N	N	H	N	6	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	4/5	4	6	4	3	3	5	4	6	6	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	01	MB	HmBa - Blueberry	Forested	6/7	2	6	3	2	2	5	4	6	5	L	L	L	N	U	U	N	H	N	M	N	N	L	M	6	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	2	6	6	3	2	1	3	4	6	4	N	N	N	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	3	6	6	3	2	1	3	4	6	2	N	N	L	N	X	X	N	N	H	N	N	N	H	N	6	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	4/5	6	6	4	3	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	06	MD	HmYc - Deer Cabbage	gentle slopes, receiving sites; deep medium- textured soils	6/7	3	6	3	2	1	5	6	6	3	M	M	M	N	U	U	N	H	N	H	N	N	L	H	6	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	1	6	6	4	4	2	4	6	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	3	6	6	3	2	1	3	4	6	1	N	N	L	N	X	X	L	N	H	N	N	N	H	N	6	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	4/5	4	6	4	3	3	5	6	6	6	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	02	MM	HmBa - Mountain-heather	gentle slopes; crest position; shallow soils	6/7	1	6	3	2	2	5	6	6	5	L	L	L	N	U	U	N	H	N	H	N	N	L	M	6	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	2	6	6	3	2	1	3	5	6	3	N	N	N	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	3	6	6	3	2	1	3	4	6	1	N	N	L	N	X	X	L	N	H	N	N	N	H	N	6	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	4/5	4	6	4	3	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	03	MO	BaHm - Oak Fern	Forested	6/7	1	6	3	2	1	5	6	6	4	M	M	M	N	U	U	N	H	N	H	N	N	L	H	6	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	H	N	6	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	3	6	6	3	2	1	3	4	6	1	N	N	L	N	X	X	L	N	H	N	N	N	M	N	6	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	4/5	4	6	4	3	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	05	MT	BaHm - Twisted stalk	Forested	6/7	1	6	3	2	1	5	6	6	3	M	M	M	N	U	U	N	H	N	H	N	N	L	H	6	N
SBR	Mhmm1	00	PK	Parkland Forest	mosaic of heather and tree islands	5	3	2	5	3	2	3	2	6	4	N	L	M	L	U	U	N	M	L	N	N	L	H	N	6	N
SBR	MHmm1	00	Rc	Rock Cliff	Non Forested	1	5	2	6	6	6	6	6	6	6	N	N	N	M	U	U	L	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	M
SBR	MHmm1	Ro	Ro	Rock Outcrop	Non-forested	1	5	2	6	6	6	6	6	6	6	N	N	M	M	U	U	M	N	N	N	N	N	L	N	6	N
SBR	MHmm1	Ro	Rt	Rock talus	Non-forested	1	6	3	6	6	6	6	6	6	6	M	M	M	H	U	U	M	N	N	N	N	N	L	N	6	N
SBR	MHmm1	00	RZ	Road	Non-vegetated	N/A	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	MHmm1	00	Sc	shrubland	Non Forested	3a/3b	5	5	5	2	1	1	3	6	2	L	L	M	L	X	X	N	N	H	N	N	N	H	N	6	N
SBR	MHmm1	00	SW	Shrubland (Willow/Alder Thicket)	Shrub complex	3a/3b	4	5	4	1	3	3	3	4	3	N	L	M	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	MHmm1	00	Vh	Avalanche Herb Meadow	Alder - fern avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) so	2/3	6	3	4	1	3	3	3	5	4	N	N	H	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	MHmm1	00	Vs	Avalanche Shrub Thicket	avalanche chute; steep slopes (use aspect modifiers); deep, (medium?) soils	3a/3b	6	3	4	1	3	3	3	5	4	N	N	H	N	X	X	N	N	H	N	N	N	M	N	6	N
SBR	MHmm1	Vt	Vt	Avalanche Treed	Non Forested	3b	2	4	4	2	4	4	3	3	3	M	M	M	N	X	X	N	L	H	N	N	N	M	M	6	N
SBR	MHmm1	Wf50	Wf50	Narrow-leaved Cottongrass-Peat Moss	Wetland	2	6	6	6	1	2	3	6	6	1	N	N	M	N	X	X	M	N	L	N	N	N	L	N	6	H
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	1	6	6	4	2	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	M
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	2	6	6	3	2	1	3	4	6	6	N	N	N	N	X	X	M	N	L	N	N	N	L	N	6	M
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	3	6	6	3	2	1	3	4	6	3	N	N	L	N	X	X	N	N	H	N	N	N	L	N	6	M
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	4/5	6	6	4	3	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	N	L	6	M
SBR	MHmm1	09	YC	YcHm - Skunk cabbage	treed swamp, deep, medium - textured soils; poorly drained	6/7	6	6	3	2	2	5	6	6	3	M	M	M	N	U	U	N	H	N	M	N	N	N	L	6	M
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes; deep medium - textured soil, wet, richer nutrient	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	N
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes; deep medium - textured soil, wet, richer nutrient	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	M	N	6	N
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes; deep medium - textured soil, wet, richer nutrient	3	6	6	3	2	1	3	4	6	1	N	N	L	N	X	X	N	N	H	N	N	N	H	N	6	N

ECO_SEC	BEC Unit	Site_S	Site S_Map Code	SiteS_Unit_Name	GenEcoType	Struc_Stage	M-ORAM-Li-W	M-ORAM-Li-S	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFL-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes; deep medium - textured soil, wet, richer nutrient	4/5	6	6	4	3	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	L	L	6	N
SBR	MHmm1	07	YH	YcHm - Hellebore	lower slope position; gentle slopes; deep medium - textured soil, wet, richer nutrient	6/7	3	6	3	2	2	5	6	6	3	M	M	M	N	U	U	N	H	N	H	N	N	L	M	6	N
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	1	6	6	4	4	2	4	5	6	6	N	N	N	N	X	X	H	N	N	N	N	N	N	N	6	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	2	6	6	3	2	1	3	4	6	3	N	N	N	N	X	X	M	N	L	N	N	N	L	N	6	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	3	6	6	3	2	1	3	4	6	2	N	N	L	N	X	X	N	N	H	N	N	N	L	N	6	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	4/5	6	6	4	4	3	5	6	6	5	N	N	L	N	X	X	N	M	N	N	N	N	N	L	6	L
SBR	MHmm1	08	YS	HmYc - Sphagnum	lower slope; treed bog; organic	6/7	5	6	3	3	2	5	6	6	3	M	M	M	N	U	U	N	H	N	M	N	N	N	M	6	L
SBR	MHmmp	00	Af	Alpine Fellfield	Non-forested	1a	6	3	6	6	5	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	L	N	N	6	N
SBR	MHmmp	00	Ah	Alpine Heath	Non-forested	2d	6	2	6	4	2	4	1	6	4	L	L	M	H	X	X	L	N	N	N	N	H	M	N	6	N
SBR	MHmmp	00	AM	Alpine Herb Meadow	Non-forested	2	6	1	5	3	1	1	1	6	4	N	N	M	H	X	X	L	N	N	N	N	H	H	N	6	N
SBR	MHmmp	00	Am	Alpine Herb Meadow	Non-forested	2a	6	1	6	4	1	3	1	6	3	N	N	M	H	X	X	L	N	N	N	N	H	M	N	6	N
SBR	MHmmp	00	As	Alpine Nivation	Non-forested	1a	6	2	6	6	4	6	6	6	6	N	N	L	M	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	CB	Cutbank	Non Vegetated	1	6	3	6	6	6	6	5	6	4	L	N	N	L	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	ES	Exposed Soil	Non-vegetated	1	6	2	6	6	4	6	6	6	6	N	N	H	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	ET	Escape Terrain	Sparsley Vegetated	1	4	1	5	5	5	5	5	6	6	N	N	M	M	U	U	L	N	N	N	N	L	N	N	6	N
SBR	MHmmp	00	ET	Escape Terrain	Treed cliffs and hypersteep slopes	6/7	2	1	5	5	5	5	2	6	6	N	M	M	M	U	U	L	M	N	N	N	H	M	N	6	N
SBR	MHmmp	00	Fl	Low Bench Floodplain	Associated with Gravel bar	3b	6	6	6	6	6	6	6	6	4	N	N	N	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	Fm	Mid Bench Floodplain	Associated with Gravel bar	3b	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	GB	Gravel Bar	Non-Vegetated	1	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	GL	Glacier	Non-vegetated; Permanent snow and ice	N/A	6	6	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	KC	Krummholz Cliffs	scrubby krummholz on cliffs and hypersteep rock	3	3	1	6	6	6	6	3	6	6	N	N	L	M	U	U	N	M	L	N	N	M	M	N	6	N
SBR	MHmmp	01	MB	HmBa - Blueberry	Forested	6/7	2	6	5	4	2	5	1	6	5	L	L	L	N	U	U	N	M	N	L	N	N	L	N	6	N
SBR	MHmmp	00	MH	Hm-Mountain heather Parkland	mosaic of heather and tree islands	2/3	3	2	5	4	2	3	3	6	4	N	L	M	M	U	U	N	M	L	N	N	L	H	N	6	N
SBR	MHmmp	00	PD	Pond	Non-vegetated	N/A	6	6	6	6	6	6	6	6	1	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	H
SBR	MHmmp	00	PK	Parkland Forest	mosaic of heather and tree islands	5	3	2	5	4	2	3	2	6	4	N	L	H	M	U	U	N	M	L	N	N	L	H	N	6	N
SBR	MHmmp	00	PN	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	5	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	MHmmp	00	PS	Permanent Snow	Non-vegetated; Permanent snow and ice	N/A	6	5	6	6	6	6	6	6	6	N	N	L	N	X	X	N	N	N	N	N	N	N	N	6	N
SBR	MHmmp	Rc	Rc	Rock Cliff	Non Forested	1	5	1	6	6	6	6	6	6	6	N	N	H	M	U	U	L	N	N	N	N	M	N	N	6	N
SBR	MHmmp	00	RI	River	Non-vegetated	N/A	6	6	6	6	6	6	6	6	5	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	L
SBR	MHmmp	Ro	Ro	Rock Outcrop	Non-forested	1	5	1	6	6	6	6	6	6	6	N	N	H	M	U	U	L	N	N	N	N	M	L	N	6	N
SBR	MHmmp	Rt	Rt	Rock talus	Non-forested	1	6	3	6	6	6	6	6	6	6	M	M	M	H	U	U	L	N	N	N	N	M	L	N	6	N
SBR	MHmmp	00	RU	Rubble	Rubble is common on the ground surface in and adjacent to alpine areas, on ridgetop	1	6	6	6	6	6	6	6	6	6	N	L	L	L	X	X	L	N	N	N	N	N	N	N	6	N
SBR	MHmmp	Sc	Sc	Shrub Carr	Non-forested	3a/3b	6	3	5	4	1	2	1	6	3	N	N	M	L	U	U	N	N	M	N	N	L	H	N	6	N
SBR	MHmmp	Sk	Sk	Shrub krummolz	Non Forested	3a/3b	4	1	5	4	2	2	2	6	2	M	M	M	L	X	X	L	N	M	N	N	L	H	N	6	N
SBR	MHmmp	Vh	Vh	Avalanche Herb	Non Forested	2	5	1	5	4	1	1	2	6	3	L	L	H	M	X	X	L	N	N	N	N	H	H	N	6	N
SBR	MHmmp	Vs	Vs	Avalanche Shrub	Non Forested	3a/3b	5	2	5	4	1	1	1	6	2	L	L	H	L	X	X	N	N	M	N	N	M	H	N	6	N
SBR	MHmmp	Vt	Vt	Avalanche Treed	Non Forested	6/7	3	2	5	4	2	2	1	6	3	M	M	H	N	X	X	N	L	M	N	N	N	M	N	6	N
SBR	MHmmp	00	WA	Alpine Wetland	Non-vegetated	2a,b or c	6	6	6	6	6	6	6	6	1	N	N	M	N	X	X	N	N	N	N	N	L	N	N	6	N
SBR	MHmmp	00	Wb	Bog Wetland	Wetland	5	5	6	5	4	6	6	6	3	3	H	H	M	N	U	U	N	M	N	N	N	N	N	M	6	M

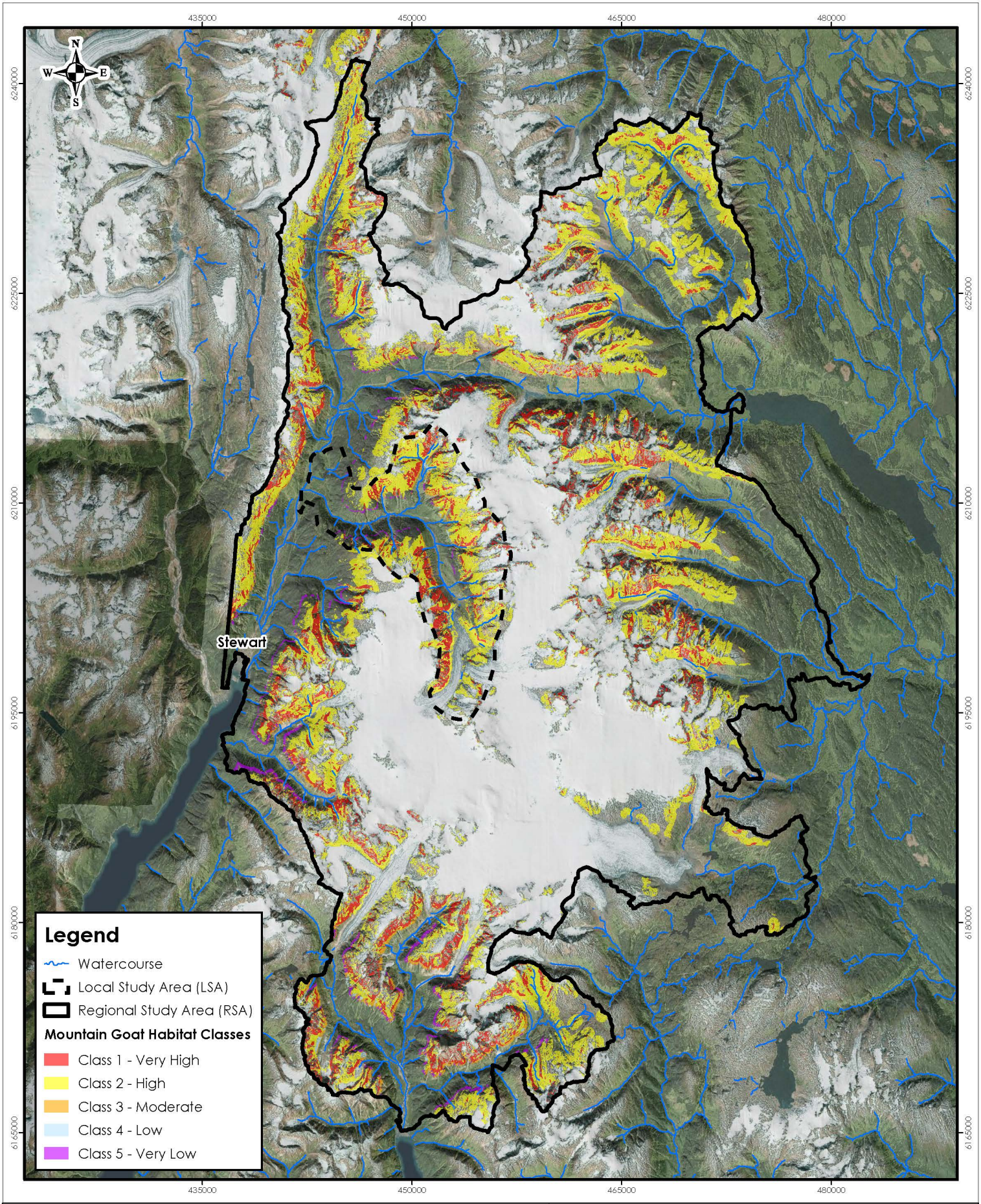
Habitat Plot	BEC_Unit	MAPcode_S1	MAPcode_S2	SiteS_Unit_Name	Map Structural Stage	Field Structural Stage	Zone	Easting	Northing	Elevation (m)	M-ORAM-Li-G	M-ORAM-Li-W	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFI-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
1	CWHwm	SO	SO	SsHw - Oak fern	7	6	9	444456	6209219	193	6	3	3	4	4	2	6	2	3	M	M	M	N	U	U	N	L	L	N	L	N	L	M	4	N
2	MHmm1	51	none	Generic Avalanche Code	3	3b	9	452127	6205928	380	6	6	6	6	3	6	6	6	1	L	L	L	N	X	X	N	M	H	N	N	N	M	N	6	M
3	MHmm1	51	none	Generic Avalanche Code	3	3b	9	452280	6205968	415	6	3	6	5	4	6	6	6	1	N	N	L	N	X	X	N	M	H	N	N	N	M	N	6	N
4	CWHwm	SD	none	SsHw - Devil's club	5	5	9	444278	6210060	218	6	4	6	6	5	5	6	4	3	L	L	L	N	X	X	N	N	N	N	N	N	L	L	5	N
5	CWHwm	SO	none	SsHw - Oak fern	6	6	9	444384	6210046	242	6	4	6	6	4	6	6	5	4	M	M	M	N	X	X	N	N	N	N	N	N	L	M	6	N
6	CWHwm	SS	SS	Ss - Salmonberry	6	6	9	444055	6210370	121	6	6	6	4	3	4	6	5	4	M	M	M	N	X	X	N	N	N	M	N	N	L	M	6	N
7	CWHwm	SS	none	Ss - Salmonberry	7	7	9	443828	6210347	118	6	6	5	3	2	3	6	1	2	L	M	M	N	U	U	N	M	M	M	N	N	L	M	4	N
8	CWHwm	CD	none	Act - Red-osier dogwood	6	6	9	443421	6210169	120	6	6	6	6	4	3	6	1	2	L	M	M	N	U	U	L	N	L	N	N	N	L	L	6	N
9	CWHwm	SS	SS	Ss - Salmonberry	6	6	9	443951	6210175	123	6	6	5	5	4	3	6	2	2	M	M	M	N	X	X	N	N	N	L	N	N	N	L	6	N
10	CWHwm	SS	SS	Ss - Salmonberry	7	7	9	443829	6210814	113	6	6	6	5	4	5	6	2	2	M	M	M	N	X	X	N	N	N	N	N	N	N	N	6	N
11	CWHwm	SD	SS	SsHw - Devil's club	6	6	9	443727	6210779	110	6	6	3	3	4	3	6	2	2	M	M	M	N	X	X	N	N	N	L	L	N	N	L	6	N
12	CWHwm	SS	none	Ss - Salmonberry	5	5	9	443586	6210744	110	6	6	4	4	4	2	6	2	2	M	M	M	N	U	U	N	N	N	H	M	N	N	L	3	N
13	CMAun	MI/Af	MI/As	Mine/Alpine Fellfield	1a	1a	9	456801	6202423	1857	3	6	6	6	6	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	M	N	N	6	N
14	CMAun	Af	Ah	Alpine Fellfield	1a	1c	9	456861	6201936	1833	3	6	6	6	5	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	L	N	N	6	N
15	CMAun	Af	As	Alpine Fellfield	1a	1c	9	456210	6201878	1590	2	6	6	6	4	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	M	N	N	6	N
16	CMAun	Af	As	Alpine Fellfield	1a	1c	9	456191	6201955	1600	2	5	6	6	3	6	6	6	6	N	N	M	H	X	X	L	N	N	N	N	H	N	N	6	N
17	CMAun	Af	As	Alpine Fellfield	1a	1c	9	456040	6201875	1555	1	6	6	6	3	6	6	6	6	N	N	M	H	X	X	L	N	N	N	N	H	N	N	6	N
18	CMAun	Af	As	Alpine Fellfield	1a	1c/2d	9	455757	6201748	1501	2	6	6	6	4	6	6	6	6	N	N	H	H	X	X	L	N	N	N	N	H	N	N	6	N
19	CMAun	Af	PN	Alpine Fellfield	1a	1a	9	456265	6202954	2132	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	L	N	N	6	N
20	CMAun	Af	RZ	Alpine Fellfield	1a	1a	9	455082	6201950	1565	1	5	6	4	2	6	6	6	6	N	N	M	H	X	X	L	N	N	N	N	M	N	N	6	N
21	CMAun	Af	Ah	Alpine Fellfield	1a	1c/2d	9	456719	6201613	1721	1	6	6	6	5	6	6	6	6	N	N	M	H	X	X	L	N	N	N	N	H	N	N	6	N
22	CMAun	Af	Ah	Alpine Fellfield	1a	1c/2d	9	456191	6201226	1641	1	6	6	6	3	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	N	N	6	N
23	CMAun	Af	Ah	Alpine Fellfield	1a	1c/2d	9	456101	6201055	1623	2	6	6	6	4	6	6	6	6	N	N	L	M	X	X	N	N	N	N	N	M	N	N	6	N
24	CMAun	Af	none	Alpine Fellfield	1a	1c/2d	9	454944	6204017	1587	1	6	6	6	3	4	3	6	6	N	N	H	H	X	X	N	N	N	N	N	M	N	N	6	N
25	MHmmp	Sc	Ro	Shrub Carr	3	2b/3b	9	453882	6201555	995	1	1	6	4	2	4	6	6	6	N	N	H	N	X	X	L	L	H	N	N	N	L	N	6	N
26	CMAun	Af	none	Alpine Fellfield	1a	1c/2d	9	455812	6201790	1525	1	6	6	6	3	6	6	6	6	N	N	H	H	X	X	M	N	N	N	N	H	L	N	6	N
27	MHmmp	Sk	Af	Shrub Krummholz	3	2d/3a	9	454614	6203927	1380	1	5	6	6	2	4	6	6	6	N	N	H	H	X	X	N	N	N	N	N	H	M	N	6	N
28	MHmmp	Sc	Ro	Shrub Carr	3	3a/3b	9	453937	6201590	1007	1	3	6	4	2	3	6	6	6	N	N	M	N	X	X	M	N	M	N	N	N	M	N	6	N
29	MHmm1	Fm50	Fm50	Black Cottonwood - Red Alder - Salmonberry	3	3b	9	451699	6207409	308	6	6	6	5	5	4	6	6	4	N	N	M	N	X	X	N	L	H	N	N	N	L	N	6	L
30	MHmm1	MT	none	BaHm - Twisted stalk	5	5	9	451833	6207473	335	6	6	6	6	3	4	6	6	2	N	N	M	N	X	X	N	N	M	N	N	N	N	N	6	N
31	CMAun	Ah	At	Alpine Heath	2d	2d	9	446641	6211008	1505	1	5	6	6	2	5	2	6	6	N	N	M	H	X	X	L	N	N	N	N	H	N	N	6	N
32	MHmm1	Mo	none	BaHm - Oak Fern	7	7	9	445584	6210351	1068	3	1	6	5	3	3	2	6	4	L	M	M	N	X	X	N	L	N	L	N	N	M	H	6	N
33	MHmm1	MT	Sc	BaHm - Twisted stalk	7	7	9	445399	6210212	966	4	1	6	6	3	4	5	6	4	H	M	M	N	X	X	N	L	N	H	N	N	M	M	6	N
34	MHmm1	MO	none	BaHm - Oak Fern	7	7	9	445130	6210147	841	4	2	6	6	3	4	5	6	4	H	M	M	N	X	X	N	N	N	H	N	N	M	H	6	N
35	MHmm1	MB	MT	HmBa - Blueberry	7	7	9	444948	6210028	750	4	2	6	6	4	6	3	6	3	H	M	M	N	X	X	N	N	N	H	N	N	M	M	5	N
36	CMAun	Ah	none	Alpine Heath	2d	2d	9	446965	6211099	1512	1	6	6	6	1	3	2	6	6	N	N	H	H	X	X	L	N	N	N	N	H	N	N	6	N
37	CMAun	Ah	none	Alpine Heath	2d	2d	9	454874	6201561	1417	1	6	6	6	3	5	3	6	6	N	N	M	H	X	X	L	N	N	N	N	N	N	N	6	N
38	CMAun	Af	At	Alpine Fellfield	1a	1a	9	455987	6202821	1994	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	L	N	N	6	N
39	MHmmp	Sk	Af	Shrub Krummholz	3	2d/3a	9	454563	6203930	1371	1	6	6	6	2	4	6	6	6	N	N	H	H	X	X	N	N	N	N	N	H	M	N	6	N
40	CMAun	Af	Ah	Alpine Fellfield	1a	1c/2d	9	455527	6200909	1580	4	1	6	6	3	4	5	6	4	N	M	M	N	X	X	N	L	N	N	L	N	L	N	6	N
41	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443683	6211228	108	6	6	4	4	5	5	6	3	3	L	L	L	N	X	X	N	N	N	L	N	N	L	L	6	N
42	CWHwm	CD	none	Act - Red-osier dogwood	5	6	9	451005	6208517	303	6	4	5	4	4	4	6	3	3	M	M	M	N	X	X	N	M	N	L	N	N	L	L	5	N
43	CWHwm	SD	none	SsHw - Devil's club	6	6	9	444176	6212229	118	6	6	4	4	4	4	6	1	2	M	M	M	N	U	U	N	N	N	M	L	N	L	L	4	N
44	CWHwm	SD	none	SsHw - Devil's club	5	6	9	444073	6212553	135	6	6	2	2	3	4	6	1	2	M	M	M	N	U	U	N	N	M	M	N	N	M	M	5	N
45	CWHwm	SD	none	SsHw - Devil's club	5	6	9	444020	6213258	162	6	6	2	2	3	4	6	1	2	M	M	M	N	X	X	N	N	L	M	N	N	M	M	5	N
46	CWHwm	SO	none	SsHw - Oak fern	5	5	9	444079	6209847	133	6	6	3	3	5	5	6	2	2	M	M	M	N	X	X	N	N	N	M	N	N	L	L	6	N

Habitat Plot	BEC_Unit	MAPcode_S1	MAPcode_S2	SiteS_Unit_Name	Map Structural Stage	Field Structural Stage	Zone	Easting	Northing	Elevation (m)	M-ORAM-Li-G	M-ORAM-Li-W	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFI-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
47	CWHwm	SO	SD	SsHw - Oak fern	5	5	9	444144	6210178	207	6	6	3	3	5	6	6	3	3	L	L	L	N	X	X	N	N	N	L	N	N	N	N	6	N
48	CWHwm	SD	none	SsHw - Devil's club	5	5	9	444268	6209984	221	6	6	3	3	5	6	6	4	4	L	L	L	N	X	X	N	N	N	L	N	N	L	L	6	N
49	CWHwm	SO	none	SsHw - Oak fern	5	5	9	444250	6209653	221	6	6	3	3	5	6	6	4	4	L	L	L	N	X	X	N	N	N	M	N	N	N	L	6	N
50	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443910	6210353	122	6	6	3	4	6	4	6	3	3	L	L	L	N	X	X	N	N	N	L	N	N	L	L	5	N
51	CWHwm	CD	none	Act - Red-osier dogwood	5	6	9	451151	6208405	323	6	5	5	5	4	5	6	3	3	M	M	M	N	X	X	N	M	N	M	N	N	L	M	5	N
52	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451363	6208277	334	6	4	5	4	4	5	6	3	3	M	M	M	N	X	X	N	M	N	H	L	N	L	M	5	N
53	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451551	6208021	320	6	5	5	4	4	5	6	3	3	M	M	M	N	X	X	N	M	N	H	L	N	L	M	5	N
54	CWHwm	SS	CD	Ss - Salmonberry	8	7b	9	447799	6208871	218	6	3	2	2	2	4	6	3	3	H	M	M	N	U	U	N	M	L	H	M	N	L	H	1	N
55	CWHwm	SD	none	SsHw - Devil's club	6	7b	9	447650	6209061	229	6	2	2	2	3	5	6	1	2	H	M	H	N	U	U	N	M	N	H	L	N	L	H	1	N
56	CWHwm	SO	none	SsHw - Oak fern	6	7a	9	445657	6208698	183	6	3	2	2	3	5	6	1	2	H	H	H	N	U	U	N	M	N	H	L	N	M	H	2	N
57	CWHwm	SS	none	Ss - Salmonberry	6	7a	9	442957	6211088	103	6	6	2	2	3	4	6	1	2	H	H	M	N	U	U	N	N	N	H	H	N	M	M	2	N
58	CMAun	Af	Ah	Alpine Fellfield	1	2d	9	455431	6200399	1401	1	6	6	6	3	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	M	N	6	N
59	CMAun	Af	Ah	Alpine Fellfield	1	2d	9	455321	6200538	1409	1	6	6	6	3	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	M	N	6	N
60	CMAun	Af	Ah	Alpine Fellfield	1a	1a/2d	9	455757	6200584	1523	3	6	6	5	5	6	6	6	6	N	N	N	H	X	X	L	N	N	N	N	H	L	N	6	N
61	MHmmp	Sk	Af	Shrub Krummholz	3	3b	9	454957	6200634	1276	1	4	6	5	2	4	6	6	4	L	L	L	H	X	X	M	N	N	N	N	H	M	N	6	N
62	CMAun	Af	Ah	Alpine Fellfield	1a	1a/2d	9	455984	6200655	1519	3	6	6	5	5	6	6	6	6	N	N	N	H	X	X	N	N	N	N	N	H	L	N	6	N
63	CMAun	Af	Ah	Alpine Fellfield	1a	1a/2d	9	455942	6201133	1653	3	6	6	5	5	6	6	6	6	N	N	N	H	X	X	N	N	N	N	N	H	L	N	6	N
64	CMAun	Af	Ah	Alpine Fellfield	1a	1a/2d	9	456152	6201276	1647	3	6	6	5	5	6	6	6	6	N	N	N	H	X	X	N	N	N	N	N	H	L	N	6	N
65	MHmmp	Sk	none	Shrub Krummholz	3	3a	9	454314	6201285	1070	2	3	6	3	2	2	6	6	3	M	M	M	L	X	X	M	L	M	N	N	L	H	L	6	N
66	MHmmp	Sk	ES	Shrub Krummholz	3	2a	9	454198	6201368	1035	1	6	6	3	2	3	6	6	5	M	M	M	N	X	X	M	N	M	N	N	L	H	N	6	N
67	MHmmp	Vs	none	Avalanche Shrub	3	3b	9	454110	6201409	1011	1	6	6	4	2	3	6	6	5	N	M	M	N	X	X	L	N	H	N	N	N	M	N	6	N
68	MHmmp	Sc	none	Shrub Carr	3	3	9	453985	6201537	1003	1	6	6	4	2	3	6	6	5	N	M	M	N	X	X	L	N	M	N	N	L	H	N	6	N
69	MHmmp	Sc	none	Shrub Carr	3	3b	9	453985	6201537	1003	1	5	6	6	2	5	6	6	3	L	M	M	N	X	X	N	N	H	N	N	L	H	N	6	N
70	MHmmp	Sk	none	Shrub Krummholz	3	3a	9	454209	6201542	1044	1	3	6	3	2	2	6	6	3	M	M	M	L	X	X	M	L	M	N	N	L	H	N	6	N
71	MHmmp	Sk	none	Shrub Krummholz	3	3a	9	454209	6201542	1043	1	3	6	3	2	2	6	6	3	M	M	M	L	X	X	M	L	M	N	N	L	H	L	6	N
72	MHmmp	Sk	none	Shrub Krummholz	3	3a	9	454608	6201623	1307	1	6	6	4	3	5	6	6	4	N	M	L	M	X	X	L	N	N	N	N	M	M	N	6	N
73	CMAun	Ah	none	Alpine Heath	2d	2d	9	455556	6201638	1454	2	6	6	4	3	6	6	6	6	N	N	M	H	X	X	L	N	N	N	N	H	M	N	6	N
74	MHmmp	Sc	none	Shrub Carr	3	3	9	453855	6201650	985	2	6	6	3	3	3	6	6	5	N	M	M	N	X	X	L	N	M	N	N	L	H	N	6	N
75	MHmmp	Sc	none	Shrub Carr	3	3	9	453855	6201650	985	2	6	6	3	3	3	6	6	5	N	M	M	N	X	X	L	N	M	N	N	L	H	N	6	N
76	CMAun	Af	none	Alpine Fellfield	1	1	9	455074	6201659	1483	3	6	6	4	3	6	6	6	6	N	N	M	M	X	X	L	N	N	N	N	L	N	N	6	N
77	CMAun	Ah	none	Alpine Heath	2d	3a	9	455248	6201670	1474	3	6	6	4	3	5	6	6	6	N	L	M	H	X	X	L	N	N	N	N	H	M	N	6	N
78	MHmmp	Sk	none	Shrub Krummholz	3	3a	9	454161	6201736	1007	1	3	6	3	2	2	6	6	3	L	M	M	N	X	X	L	N	L	N	N	L	H	N	6	N
79	CMAun	Af	none	Alpine Fellfield	1a	1a	9	455926	6202111	1638	6	6	6	6	6	6	6	6	6	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	N
80	MHmmp	Sk	Af	Shrub Krummholz	3	2d/3a	9	454663	6203776	1381	1	6	6	4	3	4	6	6	5	M	M	H	H	X	X	N	N	N	N	N	M	M	N	6	N
81	MHmmp	Sk	Af	Shrub Krummholz	3	2d/3a	9	454517	6204059	1350	1	6	6	4	3	4	6	6	5	M	M	H	H	X	X	L	N	N	N	N	M	M	N	6	N
82	mHmmp	Ro	Ro	Rock Outcrop	3	3b	9	452407	6204564	449	6	6	6	3	3	5	6	6	2	M	M	M	N	X	X	N	N	H	N	N	N	M	N	6	N
83	mHmmp	Ro	Ro	Rock Outcrop	3	3b	9	451974	6205185	360	6	6	6	3	3	5	6	6	2	M	M	M	N	X	X	N	N	H	N	N	N	M	N	6	N
84	CMAun	Af	none	Alpine Fellfield	1a	2d	9	450605	6205639	1334	1	6	6	4	2	4	3	6	6	L	M	M	M	X	X	N	N	N	N	N	H	H	N	6	N
85	MHmm1	51	none	Generic Avalanche Code	3	2b	9	452095	6205874	364	6	6	6	2	2	6	6	6	4	N	L	L	N	X	X	M	M	H	N	N	N	N	N	6	M
86	MHmm1	51	none	Generic Avalanche Code	3	4	9	451969	6206361	338	6	6	6	3	3	5	6	6	4	N	M	M	N	X	X	N	N	M	N	N	N	M	N	6	N
87	MHmm1	Fm50	MT	Black Cottonwood - Red Alder - Salmonberry	3	3	9	451871	6206612	325	6	6	2	2	2	4	6	6	4	M	M	M	N	X	X	N	L	M	N	N	N	N	L	6	N
88	MHmm1	Rl	none	River	1a	3b	9	451823	6206628	317	6	6	6	6	6	6	6	5	2	N	N	N	N	X	X	N	N	H	N	N	N	N	N	6	N
89	MHmm1	MO	none	BaHm - Oak Fern	5	4	9	451992	6206870	389	6	6	5	5	6	6	6	5	4	N	N	M	N	X	X	N	N	N	N	N	N	L	N	6	N
90	CMAun	Ah	Am	Alpine Heath	2d	2d	9	450206	6206937	1308	1	6	6	4	2	4	2	6	6	M	M	M	M	X	X	L	N	N	N	N	H	H	N	6	N
91	CMAun	Ah	Am	Alpine Heath	2d	2d	9	450158	6207184	1286	1	6	6	4	2	4	6	6	6	L	L	M	M	X	X	L	N	N	N	N	H	H	N	6	N
92	CMAun	Ah	Am	Alpine Heath	2d	2d	9	449867	6207421	1272	1	6	6	4	2	4	6	6	6	N	L	M	H	X	X	L	N	N	N	N	H	H	N	6	N

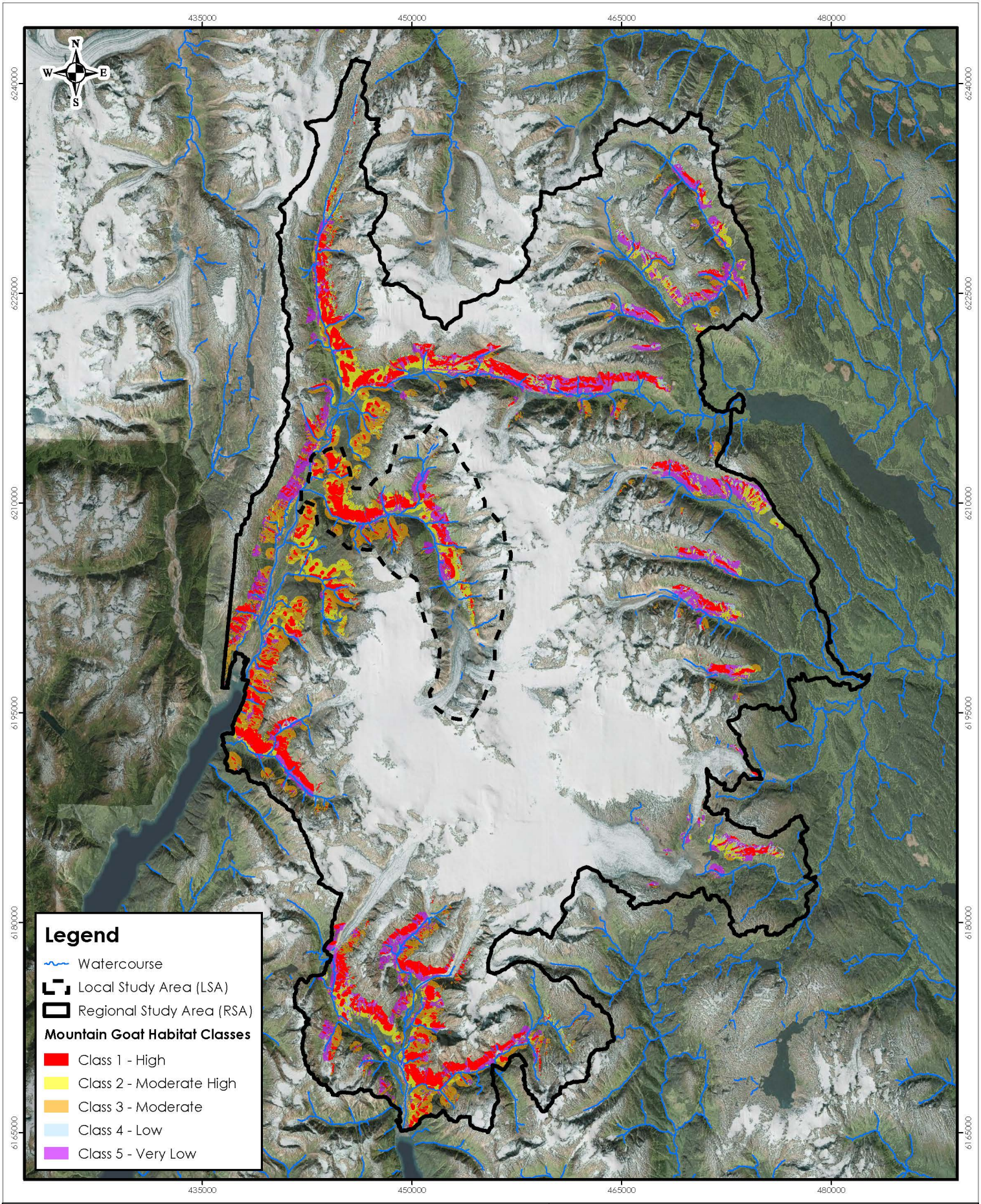
Habitat Plot	BEC_Unit	MAPcode_S1	MAPcode_S2	SiteS_Unit_Name	Map Structural Stage	Field Structural Stage	Zone	Easting	Northing	Elevation (m)	M-ORAM-Li-G	M-ORAM-Li-W	M-URAR-FD-PE	M-URAR-FD-PL	M-URAR-FD-S	M-URAR-FD-F	M-URAR-DE-W	M-ALAL-Li-W	M-ALAL-Li-S	M-MAAM-Li-W	M-GUGU-Li-W	M-GUGU-Li-G	M-MACA-Li-G	M-MYLU-Li-G	M-MYKE-Li-G	B-CONI-RE-G	B-OSFI-RE-G	B-MACW-RE-G	B-NOGO-RE-G	B-WSOW-RE-G	B-WTPT-RE-G	B-SOGR-RE-G	B-SOGR-Li-W	B-MAMU-RE-G	A-ANBO-RE-G
93	MHmm1	Fm50	Fm50	Black Cottonwood - Red Alder - Salmonberry	3	3b	9	451673	6207440	308	6	6	6	4	3	3	6	6	2	N	N	L	N	X	X	N	N	H	N	N	N	L	N	6	N
94	MHmm1	Fm50	Fm50	Black Cottonwood - Red Alder - Salmonberry	3	3b	9	451637	6207686	308	6	6	6	4	3	3	6	6	2	N	N	L	N	X	X	N	N	H	N	N	N	L	N	6	N
95	MHmm1	MT	none	BaHm - Twisted stalk	3	3b	9	451801	6207892	371	6	6	6	5	5	5	6	5	4	N	N	L	N	X	X	N	N	H	N	N	N	L	N	6	N
96	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451696	6208095	355	6	5	5	5	5	5	6	3	5	L	L	M	N	X	X	N	M	L	M	N	N	N	N	6	N
97	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451540	6208167	343	6	4	5	4	4	5	6	3	3	M	M	M	N	X	X	N	M	N	H	L	N	L	M	5	N
98	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451317	6208269	330	6	4	5	4	4	5	6	3	3	M	M	M	N	X	X	N	M	N	H	L	N	L	M	5	N
99	MHmm1	MT	none	BaHm - Twisted stalk	5	6	9	451347	6208330	350	6	5	5	3	4	6	6	4	4	L	L	M	N	X	X	N	M	N	M	N	N	N	M	6	N
100	CWHwm	CD	none	Act - Red-osier dogwood	5	6	9	451151	6208405	323	6	5	5	5	4	5	6	3	3	M	M	M	N	X	X	N	M	N	M	N	N	L	M	5	N
101	CWHwm	CD	none	Act - Red-osier dogwood	5	6	9	451098	6208420	314	6	6	3	2	2	3	6	4	3	L	L	M	N	X	X	N	M	N	M	N	N	N	M	6	N
102	CWHwm	CD	none	Act - Red-osier dogwood	5	6	9	451005	6208517	302	6	4	5	4	4	4	6	3	3	M	M	M	N	X	X	N	M	N	L	N	N	L	L	5	N
103	CWHwm	SS	none	Ss - Salmonberry	3	3b	9	446305	6208600	179	6	1	3	2	2	2	6	1	1	M	M	M	N	X	X	N	N	H	N	N	N	N	N	6	N
104	CWHwm	SS	none	Ss - Salmonberry	3	3b	9	445970	6208614	173	6	1	3	2	2	2	6	2	2	M	M	M	N	X	X	N	N	H	N	N	N	N	N	6	N
105	CWHwm	Fm50	none	Black Cottonwood - Red Alder - Salmonberry	3	3b	9	445719	6208623	168	6	5	3	3	3	3	6	3	3	L	L	L	N	X	X	N	N	H	N	N	N	L	N	6	N
106	CWHwm	Fm50	SO	Black Cottonwood - Red Alder - Salmonberry	3	6	9	445648	6208664	171	6	3	3	3	3	3	6	3	3	L	L	L	N	U	U	N	N	H	N	N	N	L	H	6	N
107	CWHwm	SS	CD	Ss - Salmonberry	8	7b	9	447799	6208871	217	6	3	2	2	2	4	6	3	3	H	M	M	N	U	U	N	M	L	H	M	N	L	H	1	N
108	CWHwm	SS	none	Ss - Salmonberry	7	7	9	444995	6208931	173	6	3	2	2	3	2	6	2	2	H	H	H	N	U	U	N	M	N	H	M	N	L	H	1	N
109	CWHwm	SD	none	SsHw - Devil's club	6	3b	9	447552	6209006	227	6	2	2	2	5	6	6	2	2	L	L	L	N	X	X	N	N	M	N	N	N	N	N	6	N
110	CWHwm	SO	none	SsHw - Oak fern	3	3b	9	447719	6209114	244	6	6	5	4	5	5	6	4	4	N	N	L	N	X	X	N	N	M	N	N	N	N	N	6	N
111	CWHwm	SD	none	SsHw - Devil's club	5	4	9	449599	6209266	256	6	6	6	4	4	4	6	4	3	L	L	L	N	X	X	N	N	L	N	N	N	N	N	6	N
112	CWHwm	SD	none	SsHw - Devil's club	5	4	9	449452	6209323	262	6	6	6	4	4	4	6	4	3	L	L	L	N	X	X	N	N	L	N	N	N	N	N	6	N
113	CWHwm	SS	none	Ss - Salmonberry	6	5	9	444133	6209411	134	6	6	5	4	3	5	6	3	3	N	N	N	N	X	X	N	N	N	N	N	N	N	N	6	N
114	CWHwm	SS	none	Ss - Salmonberry	6	5	9	444023	6209805	132	6	6	3	3	3	5	6	3	3	L	L	L	N	X	X	N	N	N	N	N	N	M	L	6	N
115	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443997	6210173	127	6	6	3	3	3	5	6	3	3	L	L	L	N	X	X	N	N	N	N	N	N	M	L	6	N
116	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443924	6210380	123	6	6	3	3	3	5	6	3	3	L	L	L	N	X	X	N	N	N	N	N	N	M	L	6	N
117	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443987	6210661	118	6	6	3	3	3	5	6	3	4	L	L	L	N	X	X	N	N	N	N	N	N	M	L	6	N
118	CWHwm	SS	SD	Ss - Salmonberry	4	5	9	443524	6211283	103	6	6	4	4	4	5	6	5	5	N	N	N	N	X	X	N	N	N	N	N	N	M	N	6	N
119	CWHwm	SS	none	Ss - Salmonberry	6	6	9	443371	6211428	99	6	6	4	3	3	3	6	1	2	L	L	L	N	X	X	N	N	N	N	N	N	M	L	6	N
120	CWHwm	SS	none	Ss - Salmonberry	6	5	9	443618	6211497	103	6	6	4	3	3	3	6	2	2	M	M	M	N	X	X	N	N	N	N	N	N	M	L	6	N
121	CWHwm	SS	none	Ss - Salmonberry	6	6	9	443181	6211579	98	6	6	4	3	3	3	6	1	2	M	M	M	N	X	X	N	L	N	L	N	N	N	N	6	N
122	CWHwm	SS	none	Ss - Salmonberry	6	6	9	443443	6211594	98	6	6	4	3	3	3	6	2	2	M	M	M	N	X	X	N	L	L	L	N	N	N	N	6	N
123	CWHwm	SS	none	Ss - Salmonberry	6	6	9	443675	6211702	101	6	6	4	3	3	3	6	2	2	M	M	M	N	X	X	N	L	L	L	N	N	N	N	6	N
124	CWHwm	SD	RZ/LA	SsHw - Devil's club	5	6	9	443968	6212020	97	6	6	2	2	3	3	6	1	2	H	M	M	N	U	U	N	H	M	M	M	N	M	H	4	N
125	MHmm1	MO	RZ	BaHm - Oak Fern	5	3b	9	451987	6206877	387	6	6	5	5	4	5	6	4	3	N	N	L	N	X	X	N	N	M	N	N	N	N	L	6	N
126	CMAun	Ah	Af	Alpine Heath	2d	2d	9	455070	6203680	1576	1	6	6	6	4	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	M	N	6	N
127	MHmm1	MT	AB	BaHm - Twisted stalk	5	6	9	451225	6208198	308	6	4	6	3	3	3	6	2	3	M	M	M	N	U	U	N	M	N	M	N	N	N	L	4	N
128	MHmmp	Sk	ES	Shrub Krummholz	3	3	9	454161	6201737	1007	2	4	6	5	3	4	6	6	3	L	L	L	N	X	X	M	N	M	N	N	L	H	N	6	N
129	CMAun	Af	RZ	Alpine Fellfield	1a	2	9	455019	6201801	1530	1	6	6	3	2	5	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	L	N	6	N
130	CWHwm	SS	SO	Ss - Salmonberry	6	7a	9	444134	6209378	222	6	3	3	3	3	3	6	1	3	M	M	M	N	U	U	N	N	N	H	M	N	N	H	1	N
131	CWHwm	SO	SD	SsHw - Oak fern	5	5	9	444144	6210178	205	6	6	3	3	5	6	6	3	3	L	L	L	N	X	X	N	N	N	L	N	N	N	N	6	N
132	MHmmp	Vs	none	Avalanche Shrub	3	3b	9	454070	6201444	1001	1	6	6	4	2	3	6	6	5	N	M	M	N	X	X	L	N	H	N	N	N	M	N	6	N
133	CMAun	Af	As	Alpine Fellfield	1a	1c/2d	9	455766	6201755	1506	1	6	6	6	4	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	L	N	6	N
134	CMAun	Af	Ah	Alpine Fellfield	1	2d	9	455432	6200395	1399	1	6	6	6	3	6	6	6	6	N	N	M	H	X	X	N	N	N	N	N	H	M	N	6	N

APPENDIX 4

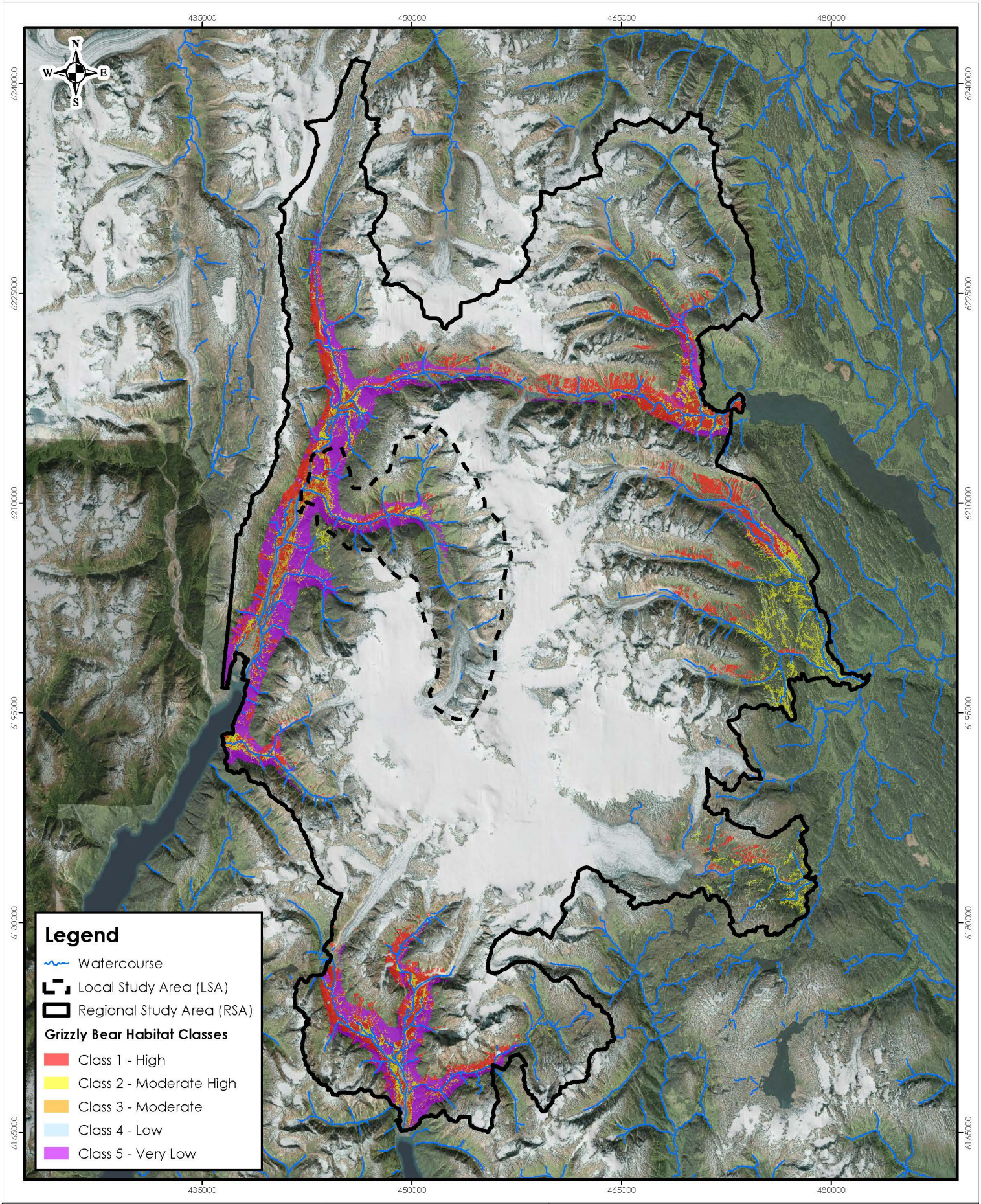
HABITAT SUITABILITY MAPS FOR SELECT SPECIES IN THE RSA



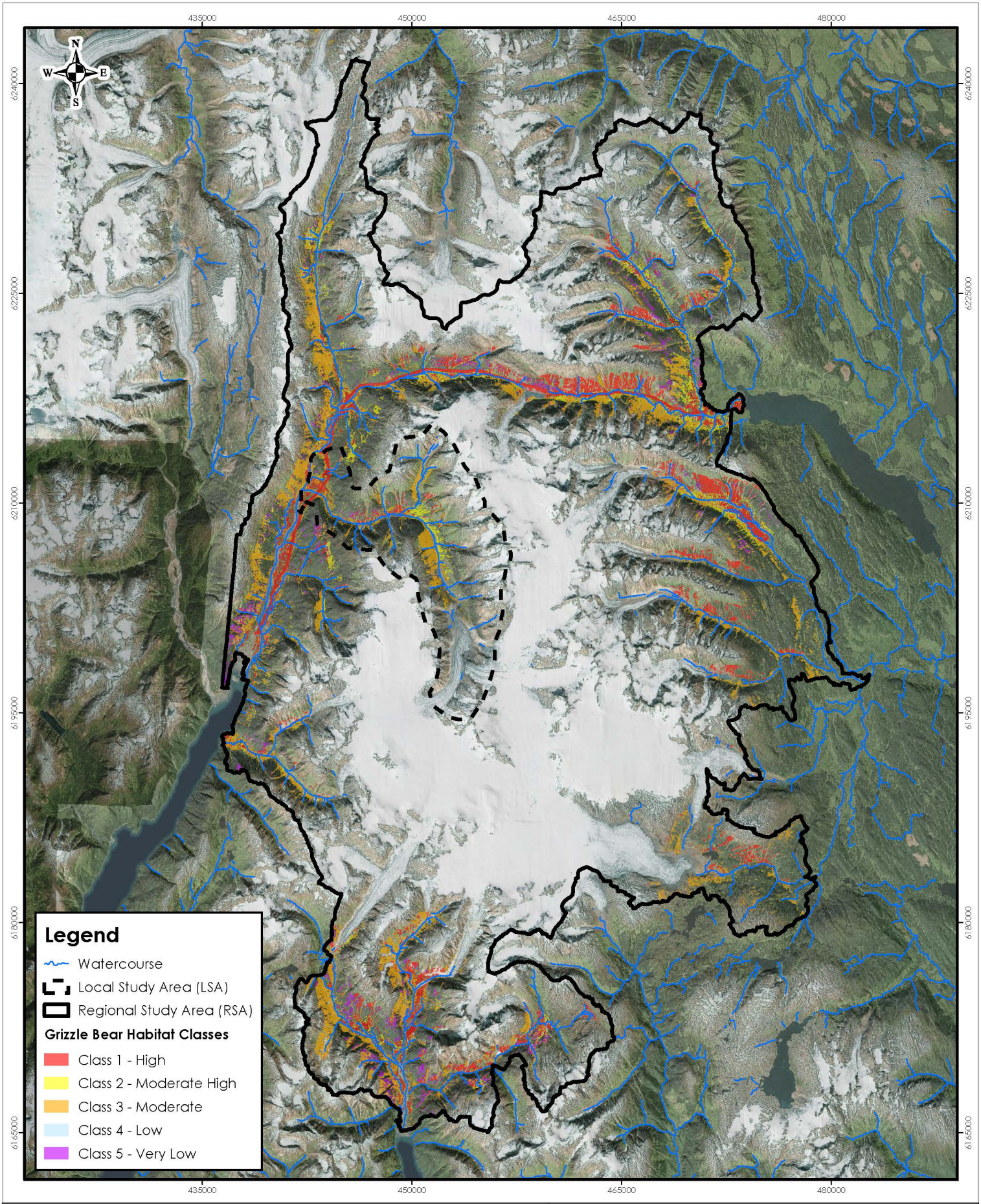
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-1_20170202.mxd
Apendix 4-1 - Mountain Goat RSA Living - Summer Habitat Suitability Map	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



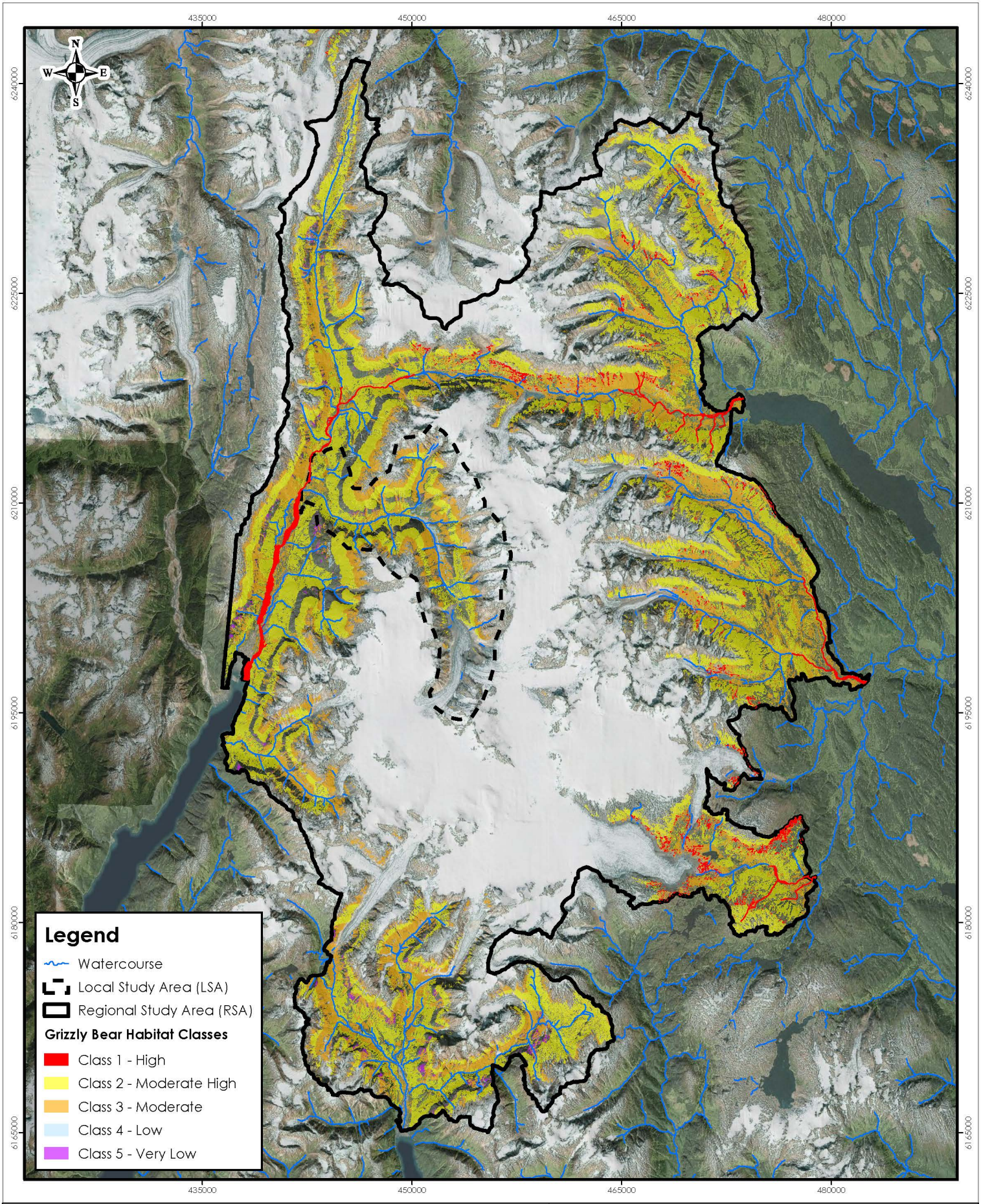
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-2_20170202.mxd
Apendix 4-2 - Mountain Goat RSA Living - Winter Habitat Suitability Map	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



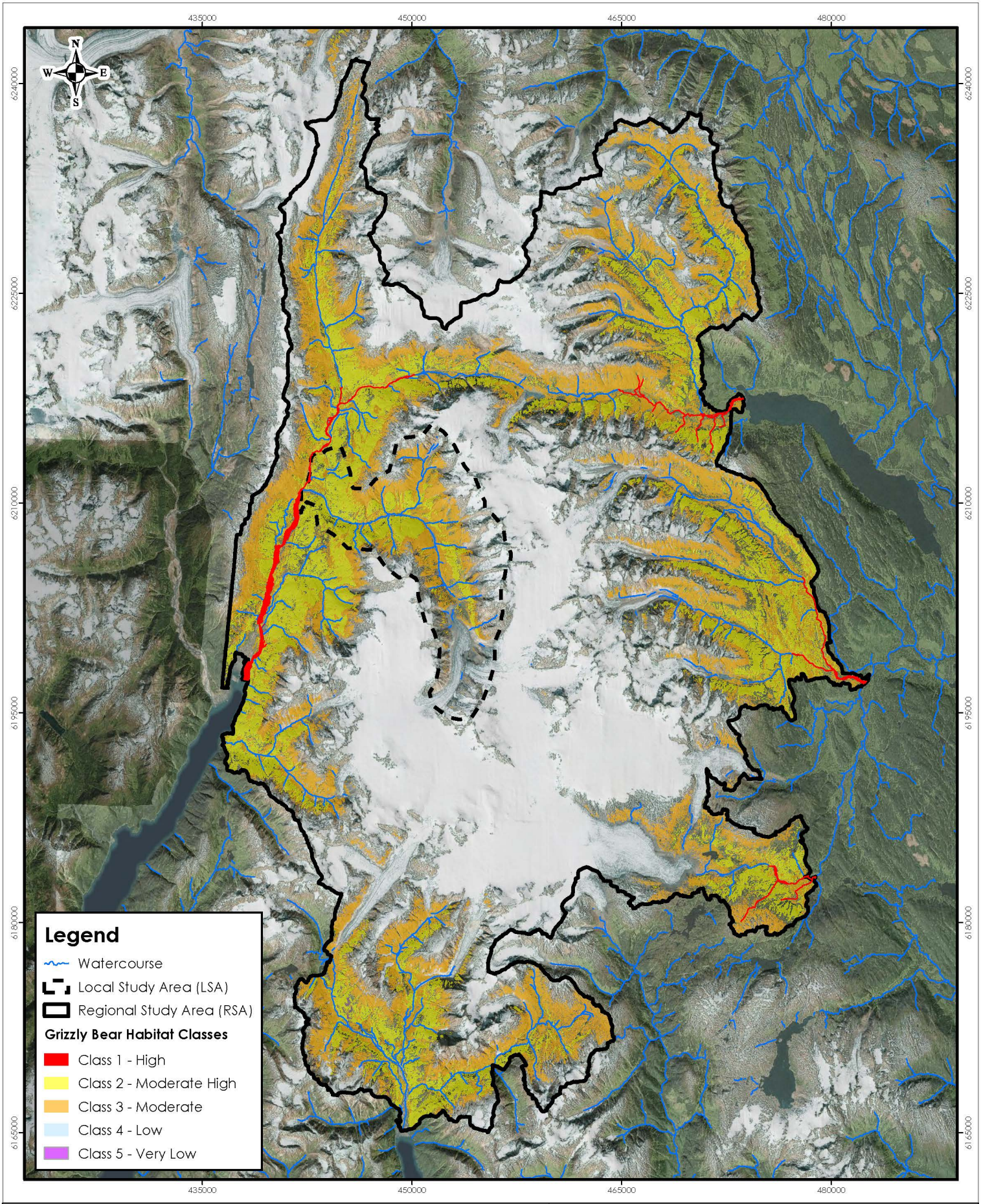
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-3_20170208.mxd
Apendix 4-3 - Grizzly Bear Early Spring Feeding Habitat Suitability	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



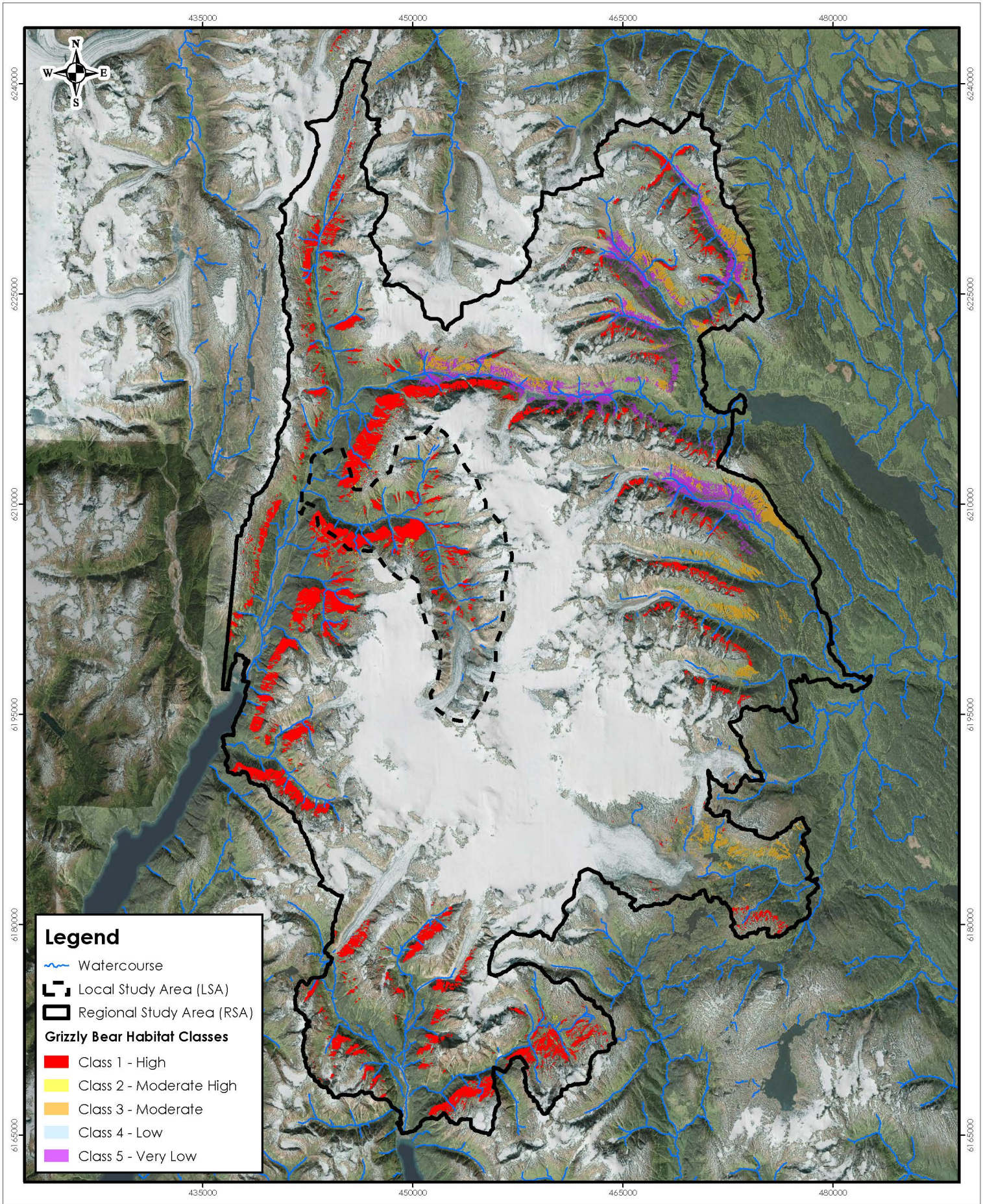
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-4_20170208.mxd
Apendix 4-4 - Grizzly Bear Late Spring Feeding Habitat Suitability	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-5_20170209.mxd
Apendix 4-5 - Grizzly Bear Summer Feeding Habitat Suitability	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



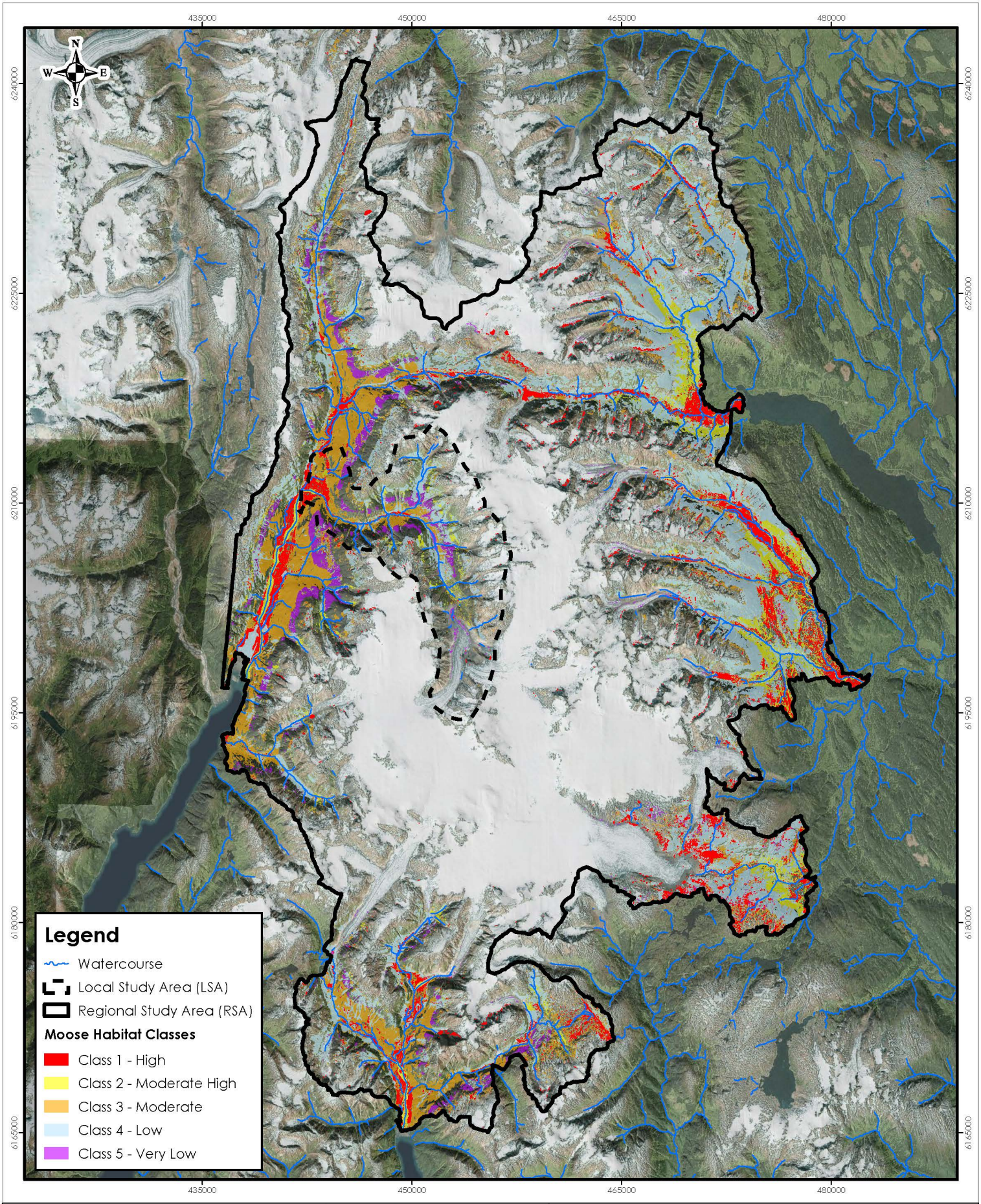
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-6_20170210.mxd
Apendix 4-6 - Grizzly Bear Fall Feeding Habitat Suitability	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



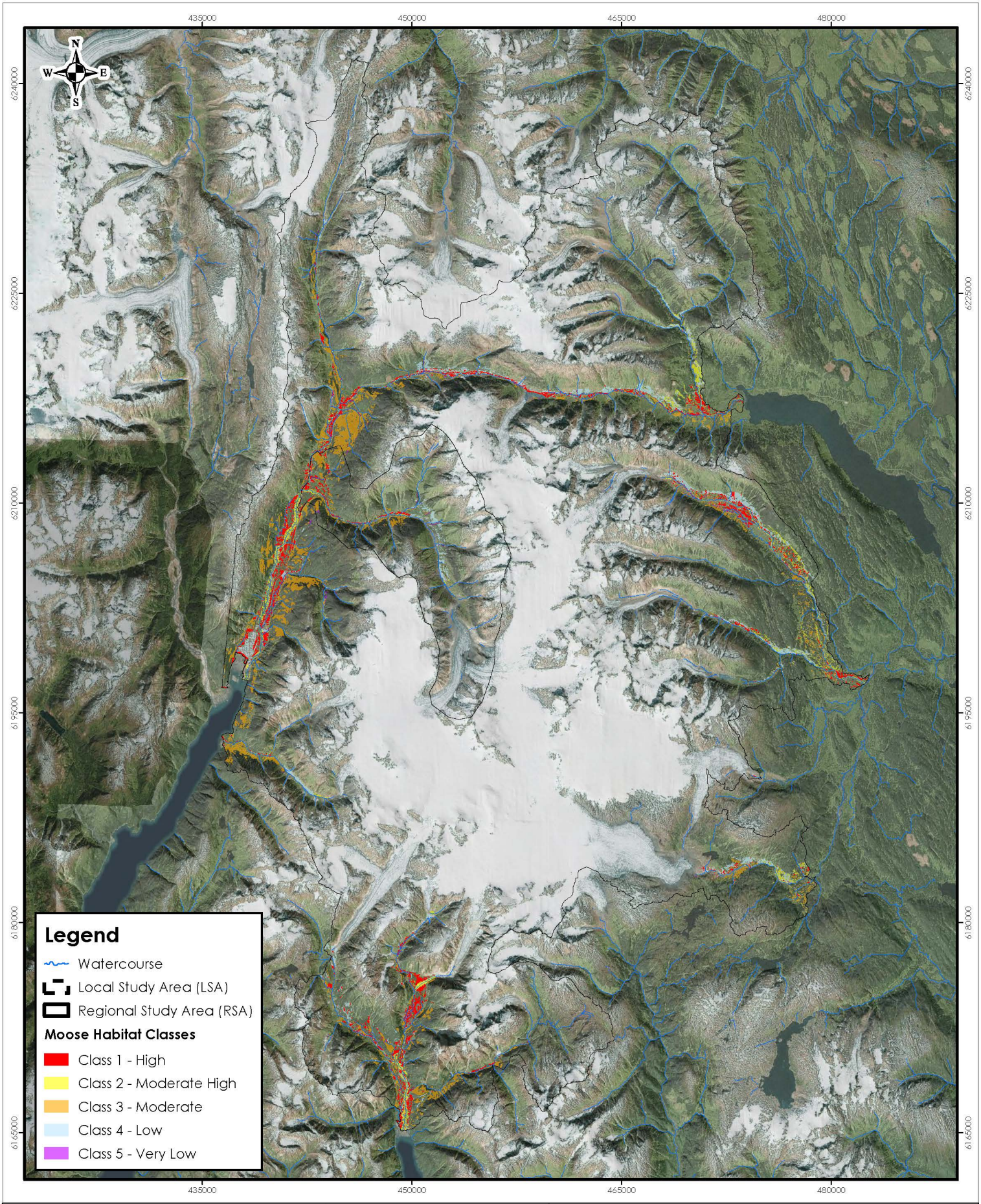
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-7_20170209.mxd
Apendix 4-7 - Grizzly Bear Winter Denning Habitat Suitability	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N

0 1 2 4 6 8 10 Kilometers

Scale: 1:350,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-8_20170214.mxd
Apendix 4-8 - Moose Habitat Rating Living During Growing (LI-G)	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N
		0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



Red Mountain Underground Gold Project

NORTHLINK CONSULTANTS LIMITED PARTNERSHIP

File Path: N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-9_20170210.mxd

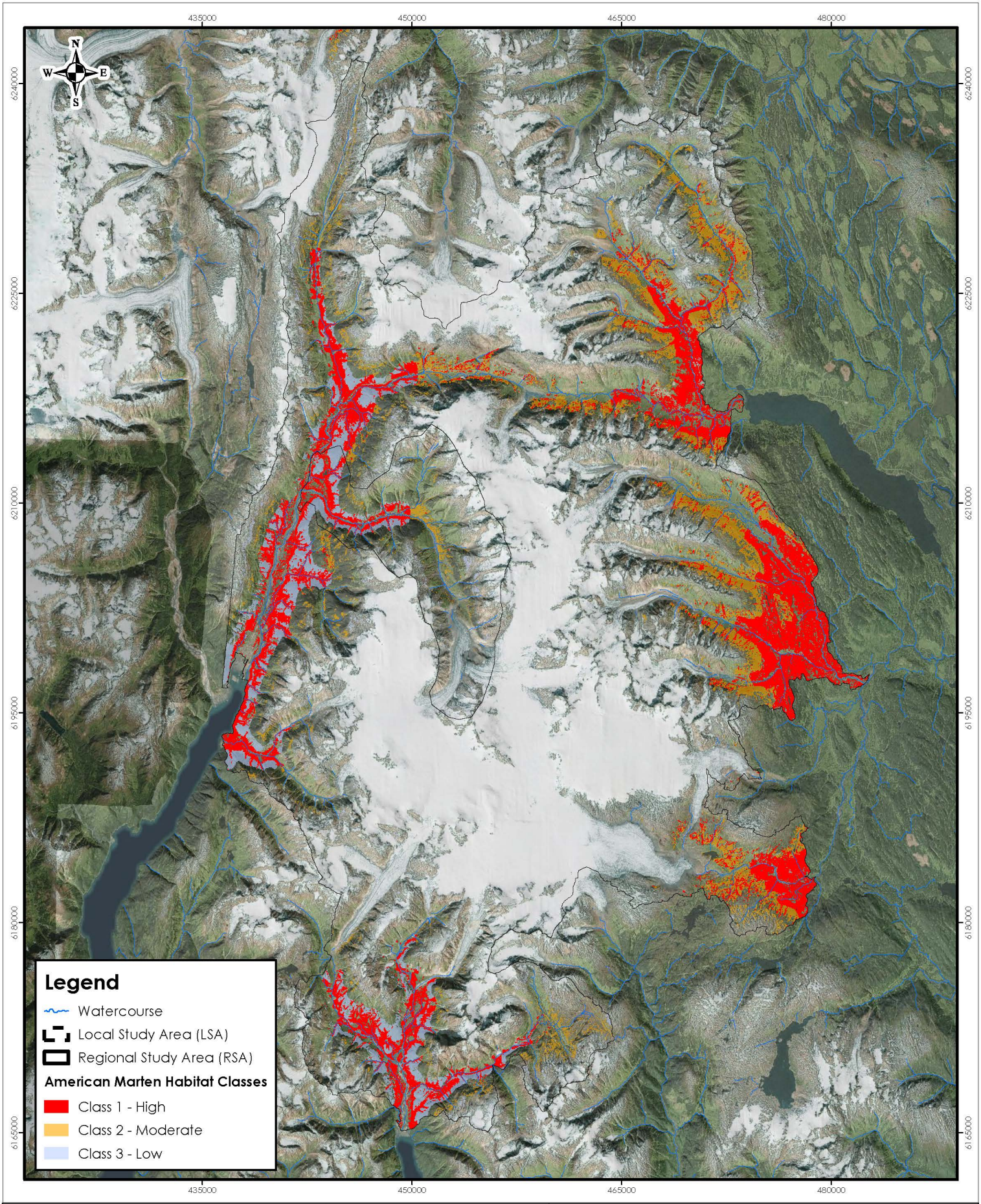
Apendix 4-9 - Moose Habitat Rating Living During Winter (LI-w)

IDM MINING

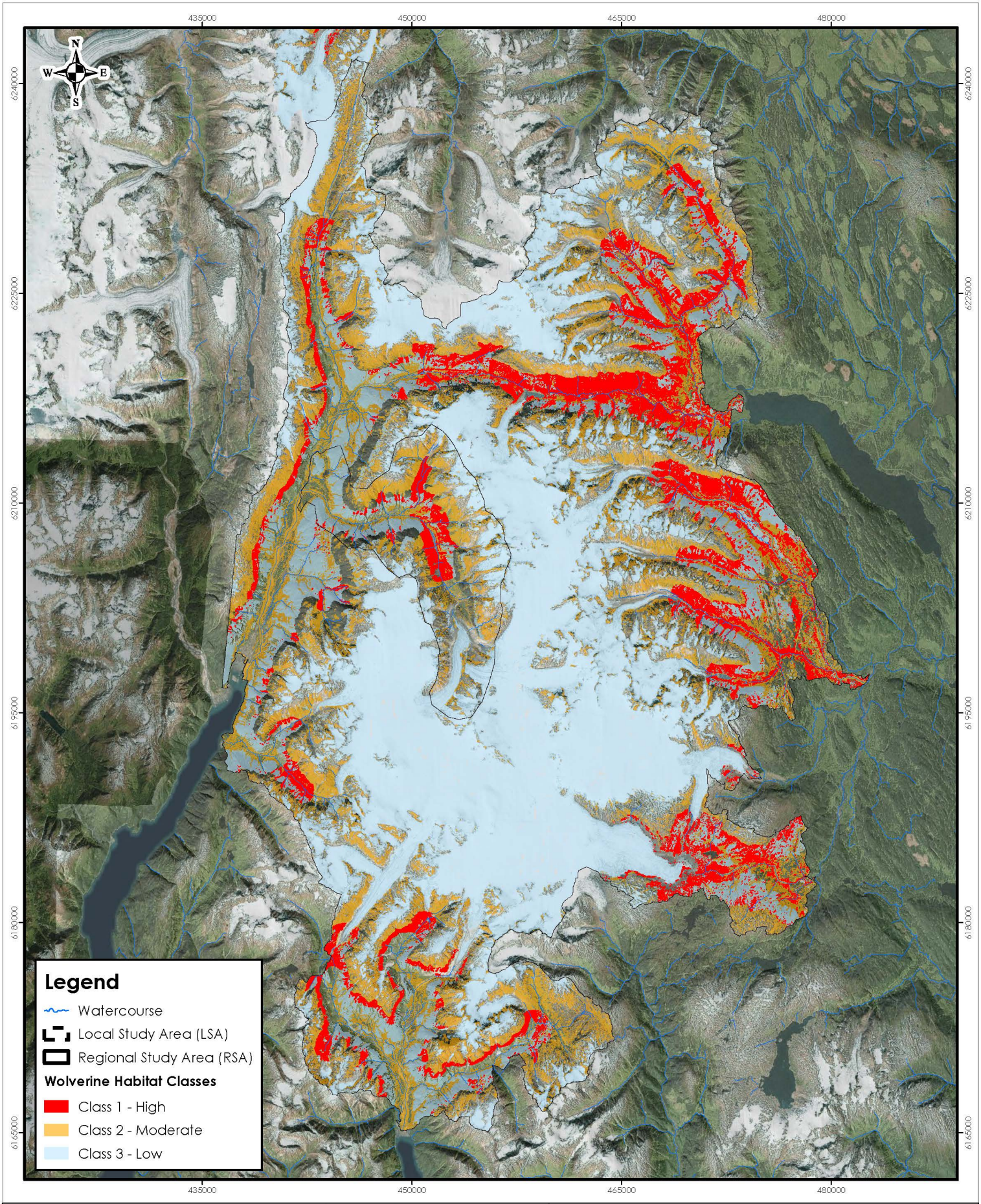
Project No:	5355
Date:	Mar 06, 2017
Basemap Source:	ESRI World Imagery
Map Datum:	NAD 1983 UTM Zone 9N

0 1 2 4 6 8 10 Kilometers

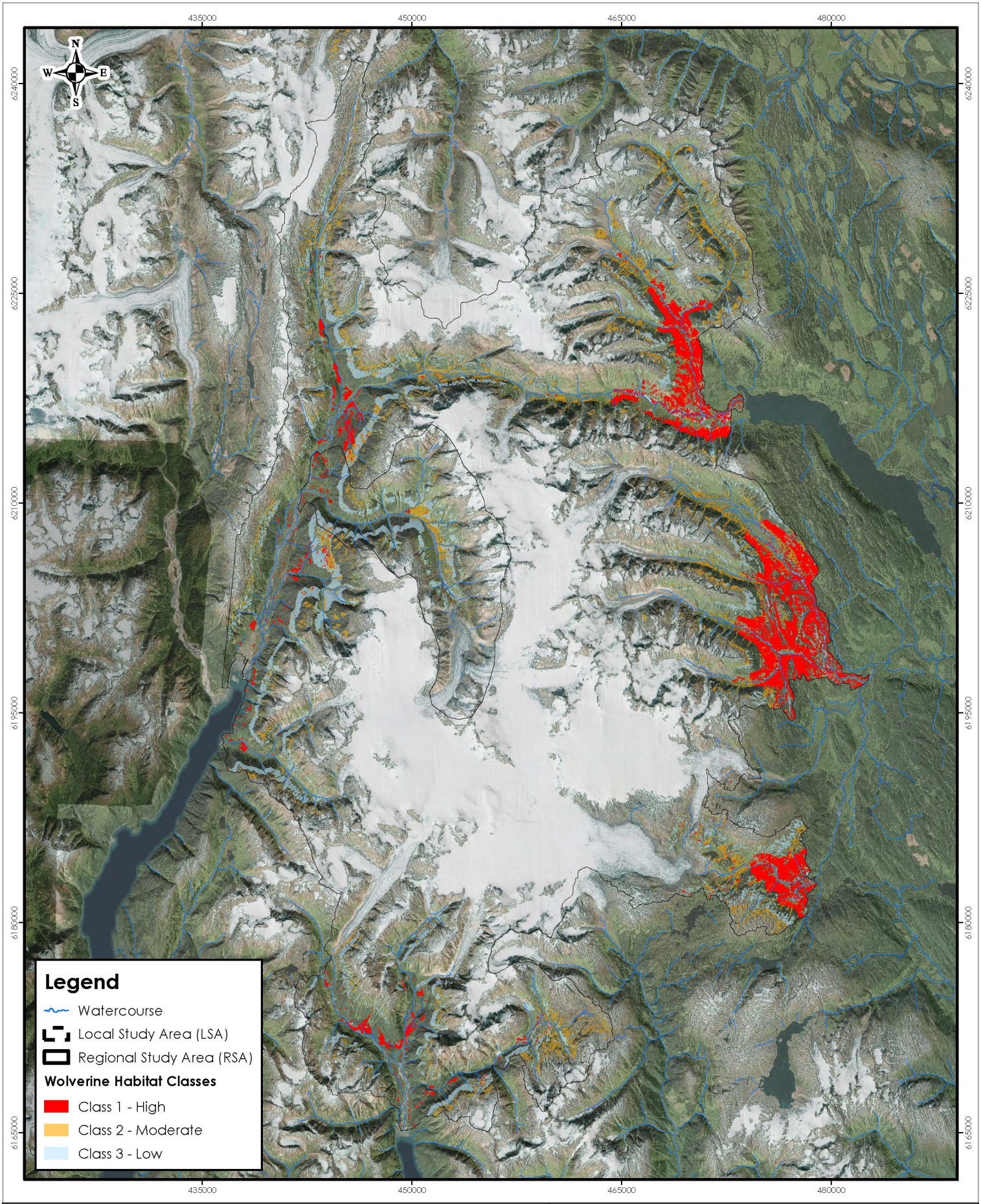
Scale: 1:350,000



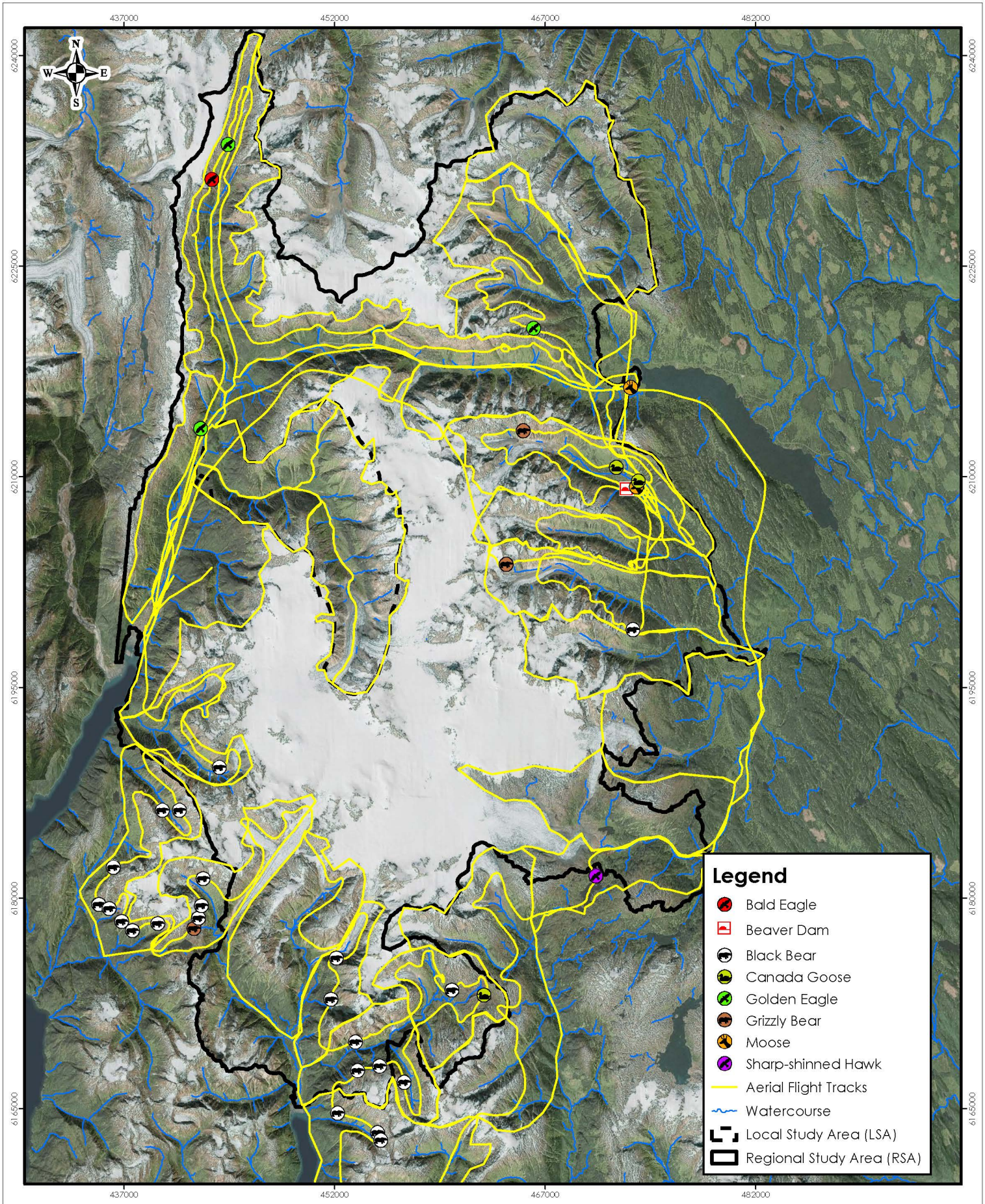
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-10_20170215.mxd
Appendix 4-10 - Marten Habitat Rating	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-11_20170215.mxd
Appendix 4-11 - Wolverine Summer Habitat Rating	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



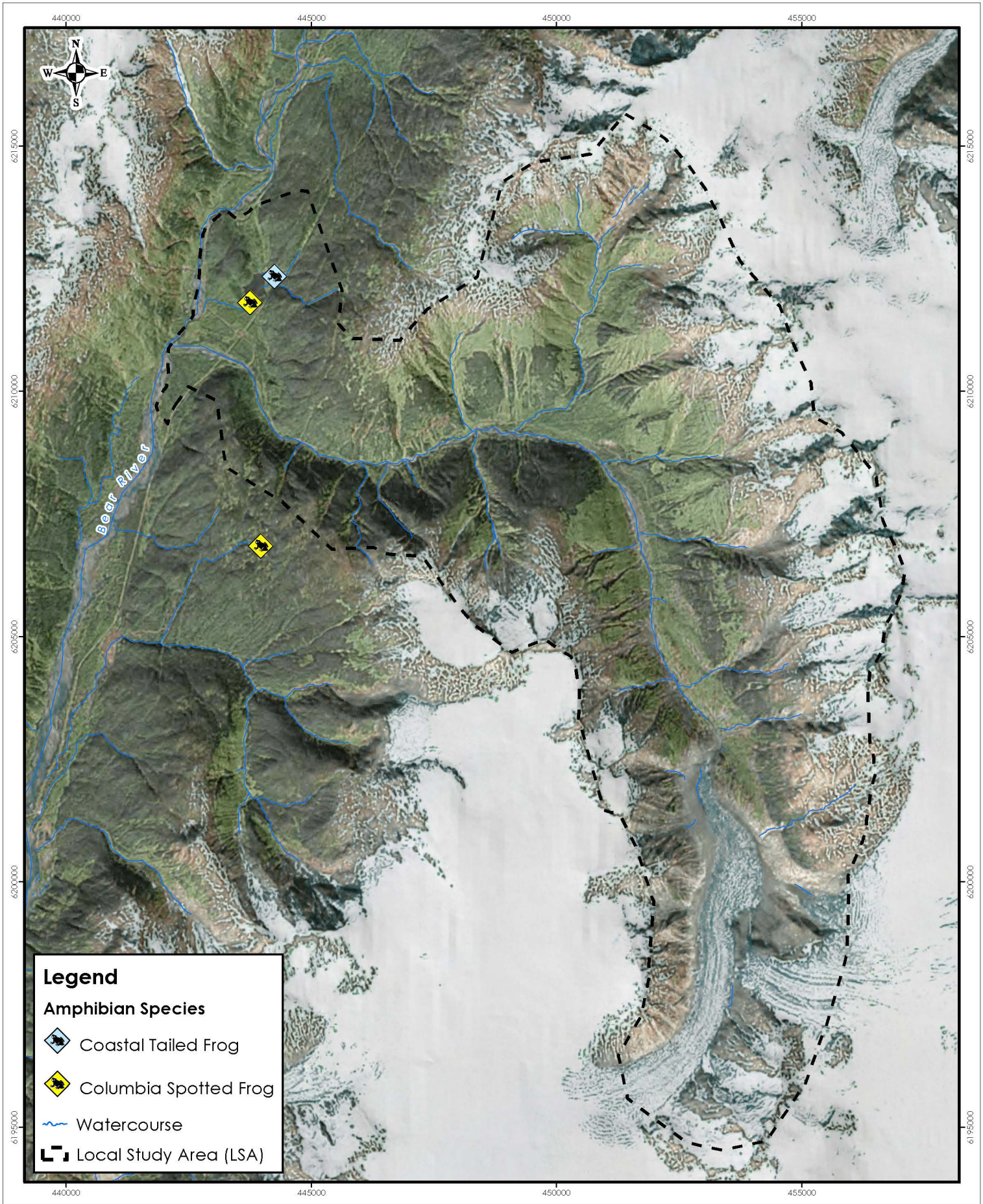
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix4-12_20170215.mxd
Appendix 4-12 - Wolverine Winter Habitat Rating	IDM MINING	**Project No:** 5355 **Date:** Mar 06, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers **Scale:** 1:350,000



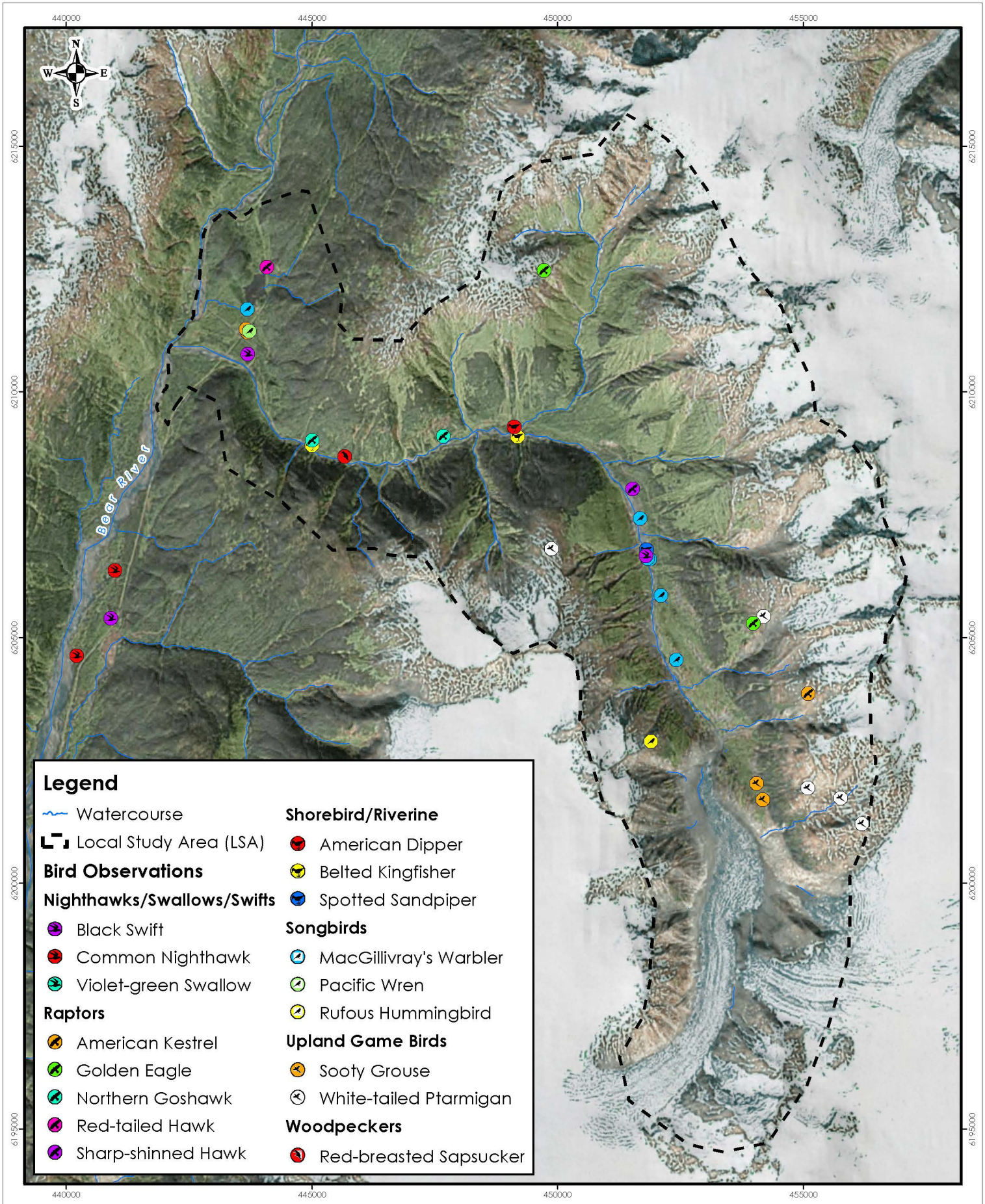
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	File Path: N:\ACTIVE\5446_5447_TMEP\MXD\5355_Appendix4-13_20170307.mxd
Appendix 4-13 - All RSA Wildlife Observations (See Appendix 4-a for Mtn. Goat Observations	IDM MINING	Project No: 5355 Date: Mar 07, 2017 Basemap Source: ESRI World Imagery Map Datum: NAD 1983 UTM Zone 9N 0 1 2 4 6 8 10 Kilometers Scale: 1:350,000

APPENDIX 5

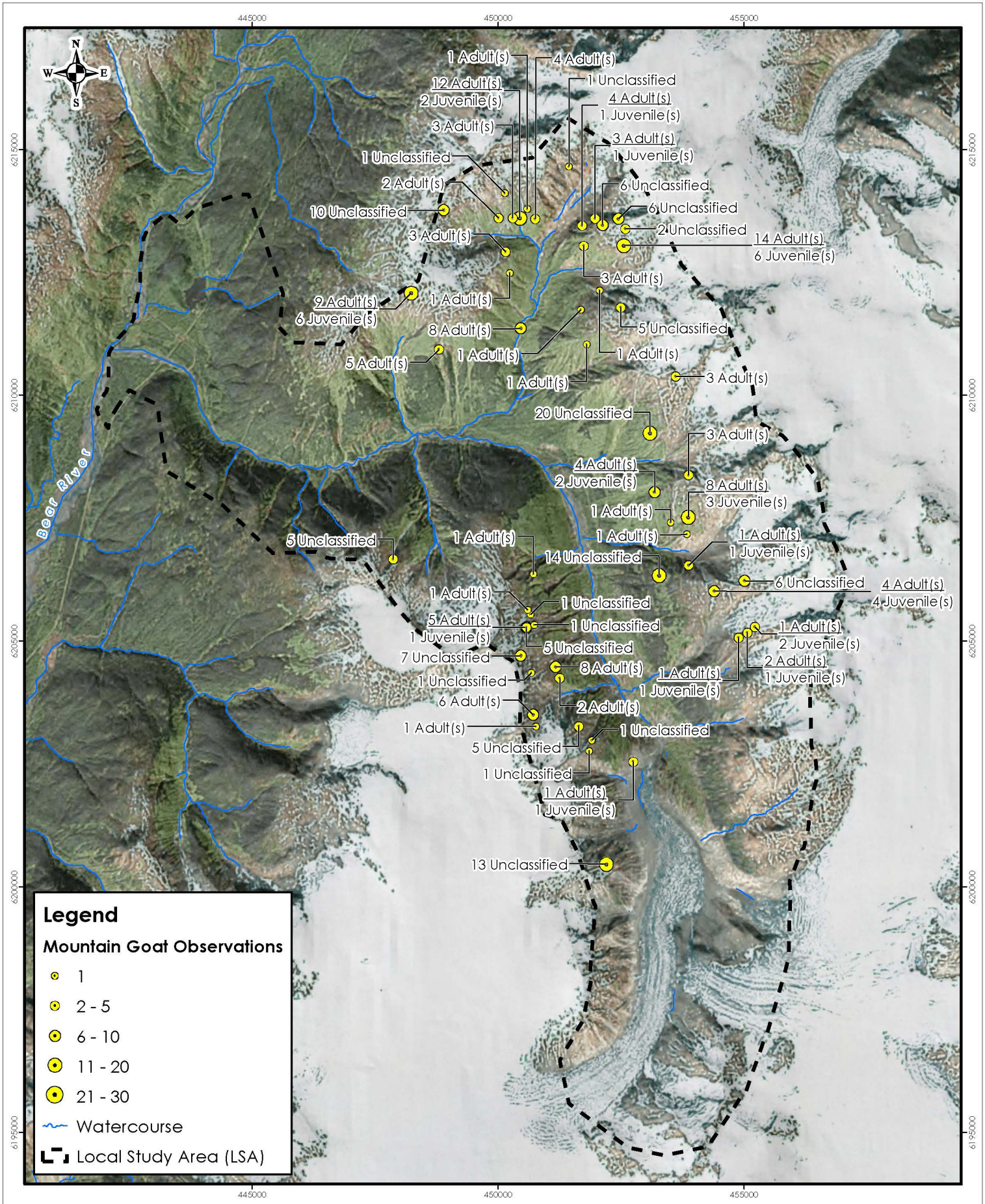
WILDLIFE OBSERVATION LOCATIONS 2015/2016 SURVEYS



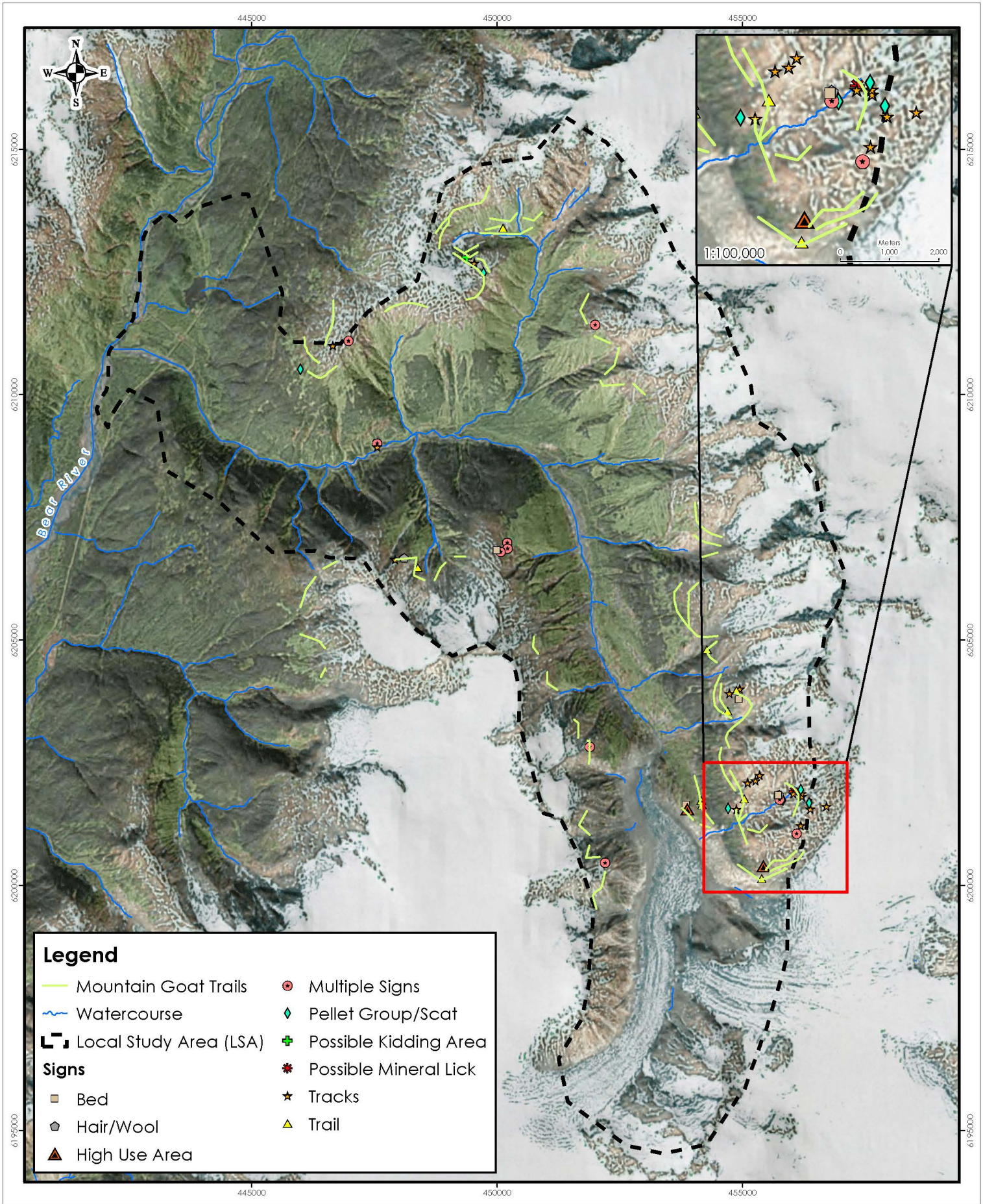
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	File Path: N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix5-1_20170228.mxd
Appendix 5-1 - All LSA Amphibian Observations	IDM MINING	Project No: 5355 Date: Mar 01, 2017 Basemap Source: ESRI World Imagery Map Datum: NAD 1983 UTM Zone 9N 0 400 800 1,600 2,400 3,200 4,000 Meters Scale: 1:100,000



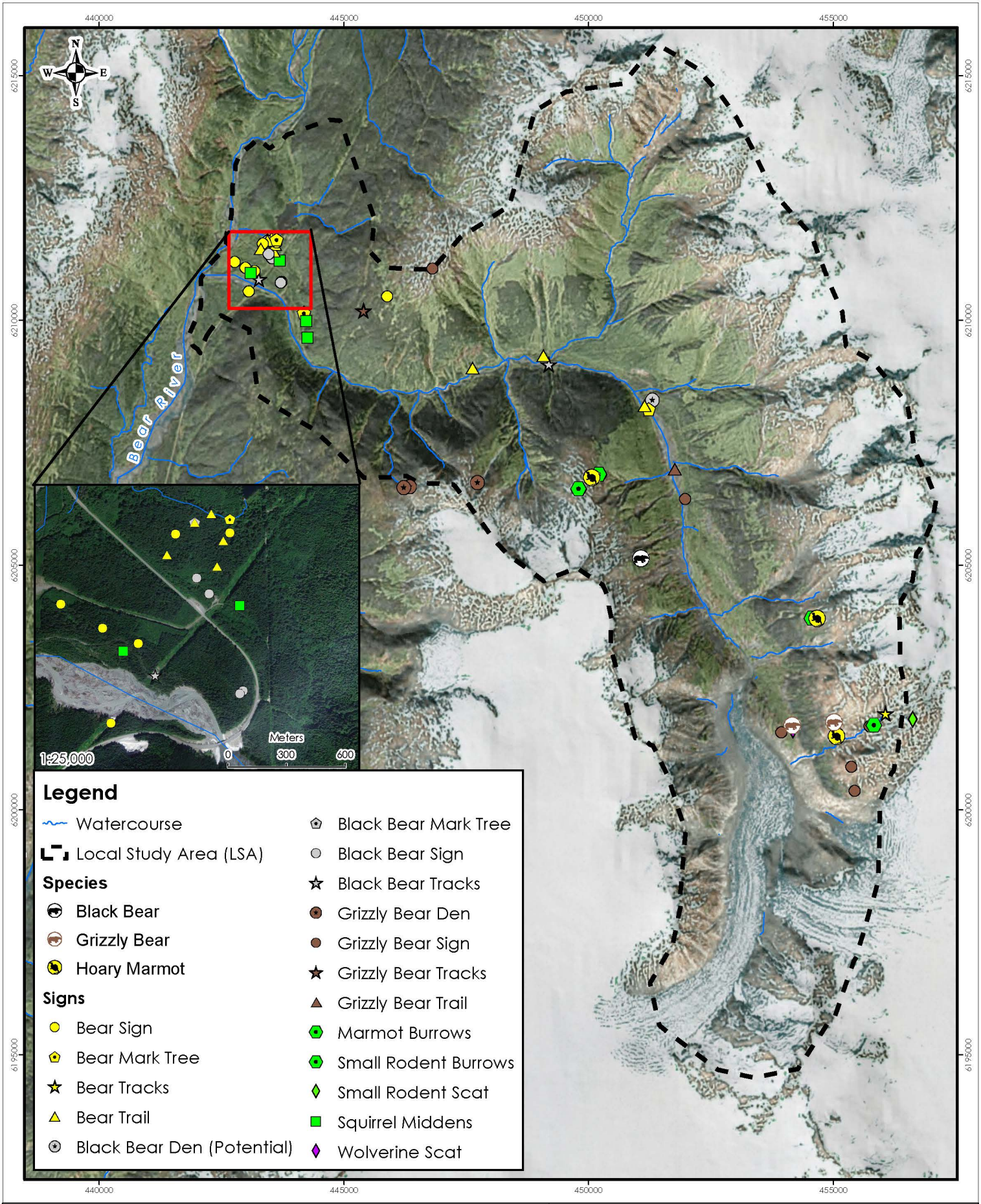
Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix5-2_20170228.mxd
Appendix 5-2 - All LSA Bird Observations	IDM MINING	**Project No:** 5355 **Date:** Mar 01, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 400 800 1,600 2,400 3,200 4,000 Meters **Scale:** 1:100,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix5-3_20170228.mxd
Appendix 5-3 - All LSA Mountain Goat Observations	IDM MINING	**Project No:** 5355 **Date:** Mar 01, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 400 800 1,600 2,400 3,200 4,000 Meters **Scale:** 1:100,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix5-3a_20170301.mxd
Appendix 5-3a - All LSA Mountain Goat Sign	IDM MINING	**Project No:** 5355 **Date:** Mar 02, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 400 800 1,600 2,400 3,200 4,000 Meters **Scale:** 1:100,000



Red Mountain Underground Gold Project	NORTHLINK CONSULTANTS LIMITED PARTNERSHIP	**File Path:** N:\ACTIVE\5355_Red_Mountain_Fisheries_Wildlife\MXD\RalphsFigures\5355_Appendix5-4_20170228.mxd
Appendix 5-4 - All LSA Bear and Other Mammal Observations	IDM MINING	**Project No:** 5355 **Date:** Mar 02, 2017 **Basemap Source:** ESRI World Imagery **Map Datum:** NAD 1983 UTM Zone 9N 0 400 800 1,600 2,400 3,200 4,000 Meters **Scale:** 1:100,000

APPENDIX 6
SELECT PHOTOS

Mountain Goat Potential Mineral Licks within the LSA

Potential Mineral Lick #1

Photo 865 and 866 Possible Mineral lick in Goldslide Creek Basin

Waypoint Name:	996 Poss Mineral Lick	Slope	40%
UTM	9 U 456053 6201921	Elevation	1562m
Aspect	234°	Nearest Escape Terrain	300m
Evidence of use:	Mountain Goat Tracks (at least 5 and digging		

Potential Mountain Goat Mineral Lick # 2

Photo 997 Photo 998

Photo 999

Photo 1000

Photo description:

- #997 – general view of slope looking south towards goldslide creek and proposed mine site. Note the patches of veg in the foreground are indicative of the heather/sedge cover.
- #998 - View of possible lick and slope looking North towards Roosevelt Creek
- #999 – view of possible mineral lick
- # 1000 – view looking southwest towards adjacent escape terrain and forage

Waypoint Name:	ORAM-12	Slope	112%
UTM	9 U 454944 6204017	Elevation	1583m
Aspect	245°	Nearest Escape Terrain	<50m
Evidence of use:	Mountain Goat Tracks (2), Major Trail (1), Digging		

Mountain Goat Winter Range

Mountain Goat Winter range and Escape Terrain in the Nelson Creek Drainage

Photo 2849 Major Mountain Goat Trail on south aspect slope in upper Nelson Creek Basin

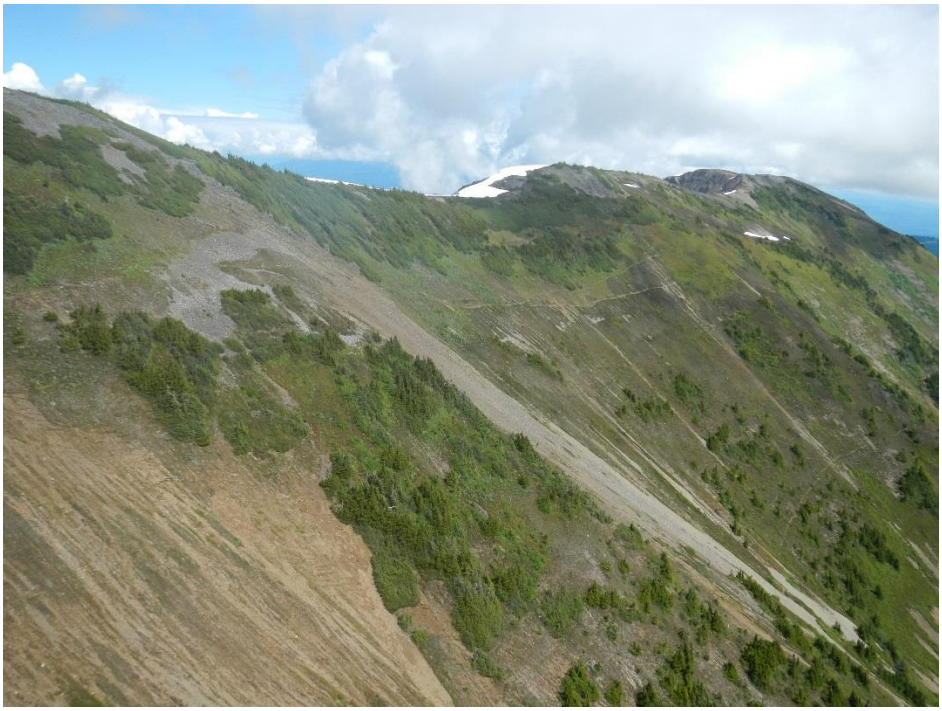


Photo 2850 Major wildlife (predominantly Mountain Goat) trails at higher and lower elevations across south facing slope.

Photo 0144 Mountain Goats (arrows) foraging in Alpine Heath meadow adjacent to escape terrain in the Marmot River Basin (9 U 440498 6194459).

Photo 2806 Mountain Goat Winter range with vegetation cover adjacent to escape terrain on south and southeast facing slopes above American Creek (9 V 442766 6223834).

Mountain Goat Winter Range and escape terrain in the LSA

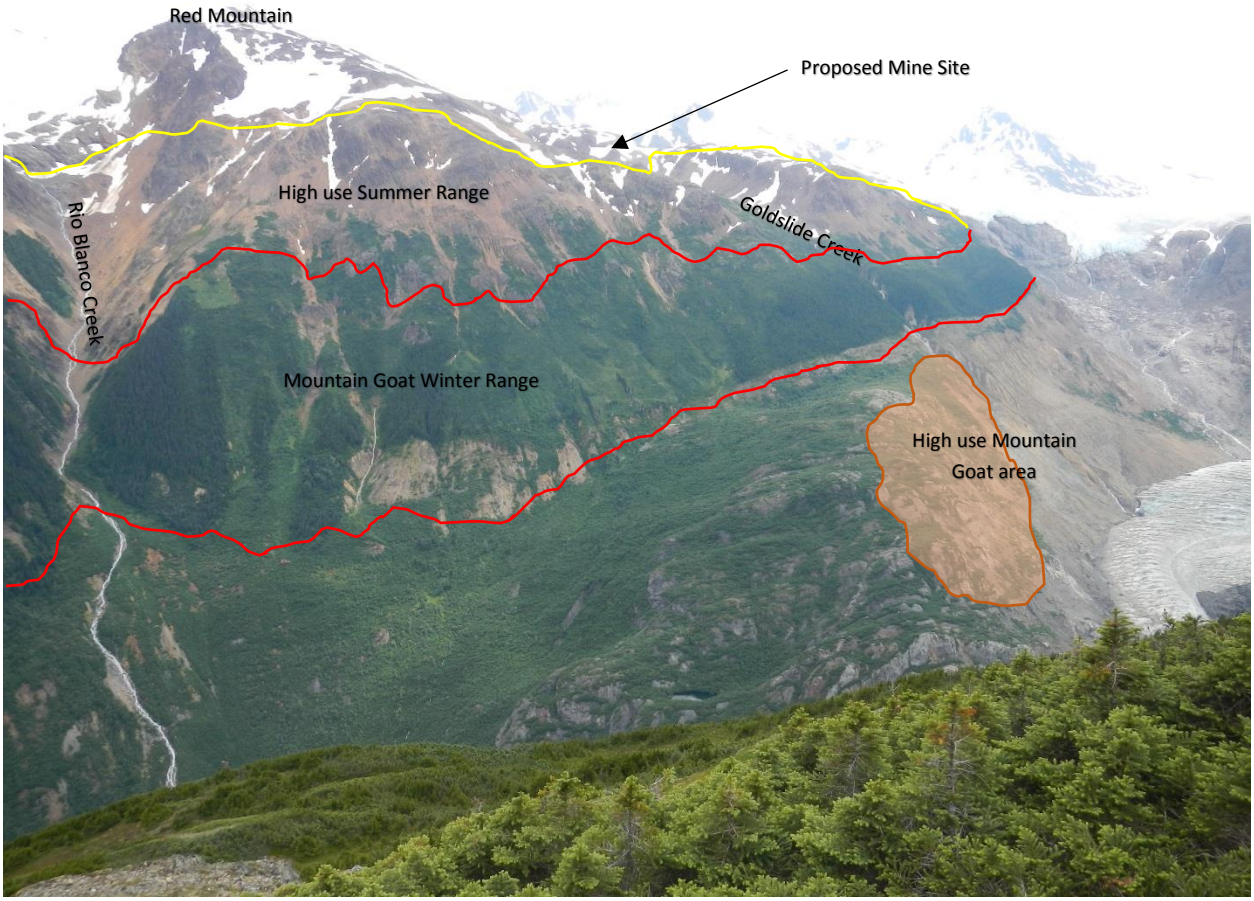


Photo 2664: View of Red Mountain and Mountain Goat habitat in and around the proposed mine site in the Goldslide Creek basin and the south and west facing slopes of Red Mountain. Photo was taken from ORAM station 5 (9 U 451901 6202985) at a bearing of 106°. High use Mountain Goat area in orange on the photo had more than 30 beds, scat piles and tracks. The goat sign was initially recorded during the August 2015 visit and again during the June 2016 visit. The age of the sign was estimated to be from the previous winter (Late Winter/early spring 2016).

High Suitability Moose Habitat within the RSA

Photo 152 Bog wetland complex (9 U 465576 6166669) above the Kitsault River

Photo 158 Bog Wetland complex with mature coniferous forest above the West Kitsault River (9 U 465023 6176384) providing high value summer Moose habitat.

Photo 171: Wetland riparian complex near Kitsault lake (9 U 466740 6178893) providing good Moose summer habitat.

Phot 2852 Wetland shrub complex adjacent to mature coniferous forest within the riparian floodplain of Nelson Creek providing High value Moose summer and winter habitat.

Photo 2861 High value Moose Summer and winter habitat in close proximity to each other. Nelson Creek (9 V 474552 6208602).

Photo 2862: Wetland shrub complex in the Nelson Creek floodplain (9 V 474552 6208602).

Photo 2863 View across Nelson Creek (9 V 474552 6208602) towards South facing slope with high shrub density providing forage adjacent to Mature Forest providing thermal and security cover.

Photo 2786: High value Moose habitat within the lower reaches of American Creek immediately North East of the LSA boundary. This is the closest high value Moose habitat to the LSA approximately 7.5km North-northeast of the confluence of Bitter Creek and Bear River.

High Suitability Western Screech Owl Habitat in the RSA

Photo 2838 Stand of very large >100cm dbh cottonwoods along the riparian zone of Strohn Creek (9 V 472240 6216467) providing high (class 1) nesting habitat for Western Screech Owl.

Photo 2837: Large wetland meadow adjacent to riparian zone with large cottonwoods providing good foraging opportunities adjacent to nesting habitat.