Big White Ski Resort

MASTER PLAN MODIFICATION

October 2018

BHA

www.brentharley.com

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1. INTRODUCTION

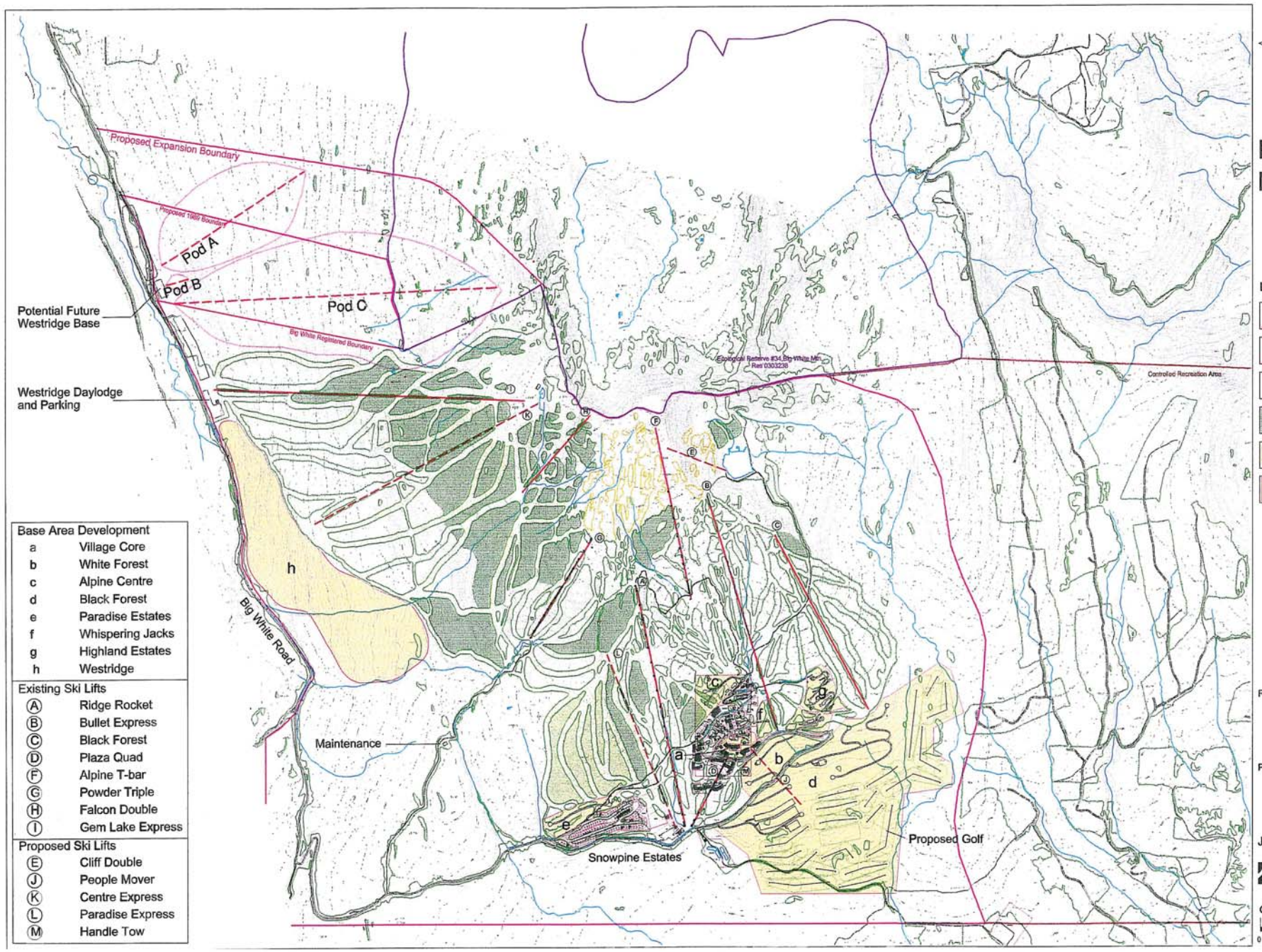
On behalf of Big White Ski Resort Ltd. (Big White), Brent Harley and Associates Inc. (BHA) is pleased to submit this Modification to the approved 1999 Big White Ski Resort Master Plan for the development for two new chairlifts, currently referred to as the Black Forest Connector and the Backcountry Chair. The Black Forest Connector and Backcountry chairlifts would be located to the east of the Black Forest Express, within Big White's existing Controlled Recreation Area. Together, these chairlifts represent the full realization of the vision described in the 1999 Master Plan, and the fulfillment of the Controlled Recreation Area's physical potential to offer a world-class alpine skiing experience.

The Black Forest Connector and Backcountry Chair will build on and complement the Black Forest Express ski pod, the most popular area at Big White. The abundance of intermediate trails and gladed terrain make the Black Forest Express well-suited to the largest segment of skier marketplace. The terrain within the Black Forest Connector and Backcountry ski pods will mimic that of the existing Black Forest Express. They will be primarily composed of intermediate terrain with extensive glading, easily accessible from the Black Forest Lodge. In adding these two chairs, Big White is addressing existing demand and alleviating the potential for crowding on the mountain and in the Black Forest Lodge staging area.

The following pages detail the background and rationale for the development, assessments of the potential impacts of development, specifics of the project scope and logistics, description of supporting utilities, and the implications of the proposed development for Big White's long-term plans. The proposed development will act to complement the existing on-mountain and base area facilities at Big White, and is aligned with the Vision, Goals, and Objectives stated in the 1999 Master Plan.

2. BACKGROUND

The 1999 Big White Ski Resort Master Plan described the development of two ski pods (i.e. a chairlift and associated ski terrain) to the west of the Gem Lake Express (Fig. 1, Pods A & C), conditional on a CRA boundary adjustment. These ski pods and the associated Westridge Base Area were not pursued for a variety of reasons. The Black Forest Connector and Backcountry Chair represent the relocation of these approved ski pods to the east of the Black Forest Express, staged from the existing Black Forest Day Lodge (Fig. 2).



Base Area Development

a	Village Core
b	White Forest
c	Alpine Centre
d	Black Forest
e	Paradise Estates
f	Whispering Jacks
g	Highland Estates
h	Westridge

Existing Ski Lifts

(A)	Ridge Rocket
(B)	Bullet Express
(C)	Black Forest
(D)	Plaza Quad
(F)	Alpine T-bar
(G)	Powder Triple
(H)	Falcon Double
(I)	Gem Lake Express

Proposed Ski Lifts

(E)	Cliff Double
(J)	People Mover
(K)	Centre Express
(L)	Paradise Express
(M)	Handle Tow

Big White Ski Resort
Kelowna, B.C. Canada

Resort Master Plan

Legend

- Existing Lifts
- Proposed Lifts
- Proposed Ski Trails
- Existing Gladed Skiing
- Proposed Gladed Skiing
- Proposed Base Area Development

Note: All legal boundaries are approximate and are not to be used for construction purposes.

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Prepared for:
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P.O. Box 2039, Stn.R, Kelowna
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June 1999

Contour Interval 5m

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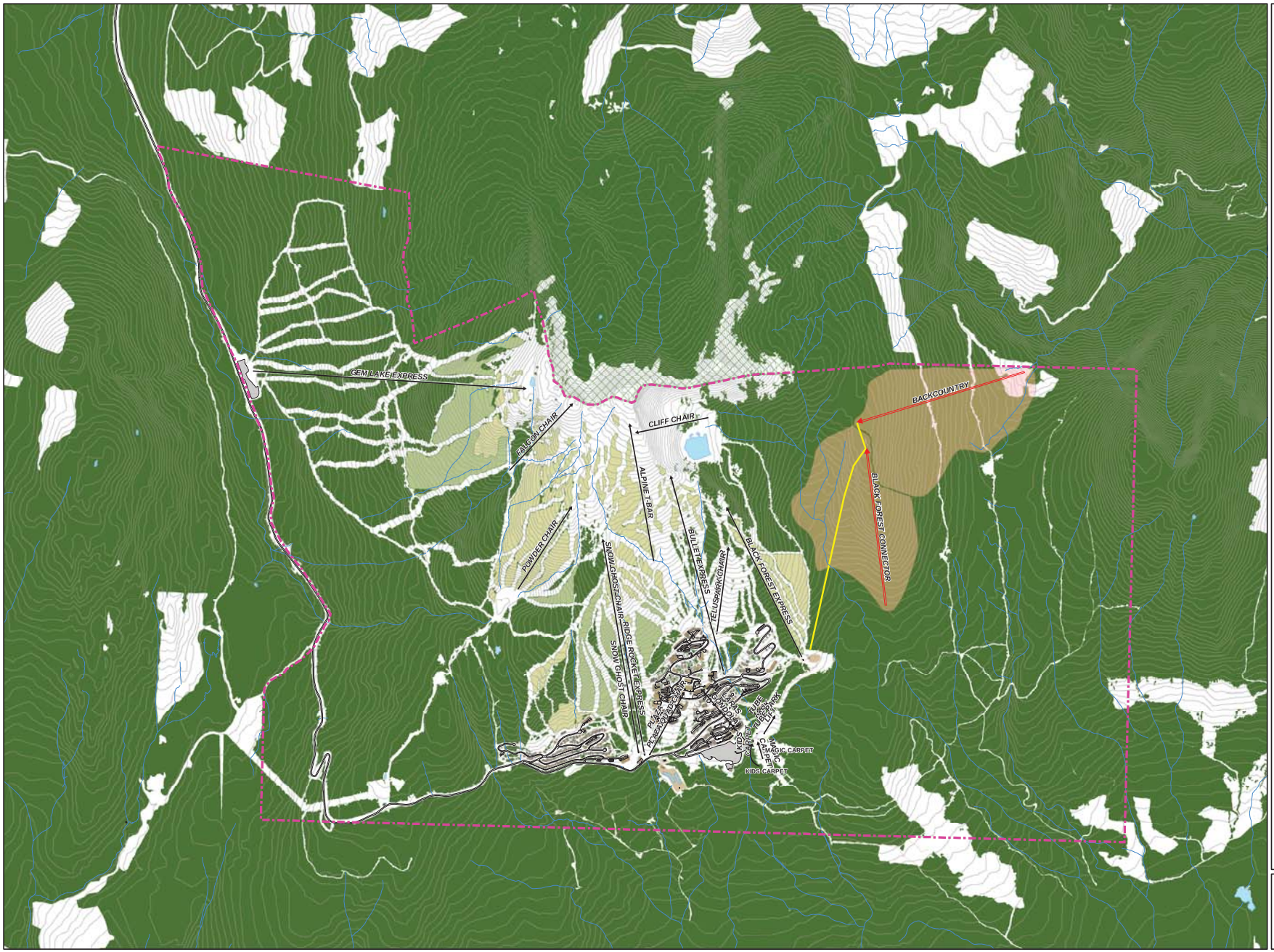

Big White Ski Resort
2018

Legend

- Proposed Lifts
- Existing Ski Lifts
- Existing CRA Boundary
- Streams
- Proposed ROW Power
- Proposed Ski Pods
- Existing Buildings
- Ecological Reserve

Existing Glading

- Glading Thin
- Glading Dense

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Figure 2.
Black Forest Connector and Backcountry Chair Context Map

3. SITE ANALYSIS

3.1 MOUNTAIN TERRAIN ANALYSIS

The proposed development has been designed to address growing demand for the Black Forest Express, the most popular area at Big White. The Black Forest Express is dominated by intermediate ski terrain and gladed ski trails. The Black Forest Connector and Backcountry Chair have similar physical characteristics and offer considerable potential to develop intermediate ski trails and a range of gladed skiing experiences. As such, the proposed chair lifts have been aligned to build upon and complement the skiing experience provided by the Black Forest Express.

To initiate the planning process, BHA revisited the analysis of Big White's terrain, updating the mapping database with the most current spatial data available. The results of this analysis confirmed that the terrain to the east of the Black Forest Express has significant recreation potential and is well-suited to intermediate skiers, the largest segment of the skier marketplace.

3.1.1 SKI SLOPE ANALYSIS

The mountain slope analysis illustrated that the area contained significant contiguous areas of beginner and intermediate terrain (Fig. 3). Small patches of expert terrain are also present in the area, allowing each of the proposed pods to contain a balance of ski terrain that closely resembles the skier marketplace.

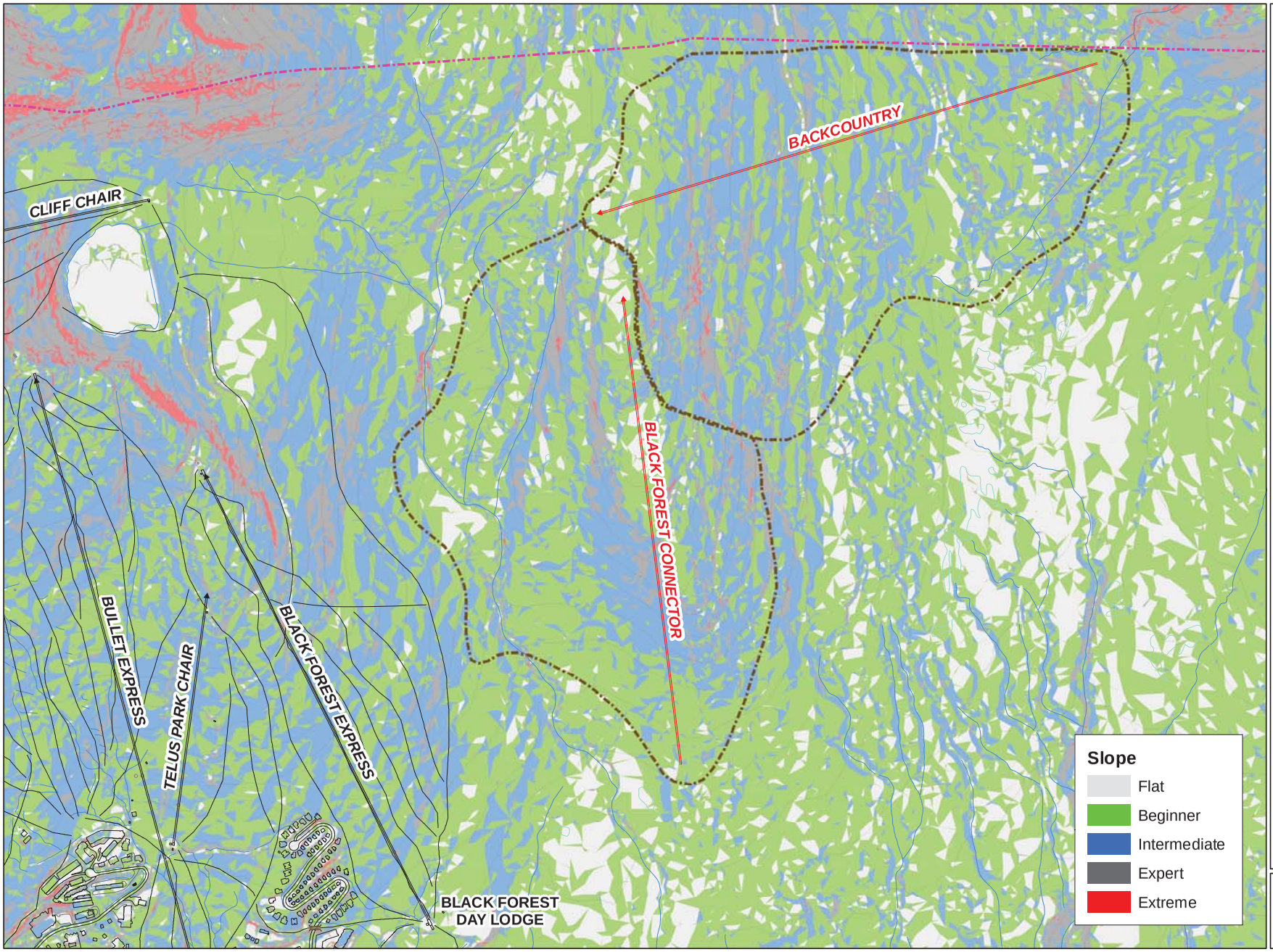
3.1.2 MOUNTAIN ELEVATION ANALYSIS

An analysis of the area's elevation highlighted the potential skiable vertical available (Fig. 4). A ridge running north-south provides a high point with slopes descending to the south and east and the peak of Big White Mountain (2,315 m) rising to the west. Elevation loss from this high point is approximately 200 m to the south and 300 m to the east, offering considerable skiable vertical.

3.1.3 MOUNTAIN ASPECT ANALYSIS

Aspect, or orientation of a slope with regards to the eight points of a compass, is critical in ski trail design as terrain with significant southern exposure can have poor snow retention and suffer from 'solar burn out'. While this can be mitigated through effective ski trail design (e.g. grading ski slopes away from the sun, narrow ski trails) and tree retention (glading), southern exposures present challenges and dictate the characteristics of the ski trails that can be developed.

The orientation of the study area is defined by the ridge noted in Sec. 3.1.2, with terrain on its west side oriented south and southwest, while terrain on its east side is predominantly east facing with pockets of northeast facing slopes (Fig. 5). The orientation of the study area's slopes informed ski trail alignment and design for the proposed ski pods, with both pods making extensive use of glading to preserve snowpack and prevent solar burn out.



Big White Ski Resort
Master Plan
2018

Legend

- Proposed Lifts
- Proposed Ski Pods
- Existing Ski Lifts
- Existing Ski Runs
- Existing CRA Boundary

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0 75 150 225 300 Meters

Figure 3. Mountain Slope Analysis

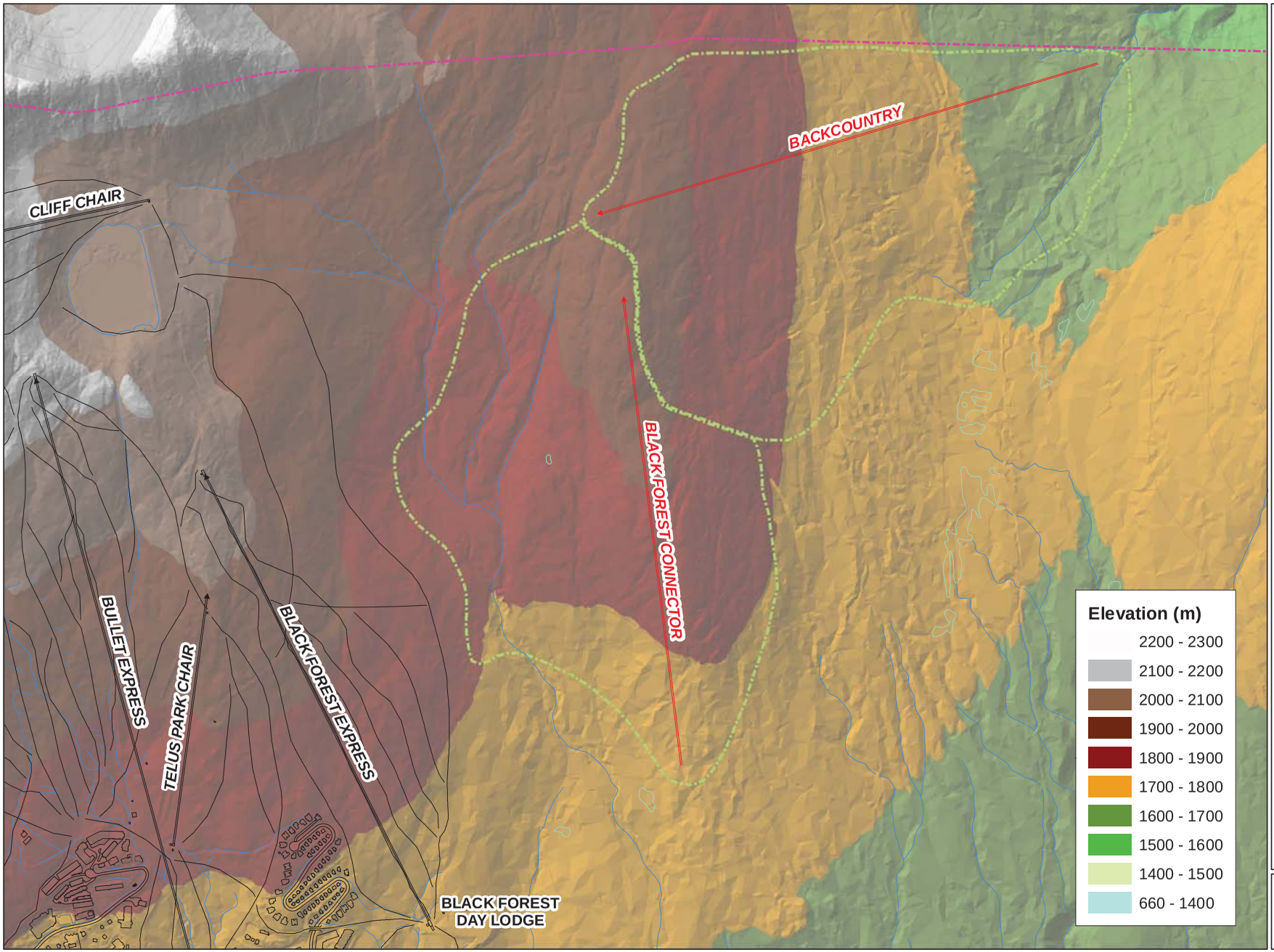

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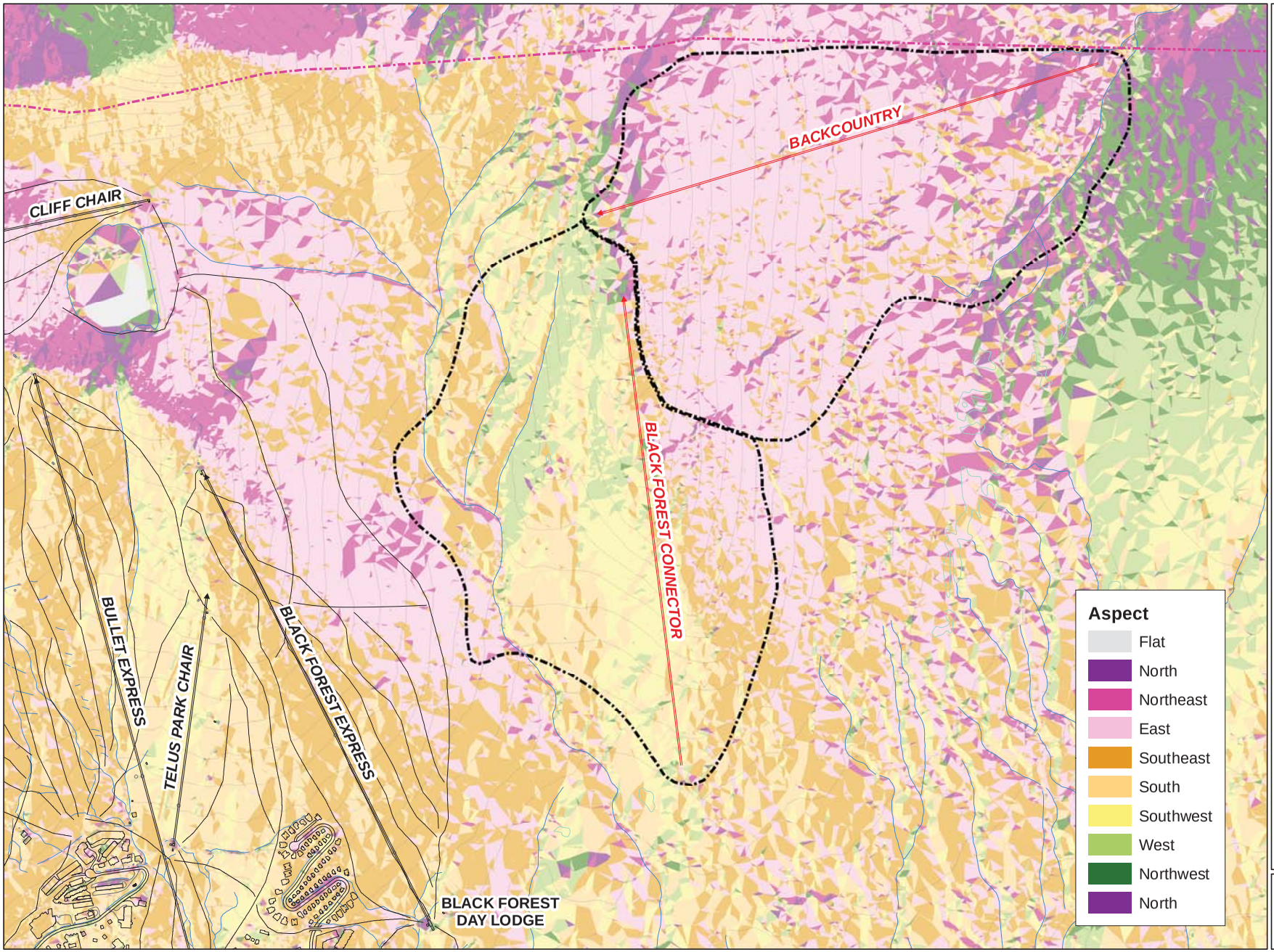
Figure 4 Mountain Elevation Analysis



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Master Plan
2018

Legend

- Proposed Lifts
- Proposed Ski Pods
- Existing Ski Lifts
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Figure 5. Mountain Slope Analysis

3.2 Environmental Review

To understand the potential impacts of the proposed development, Big White engaged Cascade Environmental Resource Group Ltd. (Cascade) to conduct an Environmental Review of the proposed development site in August 2018. The review includes documentation of the existing environmental conditions and the identification of environmentally sensitive and ecologically significant areas. The full report is included in the Appendix.

A review of existing environmental conditions found no recorded observations of Rare or Endangered Plants and Wildlife or Rare or Endangered Ecological Communities within the proposed development area. However, a review of local habitat indicated that 27 listed species have the potential to reside in the area, and anecdotal reports from Big White staff indicate that Grizzly bears have visited the area in the past.

The Environmental Review assessed the potential impacts of the proposed development. The removal of vegetation has the potential to increase erosion, the loss of topsoil, and subsequent impacts to water quality in nearby streams. Further, the construction of ski lifts and ski trails has the possibility to impact Valued Ecosystem Components, including two mapped wildlife corridors and wildlife trees. However, development is not anticipated to significantly affect the Grizzly bear population or any Rare or Endangered Plants, Wildlife, or Ecological Communities.

To address the potential impacts of development, the Environmental Review lists a series of mitigation measures for the impacts noted above, as well as methods that can be used during construction and operation to improve the suitability of the area to local flora and fauna.

3.3 Geotechnical Assessment

As part of the assessment of the potential impacts resulting from the proposed development, a Terrain Stability Assessment was conducted by Sitkum Consulting Limited (SCL) in September 2018. It included a desktop review of all available data and a field review of the proposed development site.

Based on the assessment, SCL concluded that no changes to the proposed development were anticipated. Much of the site was determined to be on benign terrain with a Very Low likelihood of slope instabilities. An area above Whitefoot Creek was determined to have Low likelihood of slope instabilities, but this area sits outside the proposed development area.

The Assessment also provided a list of recommendations for use of the existing and proposed access roads to mitigate any potential impacts to the terrain as a result of development or operation. These, plus the application of standard best construction and maintenance practices, will ensure that the likelihood of a slope instability is Low to Very Low. A Summary Memo of the Terrain Stability Assessment with supporting mapping is included in the Appendix. A finalized report will be available in the near future.

4. BLACK FOREST CONNECTOR AND BACKCOUNTRY CHAIR

The Black Forest Connector and Backcountry Chair ski pods will be dominated by intermediate ski trails and extensive glading, with a few beginner and advanced ski trails to create a comprehensive and balanced ski experience (Fig. 6). Both chairs will be easily accessible from the newly constructed Black Forest Day Lodge and supporting staging area. In relocating these two lifts, Big White is addressing existing demand and alleviating the potential for crowding in Black Forest Express ski pod.

4.1 PROPOSED SKI TRAILS

The resulting ski pods will add approximately 70 ha of skiable terrain to Big White and will primarily cater to intermediate skiers, with a few beginner and advanced ski trails (Table 1). Both pods will be connected to the resort through the existing Black Forest Express ski pod. Skiers will be able to access the proposed ski pods via Cliff Ski Out, Cougar Alley, and Whisky Jack ski trails, with egress available from both pods back to the Cliff Ski Out trail.

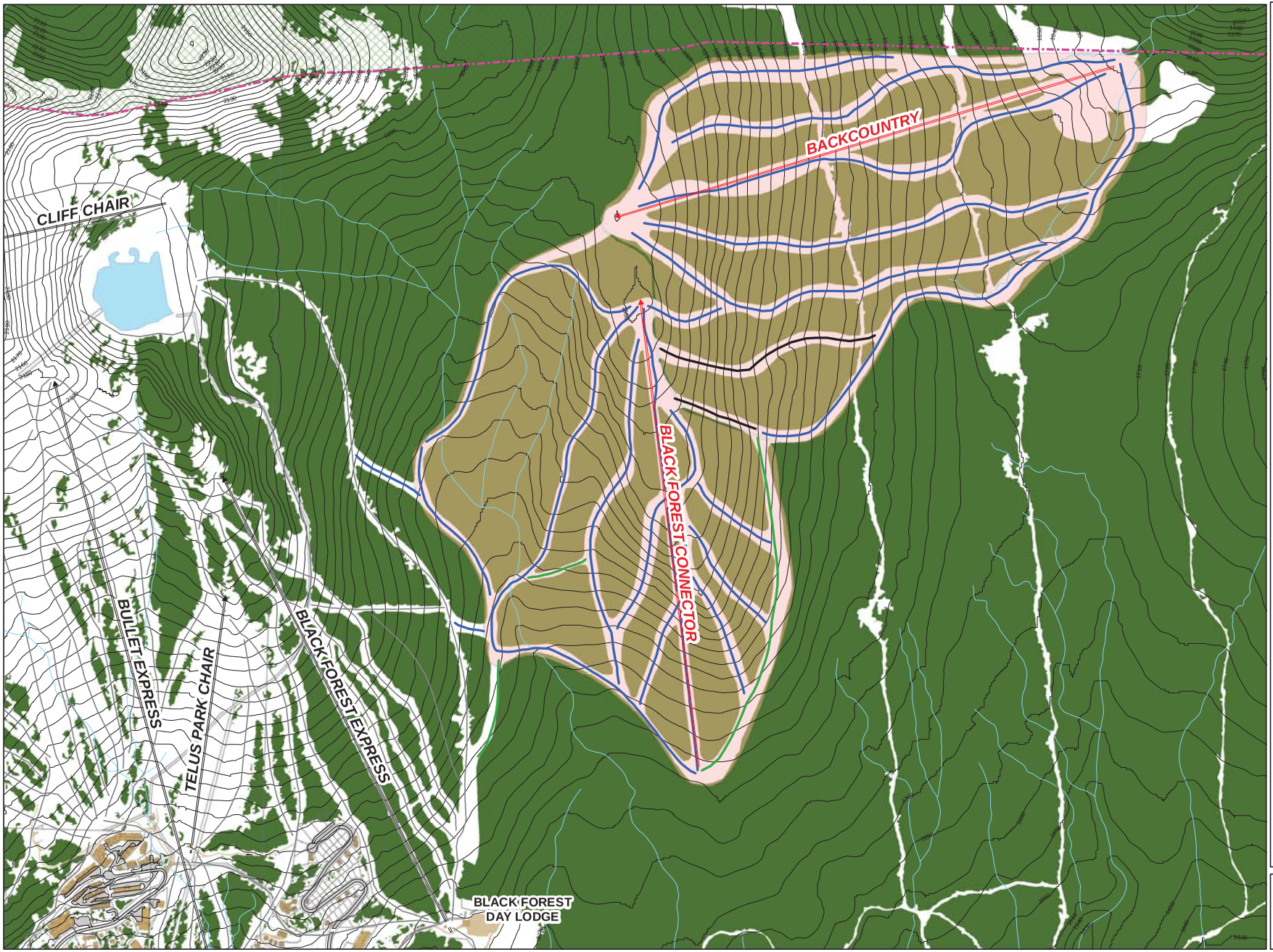
Table 1. Ski Terrain by Skier Skill Class

Skill Class	Existing Trails	Skier Marketplace	Proposed Trails
Novice	2.2%	5%	4%
Beginner	22.7%	10%	4%
Low Intermediate	20.4%	20%	46%
Intermediate	40.6%	35%	35%
Advanced	12.8%	20%	8%
Extreme	1.4%	10%	4%

4.2 PROPOSED GLADED SKIING

With the addition of the Black Forest Connector and Backcountry Chair, gladed skiing at Big White will increase by approximately 50 ha (Fig. 7). Gladed terrain will be developed using a feathering technique where tree density increases as distance from the edge of the cleared ski trail increases. For example, moving into the trees from the cleared ski trail, the tree spacing would initially be wide (5 to 7 metres) and progressively close to a minimum of 2 metres. The lower branches of gladed trees should also be limbed to a height of 3 metres above the maximum snow depth to facilitate clear paths for skiers and boarders.

A feathered ski trail edge provides an excellent skills development opportunity by creating a semi-gladed transition zone between the fully cut ski run and the denser gladed areas in between runs. As skiers gain skill and confidence they can gradually shift into denser areas of the ski trail.



Big White Ski Resort
2018

Legend

Proposed Ski Trails

- Advanced
- Intermediate
- Beginner
- Proposed Lifts
- Existing Ski Runs
- Existing Ski Lifts
- Existing CRA Boundary
- Streams
- Proposed Ski Pods
- Existing Buildings
- Ecological Reserve

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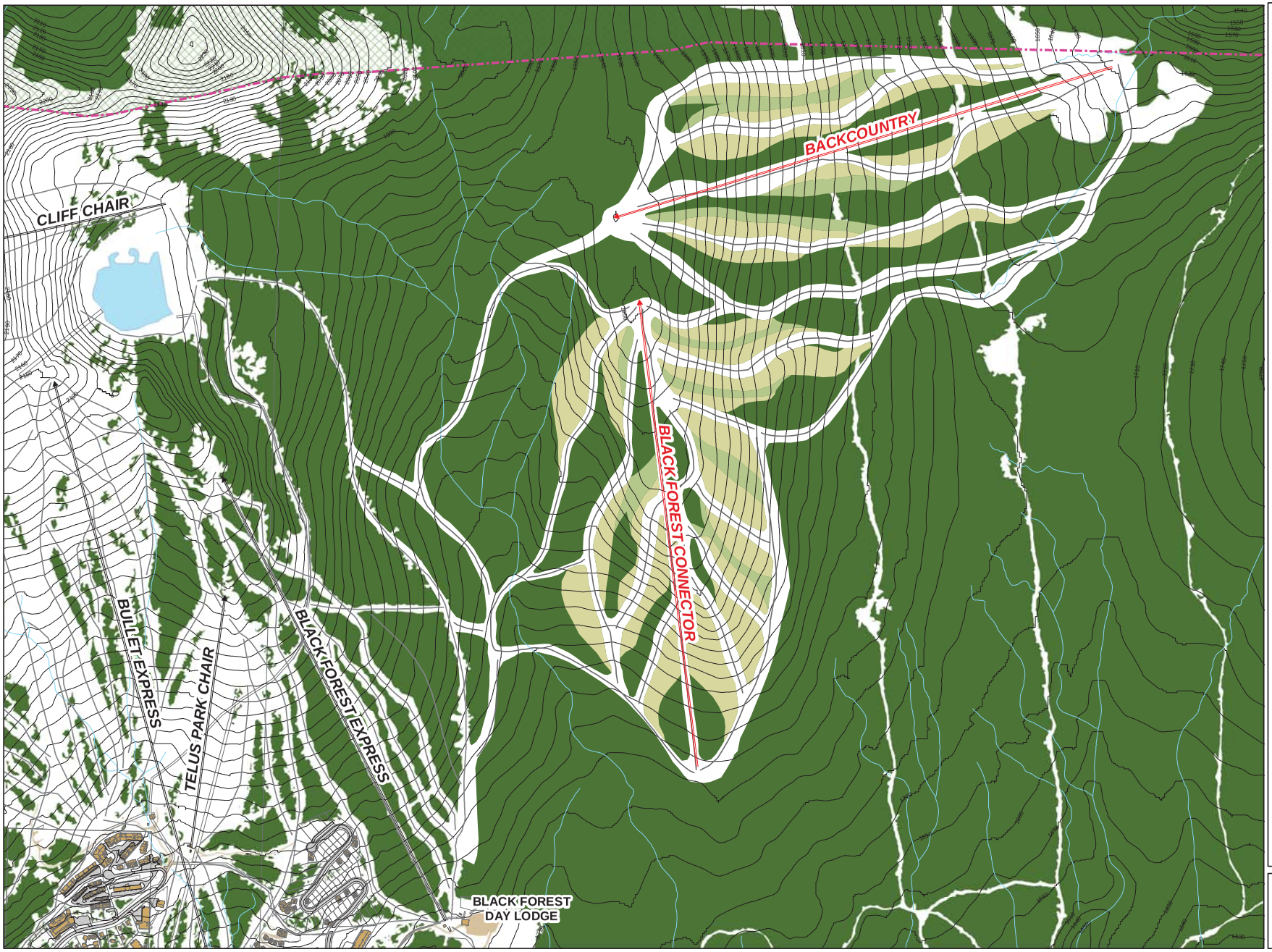
Figure 6.
Black Forest Connector
and Backcountry Chair
Ski Trails by Skier Skill Class



Big White Ski Resort
2018

Legend

Proposed Glading

- Thin (5-7m Spacing)
- Dense (2m Spacing)
- Proposed Lifts
- Proposed Ski Trails
- Existing Ski Lifts
- Existing Ski Runs
- Existing CRA Boundary
- Streams
- Existing Buildings
- Ecological Reserve

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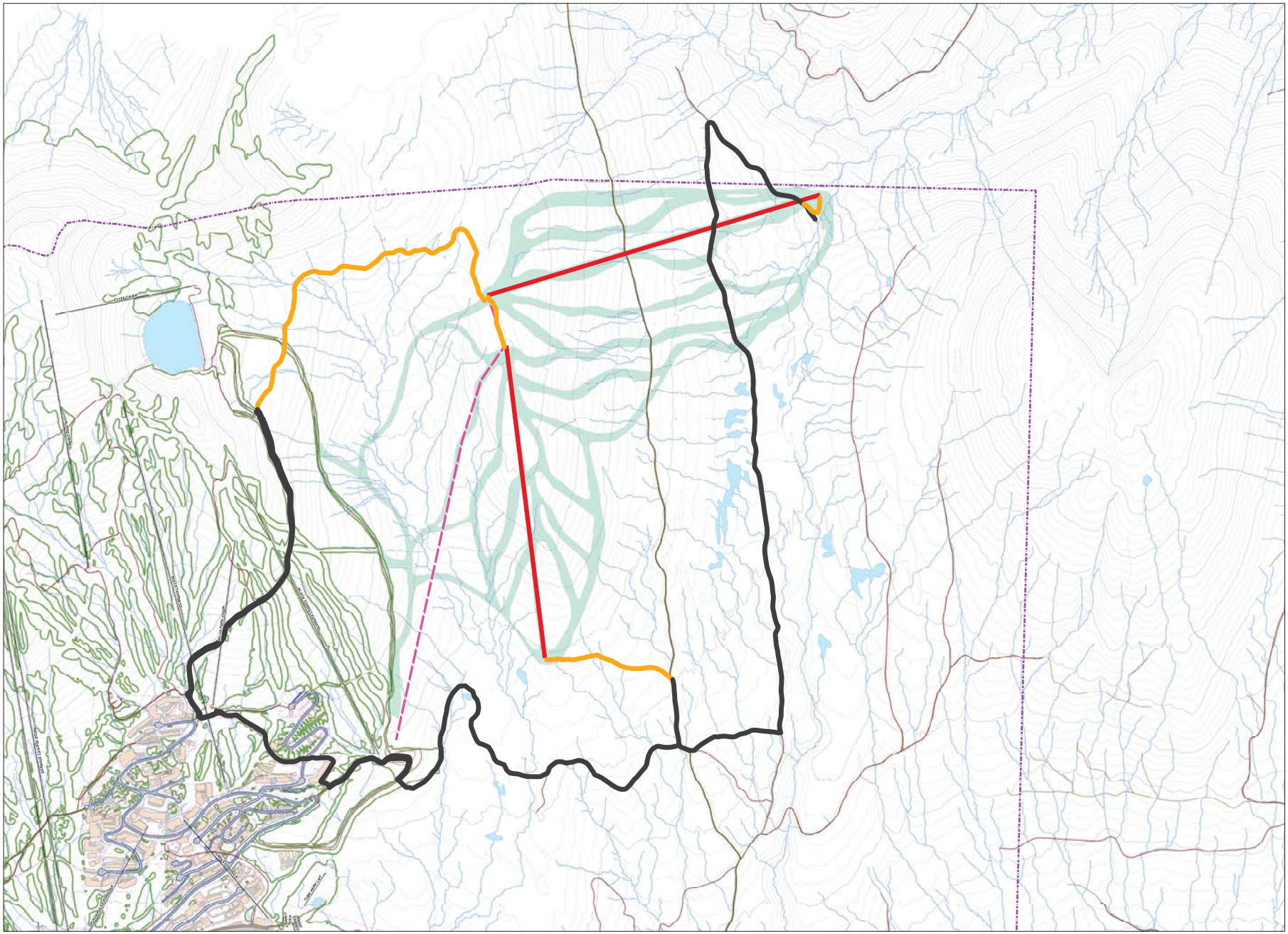
0 175 350 Meters

Figure 7.
Black Forest Connector and Backcountry Chair Proposed Glading

4.3 PROPOSED ACCESS ROADS

The construction of the proposed development will utilize existing forest roads (black) and new forest roads (orange) to access the top and bottom terminals of both lifts, the associated ski terrain, and related utilities (Fig. 8). The road alignments were developed by BHA and Cabin Forestry Services Ltd. to ensure a safe, efficient, and expedient completion of the required land clearing and construction. Construction activities will be staged from the existing Black Forest Day Lodge parking area. Both the existing and proposed access road alignments were assessed through the Environmental Review, conducted by Cascade, and the Terrain Stability Assessment, conducted by SCL.



Big White Ski Resort
Master Plan

Legend

- CRA Boundary

Proposed Road Acces

- Existing Road
- Proposed Road

Proposed Ski Area

- Proposed Ski Runs
- Proposed_Lifts
- Proposed Power ROW

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Figure 8.
Black Forest Connector
& Backcountry Chair
Proposed Road Access

5. PROJECT SCOPE AND LOGISTICS

5.1 SCOPE

As proposed, the Black Forest Connector will be a fixed grip quad chair and the Backcountry Chair will be a high-speed detachable quad chair, each with an estimated uphill capacity of 1,800 skiers per hour (Table 2). The Black Forest Connector will offer 203 m of skiable vertical while the Backcountry Chair will provide 381 m. These numbers are preliminary and conditional on further refinement by the lift engineers.

Table 2. Proposed Chair Lifts (Preliminary)

Lift Name	Lift Type	Bottom Elev. (m)	Top Elev. (m)	Vertical Drop (m)	Horiz. Length (m)	Slope Length (m)	Avg. Slope (%)	Hourly Capacity (Theor.)	Hourly Capacity (Actual)	Approx. Ride Time (m)	Rope Speed (m/s)
Backcountry Chair	D4C	1,621	1,948	381	1,465	1,517	23.6	2,400	2,.200	4.35	5.1
Black Forest Connector	4C	1,747	1,950	203	1,300	1,327	16.7	2,400	2,000	8.84	2.5

5.2 LOGISTICS

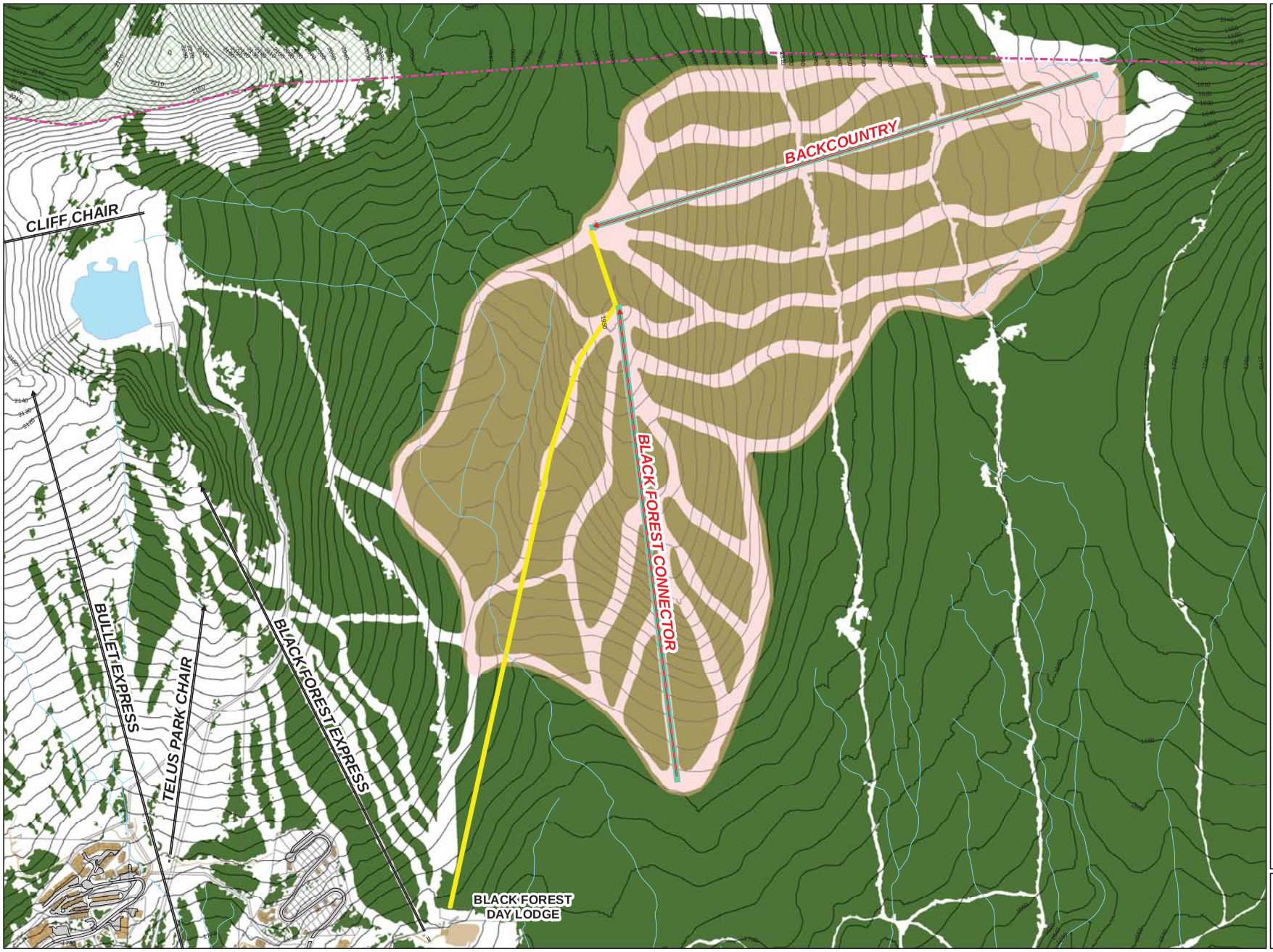
As planned, following approvals, Big White will complete construction of both lifts, related ski trails, and associated infrastructure in the summer of 2019 in preparation for the 2019/2020 ski season. As illustrated in Figure 6 and Figure 7, plans to clear the proposed access roads, ski trails and gladed areas are already in process and will serve to guide tree harvesting and thinning activities. The alignments for both the chairlifts will be finalized in coordination with the lift manufacturer, and in line with the findings and recommendations of the Environmental Review and Geotechnical Assessment (Sec. 3.2 & Sec. 3.3).

5.3 SUPPORTING INFRASTRUCTURE

As part of the development of the Black Forest Connector and Backcountry Chair, Big White will install an electrical utility from the existing Black Forest Day Lodge to the top terminals of both chairs (Fig. 9). As planned, it will be constructed concurrently with the proposed chairlifts (Summer 2019), pending approval. The electrical cable connecting the chairlifts will be laid underground in partial alignment with ski runs associated with the Black Forest Connector. This will help to minimize the forest area that will need to be cleared and limit the overall impact of the project on the surrounding environment.

5.4 FIRST NATIONS ENGAGEMENT

In preparation of this Modification to the Big White Master Plan, Big White reached out to the Westbank First Nation to solicit their input on the proposed development. Unfortunately, to date, Big White and the WFN have been unable to meet to discuss the proposal. However, building on their strong working relationship and history of mutual support, Big White is confident that the proposed development will receive the support of the WFN.



Big White Ski Resort
2018

Legend

- Proposed Lifts
- Existing Ski Lifts
- Existing CRA Boundary
- Streams
- Chairlift ROW
- Power ROW
- Proposed Ski Pods
- Existing Buildings
- Ecological Reserve

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1:10,000

0 75 150 225 300 Meters

Figure 9.
Black Forest Connector and Backcountry Chair Power ROW Site Map

6. THE FUTURE OF BIG WHITE SKI RESORT

The Black Forest Connector and Backcountry Chair are standalone ski products that complement the existing developments at Big White. However, while not reliant on future development to ensure their success, they have been designed with future development in mind, and create opportunities to access terrain with significant recreation potential.

With the advancement of the forthcoming Big White Ski Resort Master Plan, the Black Forest Connector and Backcountry Chair are envisioned as the gateway to future ski terrain surrounding the East Peak. The Black Forest Connector will allow guests to access the East Peak from the Black Forest Day Lodge, while Backcountry Chair will act as the primary egress route back from the East Peak area. Finally, pending adjustment to Big White's CRA, additional ski terrain would be added to the to the north of Backcountry Chair ski pod to incorporate adjacent terrain ideal for intermediate skiers.

7. APPENDIX

7.1 CASCADE ENVIRONMENTAL - ENVIRONMENTAL REVIEW

CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

Environmental Review:

Existing Master Plan Amendment Area – 2018
Big White Ski Resort, BC

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Prepared for:
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Project No.: 017-01-04
Date: October 25, 2018

Table of Contents

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Executive Summary

Introduction

Big White Ski Resort (Big White) retained Cascade Environmental Resource Group Ltd. (Cascade) to conduct an Environmental Review (ER) of the resort lands at the northeast corner of the Controlled Recreation Area (Map 1 and Map 2). Big White proposes to build two new chairlifts in the area. The assessment includes the documentation of existing environmental conditions on the subject property as well as the identification and delineation of environmentally sensitive areas and ecologically significant habitats. As part of the assessment, measures to assist the protection of identified environmentally sensitive areas are outlined, which include but are not limited to riparian retention. Cascade conducted the site investigations for the current project on August 8 and 9, 2018.

This Memorandum acts as summary of work completed to date, a detailed Environmental Review document will be included in the development application.

Existing Environmental Conditions

Hydrology

The subject area is drained by three watercourses and their tributaries; Trapping Creek, Whitefoot Creek and Copperkettle Creek (Map 3).

The south facing portion of the existing Big White Mountain ski terrain drains south to Trapping Creek and then into the West Kettle River. The West Kettle River is a tributary of the Kettle River which in turn is a tributary to the Columbia River drainage basin.

The remainder of the CRA is drained by Whitefoot Creek and Copperkettle Creek which flows east into the Kettle River.

Aquatic Environment

Previous studies and search of the provincial fish habitat mapping (BC MOE 2018) listed rainbow trout (*Oncorhynchus mykiss*) to be the only species of fish in the three watercourses found on the subject site.

Vegetation

Forest stands within the subject area were found to consist of pole/sapling (Structural Stage 4) second growth cut blocks and mature (Structural Stage 6) and old-growth (Structural Stage 7a) forest stands from undisturbed sites, all with a coniferous dominated composition.

Deciduous tree species are uncommon in this subalpine forest. Understory shrub vegetation is typically dominated by white-flowered rhododendron (*Rhododendrum albiflorum*). Grouseberry (*Vaccinium scoparium*) appears to dominate the herbaceous understory. Wetter sites are likely associated with Sitka valerian (*Valeriana sitchensis*), sedges (*Carex* spp.), and common horsetail.

CDC Rare and Endangered Plants and Wildlife

The CDC Imap indicated that there are no recorded observations for red or blue-listed plant species within the immediate study area (BC CDC Imap 2018). Three Red and four blue listed plants were recorded as a possibility of occurring within the subject area.

After a search for Rare and Endangered Wildlife Species within the subject area based on existing habitat, 20 species were listed as having the possibility to reside in the subject area. Of the 20 listed species, CDC iMap indicates a known occurrence polygon (Shape ID 74373) for the red-listed American badger (*Taxidea taxus*) within the subject area. Although no CDC occurrences have been noted within the database, the staff of Big White has reported sighting the occasional blue listed grizzly bear (*Ursus arctos)* within alpine and forested habitats surrounding Big White Mountain and the vicinity of the subject area.

Grizzly bears are expected to occur on an infrequent but yearly basis on and in the vicinity of the proposed development area. The Kettle-Granby grizzly population unit lies to the east of the CRA and has been identified as a recovery unit. This unit covers over 650,000 hectares and is estimated to support up to 81 individuals

CDC Rare and Endangered Communities

The CDC Imap indicated that there are no recorded observations for red or blue-listed Ecological Communities within the immediate study area (BC CDC Imap 2018)

One blue listed and four yellow listed ecological communities were listed to exist within the subject area.

Environmental Impacts

Geomorphology

The thin soils that remain on the ski runs once cut are highly susceptible to surface erosion. This condition is exacerbated by summer grooming techniques which may disturb the upper soil layers or remove larger woody material. Prompt revegetation of disturbed soils can mitigate surface erosion.

Hydrology

Three creeks were encountered during the 2018 site visit. Cutting and clearing for ski runs could cause surface erosion could potentially deposit sediment in the local stream channels over the first few seasons. Debris flows/torrents in larger creeks are possible if sedimentation is excessive.

Aquatic Environment

Any changes to water quality or development within the riparian areas adjacent to the drainages on site could affect the fisheries values in Trapping Creek, which drains into the West Kettle River downstream, and the fisheries values of Whitefoot and Copperkettle Creeks, draining into the Kettle River.

Soils

The predominantly shallow, rocky soils in the study area represent an obvious limiting factor for plant and tree growth, damage to or loss of these soils will negatively affect the productivity of the area and the ability to successfully regenerate vegetation.

Rare and Endangered Wildlife

Grizzly bear population is not anticipated to be significantly effected by development of the ski area as the subject site will be gladed and thinned with minimal clearing and no low shrub areas or avalanche chutes associated with Grizzly Bear habitat were found within the subject area. Berry producing shrubs will be affected from clearing of ski runs and construction of ski lifts in the short term. Over time, berry producing shrubs will benefit from additional availability of light resulting from forest removal.

Vegetation

Based on the cursory field investigation and communication searches conducted within B.C. Conservation Data Centre, there are no known development constraints or particular concerns associated with rare or endangered vegetation in the study area. Vegetation constraints relate to the habitat provided and the need to maintain biodiversity in the Big White Resort Area.

Valued Ecosystem Components

Valued Ecosystem Components within the Big White CRA, particularly in within the proposed lift expansion include wildlife trees, wildlife movement corridors and riparian areas associated with identified watercourses.

Riparian Areas

Riparian areas within 30 meters of a permanent water course may be subject to assessment in accordance with the *Riparian Area Regulation* (RAR) of the B.C. *Riparian Protection Act*. Any intrusion in the resulting riparian setback may require permitting under Section 11 of the B.C. *Water Sustainability Act*, and/or approval under Section 35 (2) of the Federal *Fisheries Act*.

Wildlife Movement Corridors

The construction phase of the ski runs has the possibility of affecting 2 mapped wildlife corridors in the subject area (Map 4).

Wildlife Trees

Wildlife trees that contain dens or breeding cavities may be constraining to development during the breeding season of the animal. Song birds were evident visually and acoustically, but are typically summer breeders and not permanent residents. Wildlife trees that pose a safety risk on the subject site may need to be removed outside of the breeding season.

Mitigation Measures

Geology

Caution should be taken in locating ski runs and traffic areas below cliffs faces. The integrity of the rock mass should be assessed by trail crews and any concerns should be addressed by a professional engineer (P.Eng.). Any geotechnical issues associated with potential development of the site should be addressed in a separate report. Prompt revegetation of disturbed soils can mitigate surface erosion.

Hydrology

Visual inspections of the creek systems should be conducted by summer crews prior to the fall to monitor any accumulations of debris. Any wetlands encountered in the study area should be considered as constraining to development.

Aquatic Environment

The potential impacts to water quality from development within riparian areas can be minimized by avoiding contamination of the water courses during operation of the present ski resort and during any future development at Big White, through sound, environmentally prudent construction techniques, and by respecting appropriate buffer strips adjacent to Trapping, Whitefoot and Copperkettle Creeks, as well as their tributaries.

Soils

Sound forest harvesting practices, trail development practices, proper water management, and conservation of these and other study area soils all will help to minimize surface erosion potential

A comprehensive sediment and erosion plan for construction of the expansion area will be included within the final report to ensure mitigation measures in minimizing sediment release into surrounding watercourses in the area.

Vegetation

Large tree islands should be preserved between ski runs to provide adequate shelter for resident fauna and to prevent excessive windthrow. Larger tree islands will allow for preservation of standing wildlife snags while maintaining safe distances from ski runs, trails and roads.

As a result of the climatic constraints imposed on growth of vegetation, maximizing preservation of existing vegetation should always be a priority in development planning.

No constraints to development exist as a result of vegetation; however, veteran trees developing within the protected riparian setback may present safety concerns arising from windthrow potential.

Rare and Endangered Wildlife

Several benefits of habitat modification resulting from glading and thinning of trees and clearing of ski trails have been identified and generally pertain to opportunities for increasing the structural diversity of forested habitats and providing an increase in foraging opportunities for species such as bears and ungulates. Additionally, opportunities may exist for enhancing habitats surrounding several existing or proposed developments including the creation of rock piles on the edge of ski runs. These rock piles were evident on several existing ski runs and are being used by such species as ground squirrels and marmots. Clearance of shrub producing berries should e minimized whenever possible.

If, at any point during development, breeding areas are discovered, Best Management Practices (BMPs) should be adhered to.

If tree removal is anticipated during the nesting bird season from April 1 to August 31, a nest survey must be completed in the proposed clearing area. Discovery of active nests during surveys would impose development constraints until the chicks have fledged the nest.

Valued Ecosystem Components

Riparian Areas

Any planned development within 30 m of a watercourse must be associated with a Riparian Area Assessment conducted by a Qualified Environmental Professional. Protection of riparian vegetation buffers can mitigate delivery of eroded soil into watercourses.

Wildlife Corridor

Cutting of ski runs and construction of ski lifts will be conducted in a timely manner as to not disrupt mapped wildlife corridor in the expansion area. This can also be mitigated by restricting human access to the areas during times of wildlife movement or occupation during sensitive seasons (i.e. rutting, calving).

Wildlife Trees

Wildlife trees should be retained wherever possible. A Danger Tree Assessment of all wildlife trees in close proximity of development should be surveyed by certified Danger Tree Assessor for safety integrity too surrounding development

Statement of Limitations

This Document was prepared by Cascade Environmental Resource Group Ltd. for the account of Big White Ski Resort.

Should this report contain an error or omission then the liability, if any, of Cascade Environmental Resource Group Ltd. should be limited to the fee received by Cascade Environmental Resource Group Ltd. for the preparation of this Document. Recommendations contained in this report reflect Cascade Environmental Resource Group Ltd.'s judgment in light of information available at the time of study. The accuracy of information provided to Cascade Environmental Resource Group Ltd. is not guaranteed.

Neither all nor part of the contents of this report should be used by any party, other than the client, without the express written consent of Cascade Environmental Resource Group Ltd. This report was prepared for the client for the client's own information and for presentation to the approving government agencies. The report may not be used or relied upon by any other person unless that person is specifically named by Cascade Environmental Resource Group Ltd. as a beneficiary of the report, in which case the report may be used by the additional beneficiary Cascade Environmental Resource Group Ltd. has named. If such consent is granted, a surcharge may be rendered. The client agrees to maintain the confidentiality of the report and reasonably protect the report from distribution to any other person. If the client directly or indirectly causes the report to be distributed to any other person, the client shall indemnify, defend and hold Cascade Environmental Resource Group Ltd. harmless if any third party brings a claim against Cascade Environmental Resource Group Ltd. relating to the report.

This document should not be construed to be:

- A Phase 1 - Environmental Site Assessment;
- A Stage 1 – Preliminary Site Investigation (as per the Contaminated Sites Regulations of the Waste Mgt. Act);
- An Environmental Impact Assessment.

1 Introduction

Big White Ski Resort (Big White) retained Cascade Environmental Resource Group Ltd. (Cascade) to conduct an Environmental Review (ER) of the resort lands at the northeast corner of the Controlled Recreation Area. Big White proposes to build two new chair lifts in the area. The assessment includes the documentation of existing environmental conditions on the subject property as well as the identification and delineation of environmentally sensitive areas and ecologically significant habitats. As part of the assessment, measures to assist the protection of identified environmentally sensitive areas are outlined, which include but are not limited to riparian retention.

1.1 Background

In 1996 a study team, consisting of Dave Williamson, B.E.S., Mike Cole, P.Eng., Ethan Askey, M.R.M., Mike Nelson, R.P. Bio. and Douglas Wahl, R.P. Bio., conducted a site visit and cursory ecological land survey. During the site visit which was carried out from July 25 to July 27, 1996 aquatic biophysical information was gathered on the main streams flowing from Big White Resort. The data collected was used to classify the streams according to the Riparian Management Area Guidebook standards (MOF / MOELP 1995). In addition, Global Positioning System (GPS) transects were made of the Gem Lake area and the existing ski area. General ecological information was gathered on these transects including: geology, geomorphology, hydrology, soils, plant species, wildlife observations and habitat characteristics.

In 1997 Dave Williamson returned to Big White with Martin Gebauer, R.P. Bio, to expand the review to include the bench below the existing village. The information gathered during a cursory site visit conducted on September 2, 1997 was incorporated into this updated document.

Additional site reconnaissance of the Big White was conducted on October 23, 2008 with Dave Williamson and Dan McDonald, M.E.M. attending. Terrestrial Ecosystem Mapping (TEM) principles (BC ILMB, 1998) were employed to identify and delineate ecosystem units and show their distribution within the Controlled Recreation Area (CRA). TEM principles use a classification hierarchy of ecological units, including ecoregion units and biogeoclimatic units at a broader level and site units and vegetation development stages at a more detailed scale. Within these broader units, site level polygons describe ecosystem units composed of site series, site modifiers, and structural stages. Chris Wood, M.Sc. and Ryan Coatta, B.Sc. provided G.I.S. based TEM analysis of species accounts. Additionally, prior studies and reports conducted on the study area were reviewed.

1.2 Project Team

Candace Rose-Taylor, M.Sc., R.P. Bio. and Simon Fry, B.Sc. B.I.T of Cascade, and Ms. Heather Moore, Ski Patrol Centre Manager of Big White Resort formed the field study team and conducted the site investigations for the current project on August 8 and 9, 2018. Review was provided by Dave Williamson B.E.S., Q.E.P. and Nicola Church M.Sc. constructed applicable maps and conducted initial orthophoto site review.

1.3 Project Area

Big White Ski Resort is located in south-central British Columbia, approximately 50 km east of Kelowna (Map 1). The CRA ranges in elevation from approximately 1500 m to 2300 m (Map 2). The CRA is drained to the south by Trapping Creek into West Kettle River, to the west and north by Hallam Creek into West Kettle River, and to the southeast by Whitefoot Creek and Copperkettle Creek. The CRA, the study area which includes the two-chairlift expansion area located in the northeast corner of CRA as well as the drainages are identified on the hydrology map (Map 3).

GIS Cartographer: Nicola Church
Date: April 12, 2018
CERG File#: 017-07-01
Projection: UTM Zone 10N NAD83

CASCADE ENVIRONMENTAL RESOURCE GROUP LTD

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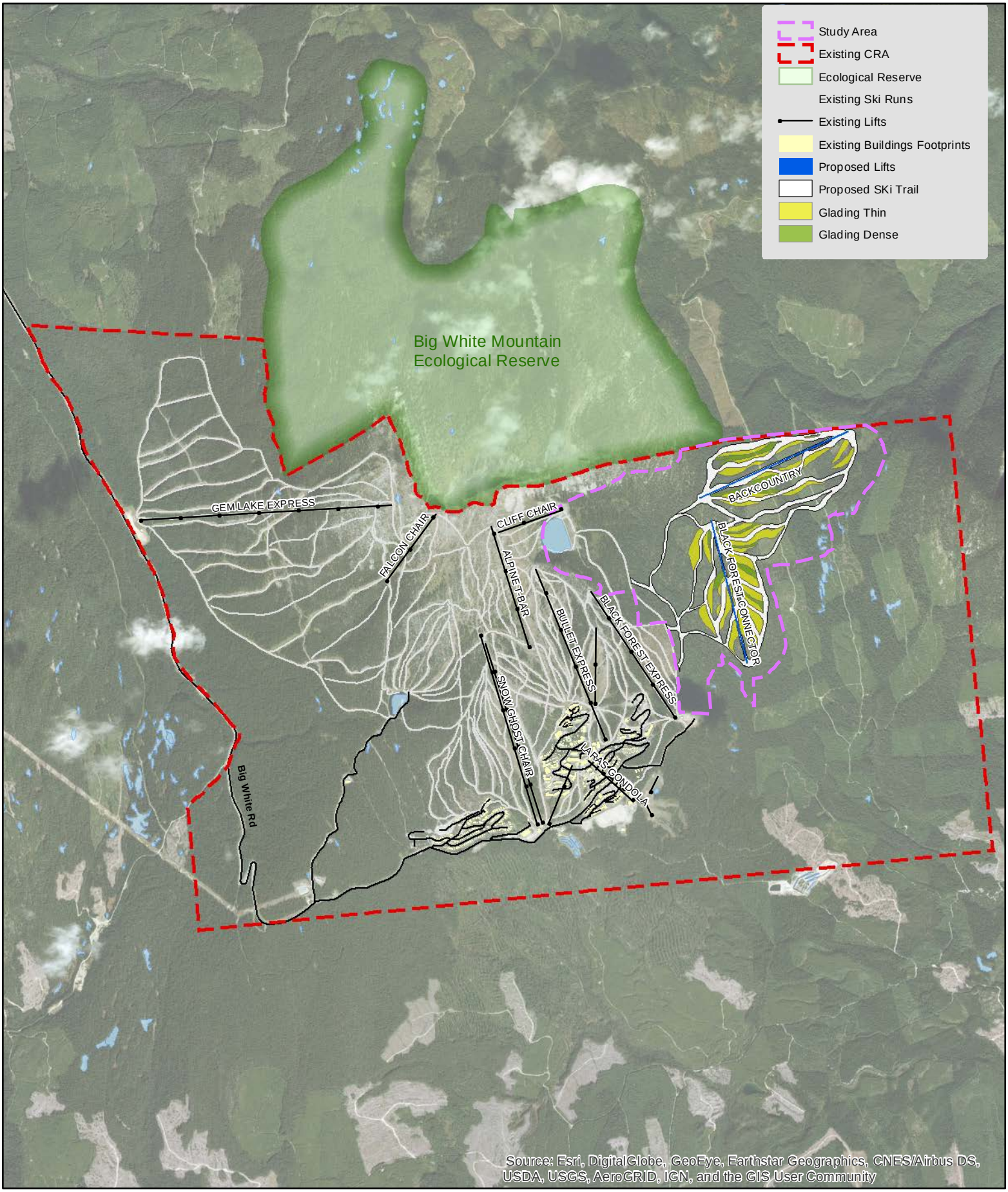
Kilometers

Map 1 - Location

Big White Resort
5315 Big White Rd,
Kelowna, British Columbia



GIS Cartographer: Nicola Church
Date: Aug 23, 2016
CERG File#: 017-06-01
Projection: BC Albers
Trails data provided by BHA and Alpine Bike Parks.

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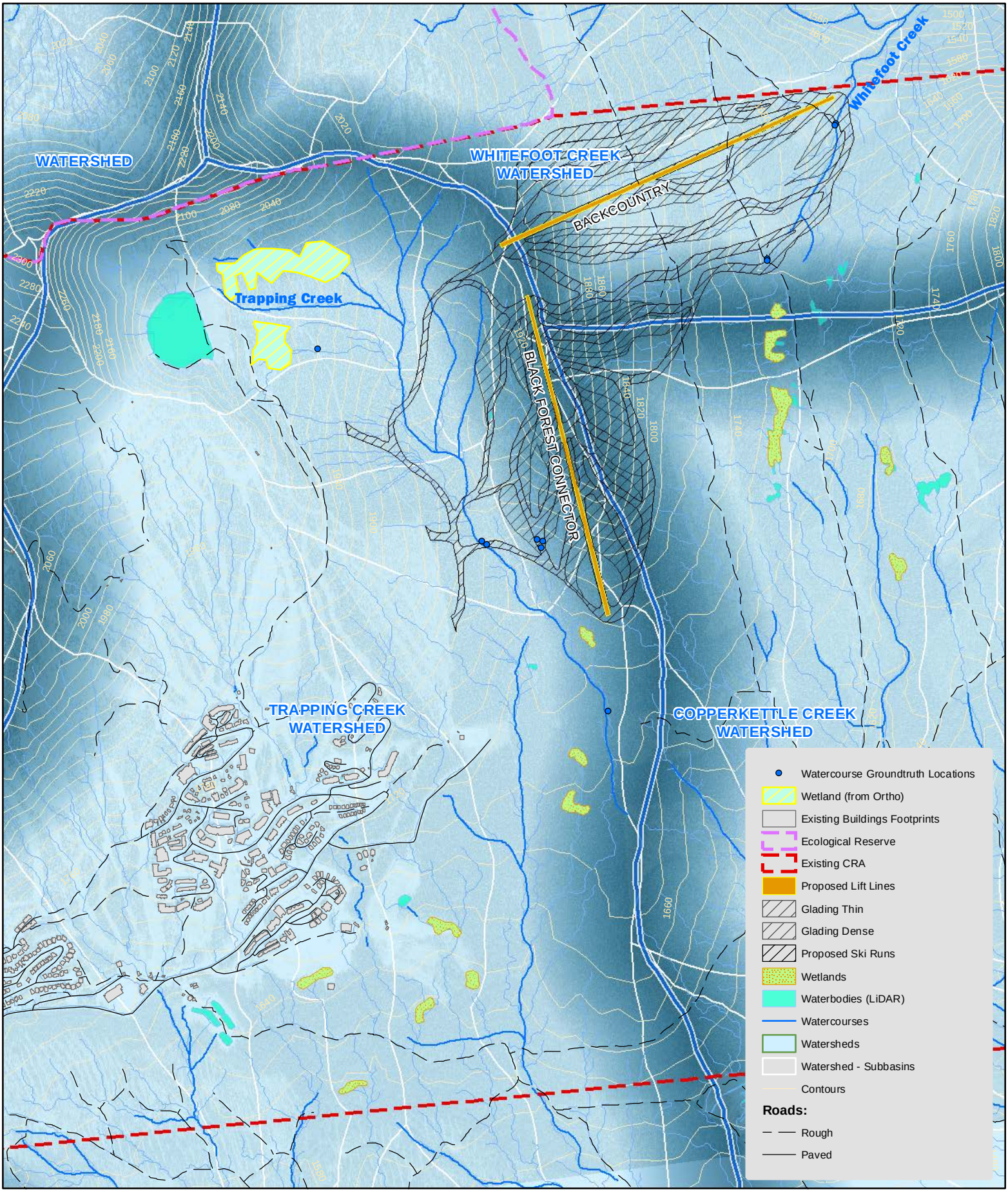
Map 2 - Big White Site Map

Big White. Kelowna
British Columbia



GIS Cartographer: Nicola Church
Date: September 12, 2018
CERG File#: 017-06-01
Projection: BC Albers

CASCADE ENVIRONMENTAL RESOURCE GROUP LTD

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Map 3 - Hydrology

Big White. Kelowna
British Columbia

1.4 Methodology

This report focuses on a two-chairlift expansion area located in the northeast corner of the existing CRA (Map 2). This report is an update from the Environmental Review Big White Ski Resort 1996 Master Plan Update (1997) and Big White Resort Mater Plan 1999, the 2008 Environmental Review (Cascade, 2008) and several earlier studies conducted other consulting firms as well as by one of Cascade's parent companies, GeoAlpine Environmental Consulting Ltd. These studies include but not limited to the following:

- Big White Ski Resort Master Plan, (BHA 1996, 2008);
- Stream Classification: "Bullet" and Trapping Creeks, Big White Mountain (CERG, 2000);
- Big White Resort – Black Forest Construction Erosion and Sediment Control Plan (CERG, 2000);
- Drainage Plan for Base Area of Westside Development, Big White Ski Area (GeoAlpine, 1996);
- Gem Lake Express and Associated Trails (management planning document), (Big White Ski Resort Ltd., 1996);
- Big White and Surrounding Area - Resource Emphasis Areas (1:20,000 scale map), (Timberland Consultants, 1995);
- Guidelines for Environmental Good Practices for Ski Areas, (Canada West Ski Areas Association, May 1992);
- Big White Village Drainage Study, (Klohn Leonoff 1981);
- Geotechnical Assessment - Proposed Village Extension of Big White Mountain, (Golder Associates 1980); and
- Environmental Analysis of Big White, (Selkirk College 1978).

Terrestrial Ecosystem standards were used to describe the site vegetation, soil and geomorphic features unique to each ecosystem unit within the study area. To ensure accurate descriptions of the current environmental conditions on the property and to reflect updated environmental reporting standards, a recent color orthophoto was used for ecosystem unit interpretation.

Wildlife was identified by visual observation, songs, tracks and feeding signs. Potential wildlife use, not observed during the site reconnaissance, was inferred from available habitats, local information, and known distributions. Valued ecosystem components such as riparian corridors, and first growth (i.e. veteran) trees, if any, were also noted during the survey.

This report provides a reconnaissance-level description of vegetation, wildlife and wildlife habitats surrounding the chair lift developments proposed at the northeast corner of the Big White Ski Resort CRA. Much of the information provided in this report, relating to the known and likely wildlife values within proposed development area is the result of a two-day site assessment.

This report does not generally provide species-specific impacts related to the proposed development. Rather, this report provides general conclusions on the likely impacts of the proposed development on various species/communities.

2 Existing Environmental Conditions

2.1 Cultural Environment

2.1.1 First Nations

Traditionally, the Okanagan people (Syilx) occupied an area which extended over approximately 69,000 square kilometers. The northern area of this territory was close to the area of Mica Creek, just north of modern-day Revelstoke, BC, and the eastern boundary was Kootenay Lake. The southern boundary extended to the vicinity of Wilbur, Washington and the western border extended into the Nicola Valley (Okanagan Nation Alliance, 2008).

The Syilx are a division of the Interior Salish and speak the Nsyilxcən language (Westbank First Nation, 2008). The Okanagan people were hunters and gatherers and were noted to be semi-nomadic. Their staple diet consisted of deer, salmon, rabbit and other wild game (Okanagan Nation Alliance, 2008). The Okanagan's were also gatherers of roots, berries and various other plants (Okanagan Nation Alliance, 2008).

Located in south central British Columbia, Canada, the Okanagan Valley is home to Westbank First Nation, one of seven native communities that belong to the Okanagan Nation (Westbank First Nation, 2008). Westbank First Nation is comprised of five reserves totaling 5,306 acres. Tsinstikeptum Reserves 9 and 10 border Okanagan Lake and are in close proximity to the City of Kelowna, one of the fastest growing cities in British Columbia (Westbank First Nation, 2008).

A heritage/archaeological investigation was not conducted as part of this study.

2.1.2 Timber Harvesting

Interfor has conducted forest harvesting and silviculture operations in the CRA. As indicated on the orthophoto maps contained within this report the area shows an extensive road forest road network and contains numerous cutblocks. Timber rights within the CRA continue remain with Interfor.

Kootenay Timber Sales Business Area:

- 475 (6) – Nk'Mip Forestry Corporation
- 658 (0) – Boundary
- 29 (8) – F06
- 601 (2) – Boundary

2.1.3 Other Land Uses

The proposed expansion area contains several BC Integrated Land Management Bureau registered land tenures for guide outfitting. These tenures typically cover large areas and are not exclusive use. They are intended to allow guide outfitters to access the land for the purpose of guided outdoor recreation activities including hunting. The following guide outfitters are listed as tenure holders in the study area:

Guide outfitters

Melvin Kilback

2.1.4 Anthropogenic Features

Anthropogenic features occurring within the study area include those features relating to forest harvesting and all-season resort communities. In addition to the existing forest road network, the study area is currently occupied by the existing resort community of Big White and its extensive infrastructure of lifts, ski trails, bike trails, hiking trails, accommodations and services.

2.2 Physical Environment

2.2.1 Climate

The study area is located in the Northern Okanagan Highlands (NOH) Ecosection, which is nested within the Thompson Okanagan Plateau Ecoregion. At higher elevations this Southern Dry climate region (Lloyd et al. 1990) is characterized by cold winters, a deep snowpack, and relatively short, cool summers. The study area falls within the Englemann spruce - subalpine fir (ESSF) biogeoclimatic zone, and the Okanagan Dry Cod variant (dc1) which is associated with a mean annual temperature of 2.0 degrees Celsius and growing season mean precipitation of 261 mm and annual mean snowfall of 635 cm (Lloyd et al, 1990).

Average annual precipitation data for various elevations on the mountain were extrapolated based on local AES climate stations. Average annual precipitation is approximately 950 mm in the present village (1800 m) and increases to 1200 mm near the summit of Big White (2350 m). The Gem Lake area could expect precipitation in the order of 850 mm at the base (1500 m) and 1100 mm near top of the west flank (2220 m) (Klohn Leonoff, 1981).

In general, snowfall increases with elevation below 1600 m but remains relatively constant thereafter. Above 1600 m, the snowpack reaches a maximum depth of approximately 160 cm (+I 30 cm) which occurs in early to mid April. The related snow density at this time of year is approximately 0.30.

Snowmelt occurs rapidly in the latter part of May and June, accounting for 39 and 38% of the year's total runoff, respectively (Klohn Leonoff, 1981). Rainfall intensity data for 30- and 100-year return periods were calculated by Klohn Leonoff (1981). No correlation was found between increasing elevation and rainfall intensity.

2.2.2 Geology

The bedrock within the study area consists of a granodiorite and quartz diorite dome consisting of a coarse crystalline structure providing competent foundations for structures. Two sets of regional jointing occur in a predominantly northern direction: one joint set being approximately 100 to the west, and the second being approximately 25° to the east. Based on elevation, drainage patterns above 2000 m elevation are largely influenced by these regional joint patterns.

The last episode of continental glaciation extended to an elevation of approximately 1800 m with a regional direction to the south (Golder, 1980). This glacial advance is responsible for producing the bulk of the surficial materials present in the study area. Alpine glaciation is largely responsible for the topographic features above 1800 m such as the cirque basins.

2.2.3 Geomorphology

The existing morphology of the study area is the direct result of past glacial activity and the resultant surficial expressions are dominated by morainal tills and glacio-fluvial deposits.

The upper elevations of Big White display exposed weathered bedrock with colluvial materials of varying thickness (CRv). Bedrock ridges (caused by jointing) provide gully features along the upper southern face. Till layers (MRv) where present are thinner than those found in the lower reaches. Slopes are moderate to steep. Permanent snowfields exist in the shadow zones of cirque basins on the northeast sides of the mountain summits.

The middle elevations of the existing CRA are covered in a thin mantle of weathered glacial till (M) overlying bedrock (R). The glacial till cover materials consist of silty sandy soils containing some gravels (sg). This material is moderately well drained.

Mid slopes are moderately steep and the thickness of till deposits across the southern hillslope ranges between 3 and 4 m (Mb).

2.2.4 Hydrology

The south facing portion of the existing Big White Mountain ski terrain drains south to Trapping Creek and then into the West Kettle River. The West Kettle River is a tributary of the Kettle River which in turn is a tributary to the Columbia River drainage basin. The remainder of the CRA is drained by Whitefoot Creek and Copperkettle Creek which flows into the Kettle River. Section 2.3 provides further discussion of study area drainages as it relates to fish habitat. Map 3, presented earlier in this report identifies the existing hydrology of the study area.

Much of the available hydrologic data for the study area is the result of studies conducted by Klohn Leonoff (1981). Due to the long-term nature of the precipitation data used by Klohn Leonoff (two AES

climate stations provide data in excess of 50 years), their hydrologic analysis is still considered valid. A summary of available Water Survey of Canada (WSC) information for stream gauging stations in the vicinity is provided in Table 1.

In general, west-facing slopes remain somewhat cooler and more moist than southern slopes. Along the Gem Lake area, winds originating from the North provide enhanced air circulation across the slopes. The south facing slopes are dry with little evidence of surface runoff collection and gullying.

2.3 Aquatic Environment

2.3.1 Streams

According to stream flow and precipitation data from Trapping Creek (8 km downstream of the Big White Village), approximately 75% of the annual precipitation reports to the local stream network as runoff. Runoff rates will likely be higher in early spring when the surficial materials are either frozen or saturated, and lower in the summer and fall when the ground is more absorbent.

Table 1: Historical Streamflow Summary, Water Survey of Canada

Name	Station No.	Period of Record	Drainage Area (km^2)	Regulated or Natural Flow	Mean Annual Discharge (m^3/s)	Maximum Daily Discharge (m^3/s)	Minimum Daily Discharge (m^3/s)
West Kettle R. near McCullough	08NN015	1949-2018*	233	Natural	3.45	35.21	0.202
West Kettle R. below Carmi Cr.	08NN022	1973-1998*	1,170	Natural	9.64	88.75	0..553
West Kettle R. at Westbridge	08NN003	1914-2018*	1,890	Regulated	11.57	112.07	0.0.939
Kettle R. near Westbridge	08NN026	1975-2018*	2,140	Regulated	27.56	231.28	1.710
Trapping Cr. at 1220 m contour	08NN020	1970-1981	22.8	Natural	0.487	7.121	0.032
Trapping Cr. near mouth	08NN019	1965-2018*	145	Natural	1.43	13.88	0.131

* Incomplete data set for expanded WSC period of record

2.3.2 Fish and Fish Habitat

The fisheries and aquatic habitat on site can be divided into those within the Trapping Creek drainage flowing south from the project area, and those within the Whitefoot and Copperkettle Creek drainages that flow eastward. Trapping Creeks flows into West Kettle River which in turn flows into Kettle River. Whitefoot Creek flows into Damfino Creek, and eventually into Kettle River, while Copperkettle Creek flows directly into Kettle River. Kettle River and its tributaries are part of the Columbia River watershed.

2.3.2.1 Trapping Creek

Trapping Creek was assessed by Cascade (2000) on behalf of Big White Ski Resort. It has an average gradient of 3.9 % over its overall length of 23.25 km. Tributaries to Trapping Creek, which lies within the project area, are ephemeral in nature, likely flowing only during spring and summer melt. The drainages in this area are also steeper than the main stem, with gradients ranging from 8 to 15%. Stream Information Summary mapping (MOE, 2008), indicates that "Clear Lake" (also locally known as "Piranha Lake"), a small waterbody located adjacent to Trapping Creek approximately 3 km south of the study area, is suspected to contain rainbow trout. Field work by the study team confirmed the presence of rainbow trout in this shallow lake. Timberland (1997a) have also conducted an overview assessment on Trapping Creek and have conducted enhancement efforts centering on installing large woody debris (LWD) and other instream structures downstream of the CRA.

Two sampling sites on Trapping Creek and one sampling site on a tributary of Trapping Creek were assessed by the Cascade study team on July 26 and 27, 1996. The sampling sites on the main stem of Trapping Creek were located at approximately the 1,460 m contour (Site 1) and at the 1,690 m contour (Site 3). The downstream site was located in the midst of a large clear cut. While the vegetation in the cut was regenerating, there was little to no canopy cover. The shrub layer was fairly dense, however, and accounted for 50% of the total stream cover (estimated at 15 % of the stream area). Shrubs found adjacent to the creek included mountain alder, trappers tea and Utah honeysuckle. The majority of the remainder of the stream cover consisted of LOD, the remnants of past logging activity. The gradient of this section of creek was 1% with a channel width of 4.3 m and a wetted width of 2.8 m. The flow was characterized as 10 % pool, averaging 47 cm deep, 40 % riffle, with mean depths of 9 cm, and 50 % run. The substrate consisted of 25 % fines, 60 % gravels, and 15 % larges. The discharge at the time of sampling was 0.25 m3/s with a water temperature of 15°C and conductivity of 16 μs/cm. The culvert under Link Road at this sampling site was set at a slope of 4 %, which cold pose a velocity barrier to fish under certain flow conditions.

Further upstream at sampling site 3, the stream gradient increased to 9 %, with a channel width of 4.7 m and a wetted width of 3.0 m. This section of creek had not been logged, although the tree canopy, consisting of subalpine fir and Engelmann spruce, was fairly scant at 10 % closure. Stream cover increased to about 20 %, consisting of approximately equal amounts of deep pool, LOD, overstream vegetation and cutbank cover. The flow was characterized as 10 % pool, 70 % riffle and 20 % run. The average maximum pool depth was 60 cm, with the average maximum riffle depth at 20 cm. The substrate was somewhat courser than downstream, as might be expected with the increased gradient. The stream discharge was 0.10 m^3/s, with similar water quality compared to the downstream sample site.

The sample site on the tributary stream, site 2, had also been impacted from past logging activities. Although the cutblock was not immediately adjacent to the stream, there was significant bar formation, especially upstream of the Link Road culvert. Similar to the culvert on the main stem of Trapping Creek, the culvert on this tributary was set at 6.5 %, and could pose a velocity barrier to fish movements. The stream gradient was low, 2 %, with an average wetted width of 1.3 m (channel with of 4.5 m). The flow was characterized as 10 % pool, 50 % riffle and 40 % run. The average maximum pool depth was 30 cm with riffles averaging 10 cm deep. Stream cover was very high at an estimated 60 %, consisting of dense overstream vegetation, with less amounts of LOD, deep pool and cutbank cover. The substrate was comprised of 20 % fines, 60 % gravels and 20 % larges. The discharge at the time of sampling was 0.09 m^3/s.

Only five fish, all rainbow trout, were captured in Trapping Creek and its tributary. Four of these fish were caught in minnow traps set overnight at the three sampling sites, with only one fish caught by electrofishing (1,530 seconds at site 1 - one fish; 1,050 seconds at site 2, no electrofishing was conducted at site 3). It is interesting to note that all the fish were captured downstream of the culverts on Links Road. Whether the culverts are in fact barriers or not, can only be determined with a more intensive sampling program.

2.3.2.2 Whitefoot Creek

Whitefoot Creek is a 3rd order stream that originates on the eastern flank of Big White and tends eastward to it confluence with Damfino Creek at the 1,010 m elevation. Damfino mCreek in turn flows into Kettle River. The creek has an overall length of 10.4 km, with an average gradient of 9.8%. Damfino Creek into which it runs is known to have a rainbow trout presence (FISS data, MOE, 2008), and Whitefoot Creek is suspected to contain fish up to at least the 1,500 m elevation (Henderson, 1998).

2.3.2.3 Copperkettle Creek

Copperkettle Creek is a 4th order stream with a total length of 23.7 km and a drainage area of 156 km^2. The creek originates on the eastern flank of Big White and tends south east to its confluence with Kettle River at approximately the 780m elevation. Timberland (1997b) have conducted an overview assessment on Copperkettle Creek, however, their assessment concluded just downstream of the proposed CRA boundaries. Their report notes that the stream contained both adult and juvenile rainbow trout up to that point. From the last assessed reach at the 1,421 m elevation to the 1600 m elevation, the creek has an average gradient of 9%, and it is likely that providing the stream has sufficient flows, it would be fish bearing to at least that location.

2.3.3 Rare and Endangered Fish Species

Although only rainbow trout have been captured in the creeks within the existing CRA, three provincially listed species are known to occur in the West Kettle and Kettle Rivers. These include the Umatila dace (*Rhinichthys umatilla*), the speckled dace (*R. osculus*), and chiselmouth (*Acrocheilus alutaceus*). FISS records also note that bull trout occur in Kettle River, however Cannings and Ptolemy (1998) report that this species does not occur in that drainage.

The speckled dace is on BC Environment's red list, indicating that it is imperiled because of rarity within the province, making it vulnerable to extirpation (BC Conservation Data Centre, 208). It is also listed as a species facing imminent extirpation by COSEWIC. The Kettle River system is the only known area where this species occurs in Canada. The speckled dace, however, is globally ranked as G5, "common to very common; demonstrably secure and essentially ineradicable under present conditions" (BC Conservation Data Centre, 2008). Speckled dace are primarily found in shallow waters within cool streams and rivers with rocky substrate, but can also in large and small lakes, warm permanent and intermittent streams, and outflows of desert springs (Cannings & Ptolomy, 1998).

The Umatilla dace is also red listed or similar reasons as the speckled dace. It is listed as a species of special concern by COSEWIC and is globally ranked G4, "apparently secure". It has a limited distribution in British Columbia and prefers habitats that are relatively warm and productive; being absent from cold tributaries in the mountains (Cannings & Ptolomy, 1998). It is therefore, unlikely to occur within the CRA.

The chiselmouth is a blue listed species that is confined to the Columbia River system. It is ranked as "not at risk" by COSEWIC and has a ranking of G5 globally, indicating that is "demonstrably widespread, abundant, and secure". It also prefers warmer streams and is therefore unlikely to occur within the CRA.

2.3.4 Water Quality

The water quality in Trapping Creeks was sampled in July 1996. The samples were analyzed for a variety of routine parameters, including ammonia, nitrate, nitrite, phosphate, total phosphorus, among others. Water quality within the Trapping Creek drainage was sampled at three locations on July 26, 1996: Trapping Creek at the "Sewage plant" road (Site 3, Lab ID # 19743-1), Trapping Creek at Link Road (Site 1, Lab ID # 19743-2), and the western tributary of Trapping Creek at Link Road (Site 2, Lab ID # 19743-3), as shown on Figure 3. The waters quality from the samples collected in the Trapping Creek drainage, fell within the Canadian drinking water standards, with the exception of iron (0.99 mg/l) in Trapping Creek at the "Sewage Plant" road (ID # 19743-1). Iron concentrations above the objective level

of <0.05 mg/l may cause staining of plumbing fixtures, etc. In addition, total suspended solid levels were slightly elevated at this site (57 mg/l), indicating possible construction activities in or about the creek upstream for the sampling site. The high iron levels may be related to the suspended solids. Nutrient levels within the Trapping Creek drainage's waters were generally low.

No water samples were taken during the 2018 field survey.

2.4 Terrestrial Environment

The study area is located within the Southern Interior Ecoprovince, the Thompson Okanagan Plateau Ecoregion, and the Northern Okanagan Highlands (NOH) Ecosection.

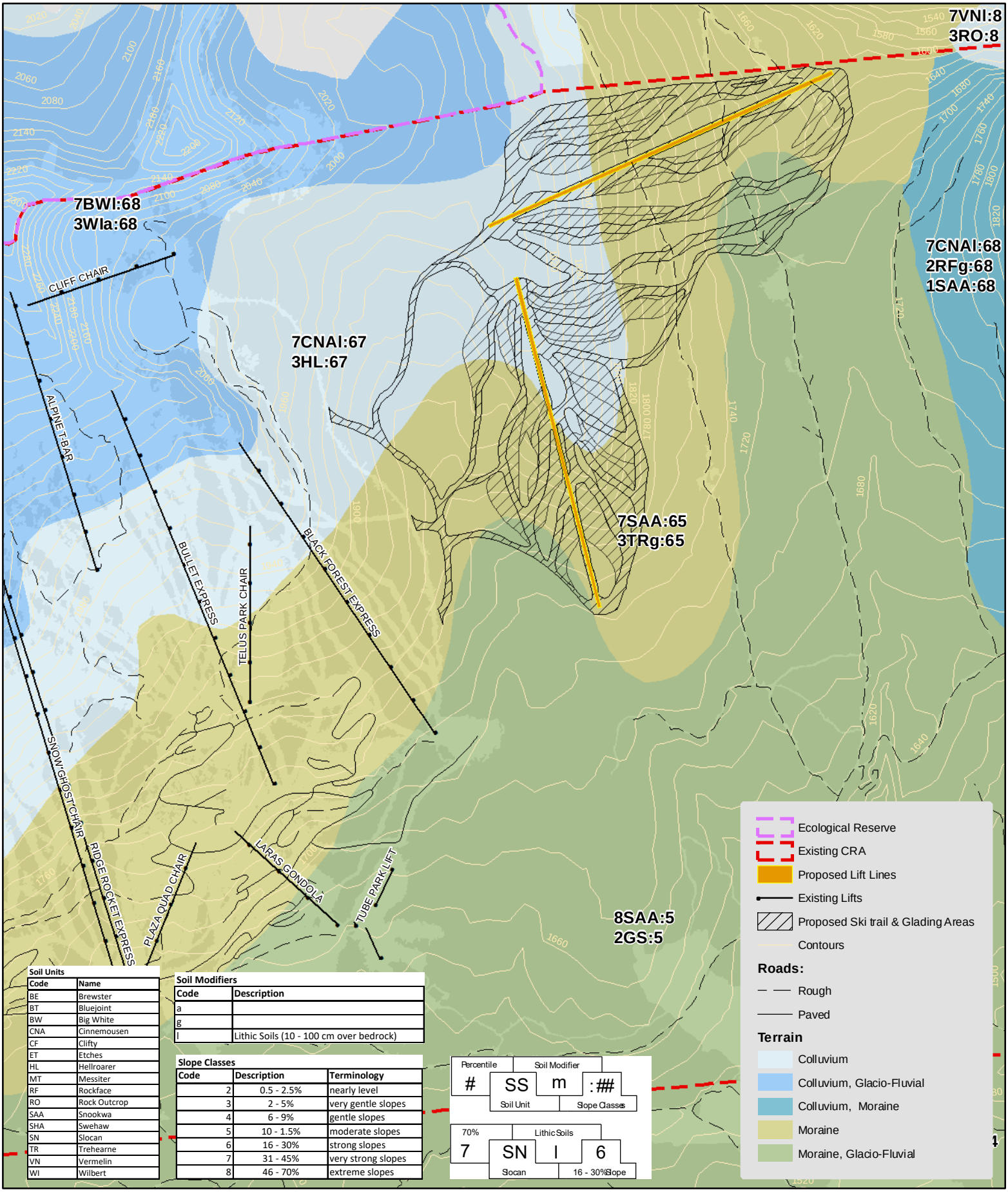
2.4.1 Soils

Soils found within the study area are classified as Orthic Humo-Ferric Podzols (CanSIS, 2018). These soils are primarily composed of mineral particles. The identified Orthic Humo-Ferric Podzols (OHFP) typically have an organic horizon (commonly LFH, or organic layers which reflect various stages of decomposition) over an eluviated A (Ae) horizon, underlain by a B horizon enriched with amorphous material (e.g. aluminum and iron mixed with organic matter). Furthermore, for the O.HFP classification, the subgroup identifier "Orthic" indicates an intergrading toward soils of another order (e.g. Brunisolic).

The soils that occur at higher elevations of the study area, approximately 1840 m to -2000 m, are described as N(CNINNEMOUSEN). These soils are well drained (CanSIS, 2018). The uppermost parent material is comprised of colluviums that is massive to moderately-well stratified, non-sorted to poorly sorted sediments with particles sizes ranging from clay to boulders with their present position based on direct gravity induced movement. The parent material below the colluviam is comprised of igneous, acidic bedrock.

The mid elevation soils of the study area, approximately 1620 m to 1840 m, are described as N(SNOOKWA). These soils are moderately well drained, as have intermediate to high water storage capacity within the control section and are usually medium to fin textured. Precipitation is the dominant water source for these soils. The parent material is comprised of morainal till deposited by glacial ice.

Although a detailed sampling program is beyond the present scope of study, preliminary site investigation revealed that Podzols are most widely distributed in the study area.



Soil Units

Code	Name
BE	Brewster
BT	Bluejoint
BW	Big White
CNA	Cinnemousen
CF	Clifty
ET	Etches
HL	Hellroarer
MT	Messiter
RF	Rockface
RO	Rock Outcrop
SAA	Snookwa
SHA	Swehaw
SN	Slocan
TR	Trehearne
VN	Vermelin
WI	Wilbert

Soil Modifiers

Code	Description
a	
g	
l	Lithic Soils (10 - 100 cm over bedrock)

Slope Classes

Code	Description	Terminology
2	0.5 - 2.5%	nearly level
3	2 - 5%	very gentle slopes
4	6 - 9%	gentle slopes
5	10 - 1.5%	moderate slopes
6	16 - 30%	strong slopes
7	31 - 45%	very strong slopes
8	46 - 70%	extreme slopes

Percentile	Soil Modifier		
#	SS	m	:##
	Soil Unit		Slope Classes

70%	Lithic Soils		
7	SN	l	6
	Slocan		16 - 30% Slope

GIS Cartographer: Nicola Church
Date: Aug 23, 2016
CERG File#: 017-06-01
Projection: BC Albers

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Map 4 - Soils Map

Big White. Kelowna
British Columbia

2.4.2 Vegetation

Information on vegetation in the study area was collected both through field investigations (Table 2), and through interpretation using the ecosystem classification system established in B.C. (Lloyd *et al*., 1990). Other referenced sources provide additional data. A vegetation inventory conducted at Big White by Klaus (1995) provides further detailed information in support of the development of landscaping guidelines for the resort.

Timber inventory data collected by Drake Forestry Services Ltd. (1996) indicates that the study area forest cover is dominated by two climax species, subalpine ("balsam") fir (*Abies lasiocarpa*) and Englemann spruce (*Picea engelmannii*). A third major forest component on lower elevation sites is lodgepole pine (*Pinus contorta*). Mature and old lodgepole pine in the area is affected by mountain pine beetle infestation (Drake Forestry Services Ltd. 1996). At elevations below 1900 m, the fir and spruce are an average height of approximately 45 m, and they are between approximately 80 and 115 years old. At higher elevations, less productive soils and other environmental conditions generally represent limiting factors for tree growth. However, veteran Englemann spruce determined by ring count to be 275 years old was noted during previous studies at an elevation of approximately 2100 m.

Forest stands within the subject area were found to consist of pole/sapling (Structural Stage 4) second growth cut blocks and mature (Structural Stage 6) and old growth (Structural Stage 7a) forest stands from undisturbed sites, all with a coniferous dominated composition. A description of this structural stage provided in Table 3. Vegetation identified in the subject area is listed in Table 2.

Deciduous tree species are uncommon in this subalpine forest. Understory shrub vegetation is typically dominated by white-flowered rhododendron (*Rhododendrum albiflorum*). Grouseberry (*Vaccinium scoparium*) appears to dominate the herbaceous understory. Wetter sites are likely associated with Sitka valerian (*Valeriana sitchensis*), sedges (*Carex* spp.), and common horsetail.

2.4.2.1 Vegetation Associations

All vegetation has been assigned to a layer dependent on vegetation type and height.

- *Tree layer* – includes all woody plants greater than 10 m tall.
- *Shrub layer* – includes all woody plants less than 10 m tall, e*xcept low (*usually < cm tall) woody or trailing plants which a*re consider*ed part of the herb layer. Established tree regeneration more than two years of age and less than 10 m in height is considered part of the shrub layer.
- *Herb layer* - includes all herbaceous species, regardless of height, and some low woody plants less than 15 cm tall.
- *Moss, lichen, liverwort and seedling layer* – Includes all bryophytes, terrestrial lichens, and liverworts, and tree *seedlings less than two years old.*

A summary of the plant species present on the study site is provided in Table 2.

Table 2: Vegetation identified on subject site

Common Name	Scientific Name
Trees	
Subalpine fir	*Pinus monticola*
Engelmann spruce	*Picea engelmannii*
Lodgepole pine	*Pinus contorta var. latifolia*
Red alder	*Alnus rubra*
Trembling aspen	*Populus tremuloides*

Common Name	Scientific Name
Shrubs	
white-flowered rhododendron	*Rhododendrum albiflorum*
Queen Ann's Lace	*Daucus carota*
Utah Honeysukcle	*Lonicera utahensis*
Grouseberry	*Vaccinium scoparium*
Black Huckleberry	*Vaccinium membranaceum*
Sticky Currant	*Ribes viscosissimum*
Sitka Mt. ash	*Sorbus sitchensis*
Forbs	
Fireweed	*Epilobium ciliatum*
Horsetails	*Equisetum arvense*
Falsebox	*Pachistima myrsinites*
Rattlesnake plantain	*Goodyera oblongifolia*
Hawkweed Sp.	*Hieracium*
Wild strawberry	*Frragaria virginiana*
Bracted lousewort	*Pedicularis bracteosa*
Mountain arnica	*Arnica latifolia*
Indian hellebore	*Veratrum viride*
Pearly everlasting	*Anaphalis margaritacea*
Queen Ann's lace	*Daucus carota*
Violet spp.	*Viola spp.*
Queens cup	*Clintonia uniflora*
Hookers fairybell	*Disporum hookeri*
Sitka valerian	*Valeriana sitchensis*
Arctic Lupine	*Lupinus arcticus*
Viola Sp.	*Viola Sp.*
Common red paintbrush	*Castilleja miniata*
One leaved foamflower	*Tiarella unifoliata*
Racemose pussytoes	*Antenna racemosa*
Arrow leaved groundsel	*Senecio triangularis*
White Mountain Heather	*Cassiope mertensiana*
Pink Mountain Heather	*Phyllodoce empe*
Showy sedge	*Carex scirpodea*
Narrow leaved cotton grass	*Riophorum angusttifolium*
Mountain Hairgrass	*Vahlodea atropurpurea*
Ferns	
Lady fern	*Athyrium felix-femina*

Common Name	Scientific Name
Bracken fern	*Pteridium aquilinum*
Mosses and Lichens	
Witches hair	
Moss Sp.	
Pipecleaner moss	Rhytidiopsis robusta
Spagnum moss sp.	

Table 3: Description of Structural Stages

Structural Stage Code	- Interpretation
1 Sparse/Bryoid	- Community is in initial stages of primary and secondary development - Bryophytes and lichens often dominant - Times since disturbance typically <20 years but may be 50-100 + years in areas with little or no soil - Shrub and herb cover <20 % of total area - Tree cover < 10 % of total area
2a/b/c/d Herb	- Early successional stage or edaphic herb community - 2a forb dominated - 2b graminoid dominated, including grasses, sedges, reeds and rushes - 2c aquatic plant dominated, but not 2b plants - 2d dwarf shrub dominated, low growing woody shrubs
3a/b Shrub	- Shrub dominated communities maintained by environmental conditions or disturbance - 3a low shrub < 2 metres tall - 3b tall shrub < 10 metres tall - Tree cover <10 %
4 Pole/Sapling	- Densely stocked trees - Self-thinning not yet evident - Time since disturbance usually < 40 years
5 Young Forest	- Stocking density persists - Self-thinning not yet evident - Time since disturbance usually 40-80 years
6 Mature Forest	- Trees established after the last disturbance have matured - The second cycle of shade-tolerant trees may have become established - Time since disturbance generally 80–140 years
7a/b Old Forest	- Structurally complex stands composed mainly of shade-tolerant and regenerating tree species - Snags and coarse woody debris in all stages of decomposition typical - 7a Old Forest 140-250 years - 7b Very Old Forest >250 years
Modifiers: B – Broadleaf C – Coniferous M – Mixed	- Broadleaf stands composed of > 75 % broadleaf tree cover - Coniferous stands composed of > 75 % coniferous tree cover - Mixed stands neither coniferous nor broadleaf compose > 75 % of the total tree cover

2.4.2.2 Biogeoclimatic Zone Classification

A standard method of land classification used in BC is the Biogeoclimatic Ecosystem Classification system (BEC). The biogeoclimatic ecosystem classification describes the variation in climate, vegetation, and site conditions occurring within ecosections. BEC is also hierarchal, with separate climate and site levels (Resource Information Standards Committee (RISC), 1998). There are six levels of organization with increasing specificity: zone, subzone, phase, variant, site association, and site series. At the highest level, biogeoclimatic zones are classed based on broad macroclimatic patterns; at the lowest level, site series describes the vegetation potential of the land area based on its ability to support the same climax plant association and displaying the same soil moisture and nutrient regimes (RISC, 1998). For the purposes of this report, descriptions are set at the biogeoclimatic subzone, variant, and site series levels of detail using Terrestrial Ecosystem Mapping (Map 5).

Most of the study area is classified as a dry, cold Okanagan variant of the Englemann spruce subalpine fir biogeoclimatic zone (ESSFdc1). This and the Thompson variant (ESSFdc2) occur on the southwestern, eastern, and northern edges of the Thompson Plateau (Lloyd *et al.,* 1990). This subzone is drier than all ESSF subzones in the region with the exception of the ESSFxc, which occurs west of the Fraser River. ESSFdc1 classification was confirmed with both the Kamloops Forest Region and Nelson Forest Region offices. Higher elevation (approximately 2000 m asl) sites in the study area comprise the parkland variant (ESSFdcp) of this subzone, while the peak of Big White Mountain (over 2000 m in elevation) falls within the alpine tundra (AT) zone.

2.4.2.3 Terrestrial Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) is built on the foundation of the BEC system principles. TEM provides the framework in which biotic and abiotic elements can be integrated to provide information on the spatial distribution of ecological units on the ground. Aerial photos and field surveys are used to delineate ecosystem polygons containing features with the similar site conditions, using variables such as vegetation, soil, aspect, and vegetation structural stage. This information can then be used to develop wildlife habitat capability / suitability mapping based upon individual species habitat preferences.

The derivation of the TEM code is described as:

Derivation of the TEM Code

TEM CODE DERIVATION						
Decile	Site Modifiers			Structural Stage modifiers		Seral Community Type
#	**SS**	**mm**	**#**	**x**	**X**	
% of polygon Site Series designation	Site Series		Structural Stage		Stand Composition Modifier	

A temporary supplement to Land Management Handbook 70 was produced in 2016 which contained updates on the site series contained within the ESSFdc1 subzone (MacKillop, 2016). This supplement updated the site series contained within the subzone including name and description. Table 4 describes TEM code the original site series and current site series crossover for the ecosystem classifications (Mackillop 2016). The following vegetation descriptions for the polygons are written with the newly classified site series, however, corresponding TEM codes have not currently been published for these sites and therefore, the original site series names were converted and used.

Table 4 TEM Unit Code, Old Site Series and Current Site Series Crossover

TEM Code	Old Site Series Name/Description	Current Site Unit/Description
FG	03-Bl-Grouseberry - Cladonia	102-BlPl Huckleberry 103-BlPl-Falsebox-Grouseberry
FR	01-Bl-Rhododendron - Grouseberry	104- Bl-Rhododendron-Grouseberry
FT	05-Bl-Trapper's Tea	111-Bl-Valerian-Foamflower
FH	06-Bl - Horsetail - Glow moss	112-Se-Horsetail-Globeflower 111-Bl-Valerian-Fomaflower
RV	04-Bl-Rhododendron - Valerian	101-BlSe-Rhododendron-Valerian

Table 5: Aerial representation of TEM codes

TEM Code	Site Series Name/Description	Area (ha)	% of Total Area
FG	03-Bl-Grouseberry - Cladonia	53.92	12.85
FR	01-Bl-Rhododendron - Grouseberry	55.28	13.18
FT	05-Bl-Trapper's Tea	55.05	13.12
FH	06-Bl - Horsetail - Glow moss	8.81	2.10
RV	04-Bl-Rhododendron - Valerian	240.50	57.33
PD	Pond – small body of water greater than 2 m deep but not large enough to be classified as a lake e.g. less than 50 ha	5.91	1.41
Total TEM Area:			**419.50**

The subject area was classified as eight polygons: Polygon 1 - RV4C (Site Series 04); Polygon 2 – FR7aC (Site Series 01); Polygon 3 – 7FR4C (Site Series 01) and 3RV4C (Site Series 04); Polygon 4 – 5RV4C (Site Series 04) and 5FG4C (Site Series 03); Polygon 5 – RV7aC (Site Series 04); Polygon 6 – FH7aC (Site Series 06); Polygon 7 – 5RV7aC (Site Series 04) and 5FT7aC (Site Series 05); Polygon 8 – 5RV7aC (Site Series 04) and 5FG7aC (Site Series 03). In the following sections, the polygon TEM codes are described.

Polygon 1 RV4C

Polygon 1 – TEM Code RV – Site Series 101 (BlSe-Rhododendron – Valerian)

Polygon 1 TEM CODE DERIVATION			
Decile			
10	**RV**	**4**	**C**
100%	102- BlSe-Rhododendron – Valerian	Pole/Sapling	Coniferous

This polygon represents a pole/sapling coniferous forest recently harvested as a cut block. Soils are poorly drained at a receiving position on the slope with deep and medium textured soils. The tree layer is dominated by subalpine fir with lesser amounts of lodgepole pine. White flowered rhododendron dominates the shrub layer and mountain arnica and Indian hellebore are found within the herb layer. Subalpine firs had an average dbh of 80 mm.

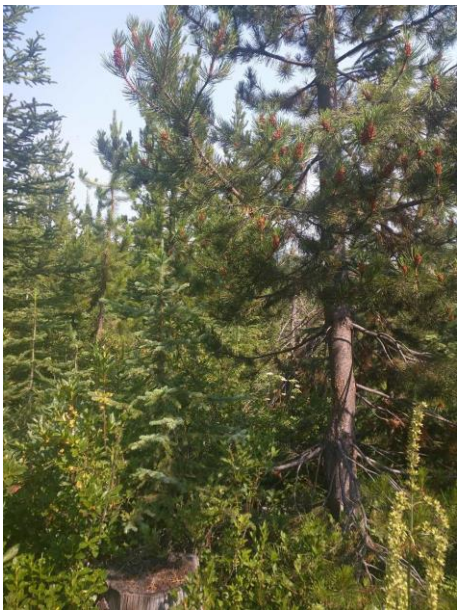


Photo 1: Polygon 1 RV4C vegetation association, August 8, 2018

Polygon 2 FR7aC

Polygon 2 – TEM code FR-Site Series 104 (bl- Rhododendron – Grouseberry)

Polygon 2 TEM CODE DERIVATION				
Decile				
10	**FR**	**7a**	**a**	**C**
100%	104- Bl-Rhododendron – Grouseberry	Old Forest		Coniferous

This Polygon represents an old forest estimated to between 140-250 years old with moderately steep slopes of 40% with sub-mesic to subxeric soil conditions with deep medium textured soils. Subalpine fir dominates the tree cover with lesser amounts of engelmann spruce. The shrub layer is dominated by white flowered rhododendron with lesser amounts of black huckleberry. Herb layer was less developed with minimal occurrence of rattlesnake plantain, queen's cup and hooker's fairybells. The average engelmann spruces were measured at a dbh of 513mm with an approximate height of 30 m.

Photo 2: Polygon 2 FR7aC, August 8, 2018.

Polygon 3 7FR4C 3RV4C

Polygon 3– TEM code FR-Site Series 104 (Bl- Rhododendron – Grouseberry)

Polygon 3 TEM CODE DERIVATION			
Decile			
7	**FR**	**4**	**C**
70%	104- Bl-Rhododendron – Grouseberry	Pole/sapling	Coniferous

Polygon 3 – TEM Code RV – Site Series 101 (BlSe-Rhododendron – Valerian)

Polygon 3 TEM CODE DERIVATION			
Decile			
3	**RV**	**4**	**C**
30%	101- BSel-Rhododendron – Valerian	Pole/Sapling	Coniferous

Polygon 7FR4C 3RV4C represents a harvested cut block vegetation with a pole/sapling structure with an estimate age of 30 year and stand height of 7 m. Lodgepole pine dominated the tree layer with lesser amounts of Englemann spruce and subalpine fir. Utah honeysuckle dominated the shrub layer with lesser amounts of grouseberry and sticky current. A less developed herb layer was present with a dominant layer of mountain arnica. The site series was in a transition stage between 104 (Bl- Rhododendron Grouseberry) and 101 (BlSe-Rhododendron – Valerian) with deep and medium textured soils.

Photo 3: Polygon 3 7FR4C 3RV4C vegetation association, August 8, 2018

Polygon 4 5RV4C 5FG4C

Polygon 4 – TEM Code RV – Site Series 101 (Bl-Rhododendron – Valerian)

Polygon 4 TEM CODE DERIVATION			
Decile			
5	**RV**	**4**	**C**
50%	101- Bl-Rhododendron – Valerian	Pole/Sapling	Coniferous

Polygon 4 – TEM Code FG – Site Series 103 (BlPl-Grouseberry Cladonia)

Polygon 4 TEM CODE DERIVATION			
Decile			
5	**FG**	**4**	**C**
50%	103 –BlPl Falsebox-Grouseberry	Pole/Sapling	Coniferous

This polygon represents a recently harvested cutblock with a pole sapling structural stage. Lodgepole pine is the dominant tree, white flowered rhododendron is dominant within the shrub layer and Indian hellabore, arctic lupine and hookers fairybells is present within the herb layer. Due to drier characteristics and dominant presence of lodgepole pine and arctic lupine and the dominant shrub layer of white-flowered rhododendron the polygon was characterised as a transition stage between site series 101 and 103.

Photo 4: Polygon 4 5RV4C 5FG4C, August 8, 2018.

Polygon 5 RV7aC

Polygon 5 – TEM Code RV – Site Series 101 (BlSe-Rhododendron – Valerian)

Polygon 5 TEM CODE DERIVATION				
Decile				
10	**RV**	**7a**	**a**	**C**
100%	101- BlSe-Rhododendron – Valerian	Old forest		Coniferous

Polygon 5 shared the same soil and vegetation associations with polygon 1 RV4C except the forest structural stage was found to be in an old forest structural stage without recent disturbance. Stand age was estimated to be 200 years or more with an estimated height of 20 m.

Photo 5: Polygon 5 RV7aC vegetation associations, August 8, 2018.

Polygon 6 FH7aC

Polygon 6 – TEM Code FH – Site Series 112 (Se - Horsetail - glow moss)

Polygon 6 TEM CODE DERIVATION				
Decile				
10	**FH**	**7a**	**a**	**C**
100%	112- Se-Horestail-Globeflower	Old forest		Coniferous

Polygon 6 FH7aC represents deep hygric soils with a high water table found in level areas on the outflow below Rhonda Lake. Vegetation included engelmann spruce and subalpine fir on raised microtopography with a well developed herb layer dominated with horsetail and lesser amounts of Indian hellebore and arrow leaved groundsel with a 30 % spagnum moss coverage within the site.

Photo 6: Polygon 6 FH7aC vegetation association, August 9, 2018.

Polygon 7 5RV7aC 5FT7aC

Polygon 7 – TEM Code RV – Site Series 101 (BlSe-Rhododendron – Valerian)

Polygon 7 TEM CODE DERIVATION				
Decile				
5	**RV**	**7a**	**a**	**C**
50%	101- BlSe-Rhododendron – Valerian	Old Forest		Coniferous

Polygon 7 – TEM Code RV – Site Series 110 (BlSe-Rhododendron - Hellebore)

Polygon 7 TEM CODE DERIVATION				
Decile				
5	**FT**	**7a**	**a**	**C**
50%	110- BlSe-Rhododendron - Hellebore	Old Forest		Coniferous

This polygon is represented by gentler slopes in the higher alpine producing a 110 BlSe-Rhododendron-Hellebore series with a forested alpine meadow with a tree cover of 10 % including Engelmann spruce and subalpine fir. The shrub layer is dominated by heather and grouseberry and herb layer mainly dominated by Indian hellebore. As the polygon slopes percentage increases and soils become coarser 101 BlSe- Rhododendron -Valerian site series is represented.

Photo 7: 5RV7aC 5FT7aC, August 9, 2018.

Polygon 8 5RV7aC 5FG7aC

Polygon 8 – TEM Code RV – Site Series 101 (BlSe-Rhododendron – Valerian)

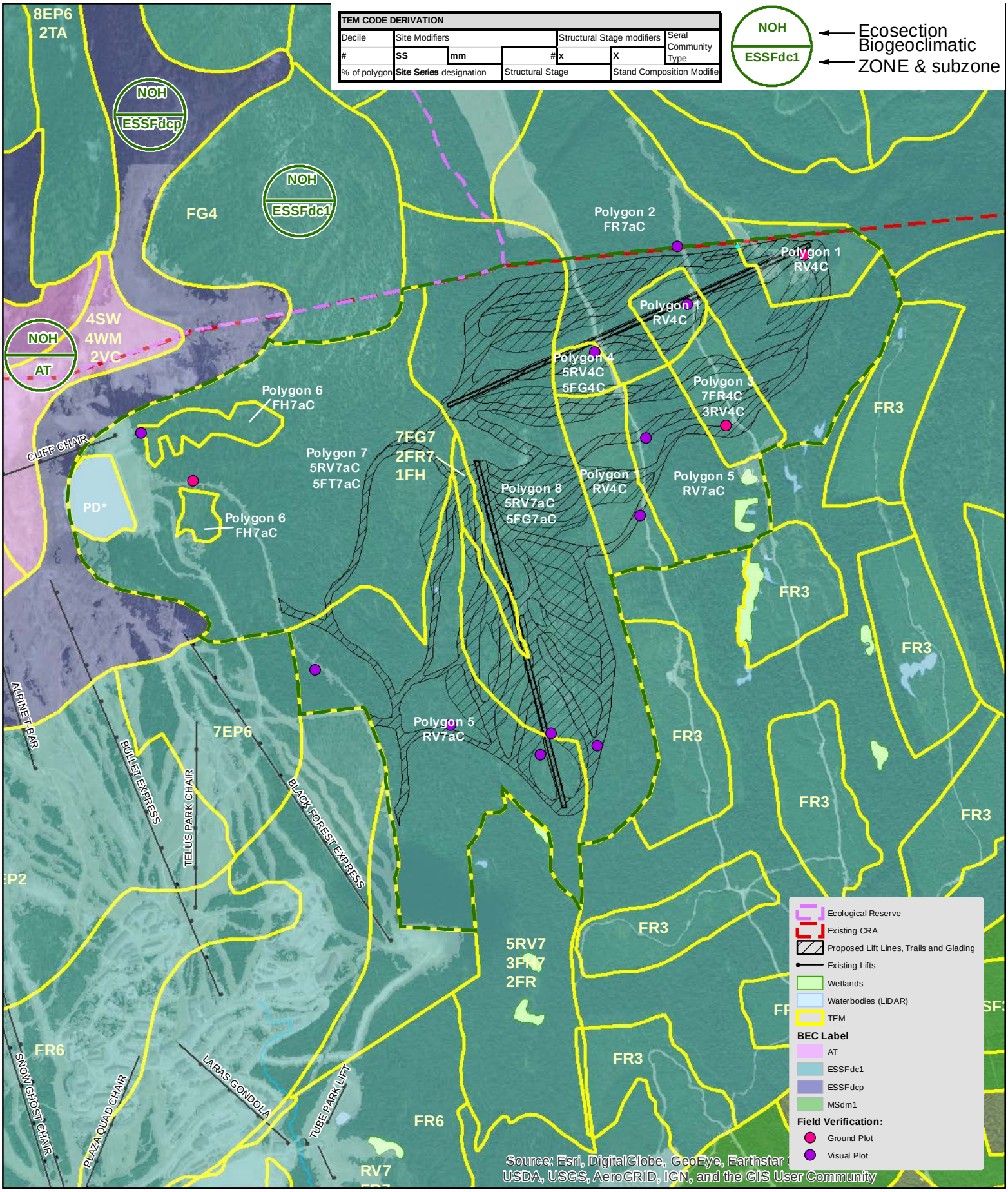
Polygon 4 TEM CODE DERIVATION				
Decile				
5	**RV**	**7a**	**a**	**C**
50%	101- BlSe-Rhododendron – Valerian	Old forest		Coniferous

Polygon 8 – TEM Code FG – Site Series 103 (BlPl – Falsebox – Grouseberry)

Polygon 4 TEM CODE DERIVATION				
Decile				
5	**FG**	**7a**	**a**	**C**
50%	103 – Grouseberry - Cladonia	Old forest		Coniferous

This polygon shares similar vegetation and soil characteristics as Polygon 4 5RV4C 5FG4C, however, the structural stage was to be found as old forest with a stand age of approximately 200 years and a stand height of 25 m. Areas of this polygon were observed with steep slopes, rocky outcrops and subxeric soils producing the 103 (BlPl - Falsebox – Grouseberry) vegetation associations.

Photo 8: Polygon 8 5RV7aC 5FG7aC, August 9, 2018.



GIS Cartographer: Nicola Church
Date: October 03, 2018
CERG File#: 017-06-01
Projection: BC Albers

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Map 5 - Terrestrial Ecosystem Map

Big White. Kelowna
British Columbia

2.4.2.4 Rare and Endangered Plant Species and Ecological Communities

2.4.2.4.1 Plant Species

In BC, there are two governing bodies involved with the ranking of species and/or ecological communities at risk. At the national level, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) provides advice to the *Species at Risk Act* (SARA), and at the provincial level, the Conservation Data Centre (CDC) manages the BC Status List.

The Canadian government created SARA in 2002 to complement the Accord for the Protection of Species at Risk (a national effort to identify and protect threatened and endangered wildlife and their associated habitats across the country). COSEWIC is the scientific body responsible for assigning the status of species at risk under SARA. This system uses the following terminology:

- Extinct (XX)
- Extirpated (XT)
- Endangered (E)
- Threatened (T)
- Special concern (SC)
- Not at risk (NAR)
- Data deficient (DD)

A species that is listed as Endangered, Extirpated or Threatened is included on the legal list under Schedule 1 of the *Act* and is legally protected under the Act with Federal measures to protect and recover these species in effect.

The BC CDC designates provincial red or blue list status to animal and plant species, and ecological communities of concerns (BC MOE, 2018). The red list includes indigenous species or subspecies considered to be endangered or threatened. Endangered species are facing imminent extirpation / extinction, whereas threatened groups or species are likely to become endangered if limiting factors are not reversed. The blue list includes taxa considered to be vulnerable because of characteristics that make them particularly sensitive to human activities or natural events. Although blue listed species are at risk, they are not considered endangered or threatened. Yellow listed species are all others not included on the red or blue list and may be species which are declining, increasing, common, or uncommon. Table 6 below include CDC listed (i.e. rare and threatened) species that have the potential to occur on the subject site; species designated as SARA Schedule 1 are also noted.

This potential is based on broad habitat preferences delineated by forest district, MOE region, regional district and biogeoclimatic zone and refined by habitat type available in the subject area. The biogeoclimatic zone ESSF was used in the search as this was the only unit found within the subject area.

Potential occurrences are then designated as unlikely or possible based upon species specific habitat requirements and an on-site assessment of those habitats. Note that a comprehensive evaluation of the study area for each species was not possible due to time constraints, seasonal migration patterns, and the transient nature of some species. The occurrence of “Possible” specific rare and endangered plant species can only be verified through a detailed field survey specific to the areas of the property slated for disturbance and including a reasonable buffer around those areas.

The CDC iMAP indicated that there are no recorded observations for red or blue-listed plant species within the immediate study area (BC CDC iMAP 2018). The closest occurrence is displayed in CDC polygon #14329 is the nettle-leaved giant hyssop (*Agastache urticifolia*), which is currently yellow-listed by the CDC, has been identified at a location approximately 30 km east/southeast of the study area, near the Granby River.

Table 6: Rare and Endangered Plant Species Potentially Occurring Within the Subject Area.

Common Name *Scientific name*	Status		Habitat Requirements	Potential Occurrence
	BC List	SARA Status		
Bryum calobryoides	Red		Non-vascular moss found on moist to dry soil or rock; found at montane to alpine elevations in the Coast Ranges and Rocky Mountains	Possible
steer's head *Dicentra uniflora*	Blue	-	Perrenial herb found in Mesic to dry meadows and scree slopes in the montane and subalpine zones	Possible
Philonotis yezoana	Blue		Non-vascular plant which grows over rock in shaded stream gorges and on cliffs or steep slopes wet by seepage	Possible
Pohlia elongata	Blue		Non-vascular plant, limited information on habitat data	Possible
Lemmon's holly fern *Polystichum lemmonii*	Red	Threatened	Evergreen Perennial fern found in Dry to mesic, ultramafic rock outcrops in the montane zone; rare in BC, known only from the Mt. Baldy area	Possible
Alpine Sorrel *Rumex paucifolius*	Red		Moist to wet forest openings and meadows in the subalpine and alpine zones	Possible
sweet-marsh butterweed Senecio hydrophiloides	Blue		Wet to moist meadows and forest openings in the montane and lower subalpine zones	Possible

Source: Conservation Data Centre (BC CDC, 2018)

2.4.2.4.2 Rare and Endangered Ecological Communities

The term "ecological" is a direct reference to the integration of non-biological features such as soil, landform, climate and disturbance factors. The term "community" reflects the interactions of living organisms (plants, animals, fungi, bacteria, etc.), and the relationships that exist between the living and non-living components of the community. Currently, the most common ecological communities that are known in BC are based on the Vegetation Classification component of the Ministry of Forests and Range Biogeoclimatic Ecosystem Classification, which focuses on the terrestrial plant associations of BC's native plants.

The CDC iMAP indicated that there are no recorded observations for red or blue-listed Ecological Communities within the immediate study area (BC CDC iMAP 2018)

One blue listed and four yellow listed ecological communities exist within the subject area and are described below in Table 7. Yellow listed plant communities are neither rare nor endangered, but are of concern and are listed here for information purposes only.

Table 7: Rare and Endangered Ecological Communities Occurring on the Subject Site.

Site Series Name **Common Name** *Scientific name*	TEM Code	Status BC List	BCG Zone/Site Series	Polygons	Structural stage	Size of polygon (ha)
subalpine fir / horsetails / leafy mosses *Abies lasiocarpa / Equisetum spp. / Mnium spp.*	FH	Yellow	ESSFdc1/06	6	7	8.38

Site Series Name **Common Name** *Scientific name*	TEM Code	Status BC List	BCG Zone/Site Series	Polygons	Structural stage	Size of polygon (ha)
subalpine fir / white-flowered rhododendron / grouseberry *Abies lasiocarpa / Rhododendron albiflorum / Vaccinium scoparium*	FR	Yellow	ESSFdc1/01	2	7	45.81
				3	4	8.60
subalpine fir / white-flowered rhododendron / sitka valerian *Abies lasiocarpa / Rhododendron albiflorum / Valeriana sitchensis*	RV	Blue	ESSFdc1/04	5	7	98.22
				1	4	32.62
				7	7	55.06
				4	4	1.98
				8	7	48.95
				3	4	3.69
subalpine fir / trapper's-tea / grouseberry *Abies lasiocarpa / Rhododendron columbianum / Vaccinium scoparium*	FT	Yellow	ESSFdc1/05	7	7	55.06
subalpine fir / grouseberry / clad lichens Abies lasiocarpa / Vaccinium scoparium / Cladonia spp.ens	FG	Yellow	ESSFdc1/03	8	7	48.95
				4	4	1.98

Source: Conservation Data Centre (BC CDC, 2018)

2.4.3 Wildlife and Wildlife Habitats

2.4.3.1 Wildlife

Research for this study area was conducted in three stages. First, a literature search of available information related to the terms of reference for this study was conducted including: environmental impact assessments undertaken within or adjacent to the Big White Ski Resort; available literature on relevant studies undertaken within the study area; and life history information including habitat requirements of species suspected of occurring within the study area.

The second stage of research involved obtaining all relevant wildlife habitat information for the study area including: 1:100,000 scale Biogeoclimatic subzone and variant mapping; 1:15,000 scale forest cover mapping; and 1:12500 scale (approx.) colour air photos; and communication with Ministry of Environment, Lands and Parks personnel including the Wildlife Program and the Conservation Officer Service.

In 2008 site reconnaissance surveys were conducted to identify known or probable wildlife use, based on sightings or evidence of wildlife use (i.e., scat, tracks, browsing etc.). No wildlife surveys were conducted during the 2018 field survey.

Species use were noted by visual observation, the occurrence of tracks, fecal droppings, feathers, browsing, game trails, shed antlers and wildlife tree use. Existing habitat conditions were also evaluated.

While the area apparently has had little inventory work, it is known to provide summer range habitat for several ungulate species including moose *(Alces alces),* mule deer *(Odocoileus hemionus hemionus),* and white-tailed deer *(O. virginianus).* Wildlife species associated with the AT and ESSF are described in more detail below.

2.4.3.2 Birds

During the 2008 reconnaissance surveys a total of 12 bird species were observed. Species observed included blue grouse (see Table 5 for scientific names), boreal chickadee, Clark's nutcracker, flycatcher, violet-green swallow and dark-eyed junco, golden-crowned kinglet, gray jay, mountain chickadee, red crossbill, red-breasted nuthatch, red-naped sapsucker, Steller's jay and winter wren. An American pipit was also seen along the edge of the sewage treatment ponds. All birds, except blue grouse, were observed either within or moving between residual spruce/balsam clumps. Little activity was noted in open habitats. During the August 2018 survey a hummingbird (*Selasphorus rufus*) was observed at the base of the proposed Backcountry Connector chairlift (Map 2).

Several other bird species are expected to occur in the alpine, riparian and forested habitats of the study area. Table 8 lists bird species known or expected to occur regularly in the study area.

Table 8: Bird Species Known or Expected to Occur in the Study Area.

Common Name	Scientific Name	Status
Geese and Ducks		
Canada Goose	*Branta Canadensis*	RarVis
Mallard	*Anas platyrhynchos*	RarVis
Shorebirds		
Killdeer	*Charadrius vociferous*	RarSuRes
Solitary Sandpiper	*Tringa solitarius*	RarMig
Spotted Sandpiper	*Actitis macularia*	RarSuRes
Hawks		
Merlin	*Falco columbarius*	RarRes
Northern Goshawk	*Accipiter gentilis*	UncRes
Red-tailed Hawk	*Buteo jamaicensis*	RarRes
Sharp-shinned Hawk	*Accipiter striatus*	UncMig
Grouse		
Blue Grouse	*Dendragapus obscurus*	UncRes
Ruffed Grouse	*Bonasa umbellus*	RarRes
Spruce Grouse	*Dendragapus canadensis*	UncRes
Owls		
Barred Owl	*Strix varia*	RarRes
Boreal Owl	*Aegolius funereus*	RarRes
Great Horned Owl	*Bubo virginianus*	UncRes
Northern Hawk-Owl	*Surnia ulula*	RarRes
Northern Pygmy-Owl	*Glaucidium gnoma*	RarRes
Northern Saw-whet Owl	*Aegolius acadicus*	UncRes
Hummingbirds		
Calliope Hummingbird	*Stellula calliope*	RarRes
Rufous Hummingbird	*Selasphorus rufus*	UncRes

Common Name	Scientific Name	Status
Woodpeckers		
Black-backed Woodpecker	*Picoides arcticus*	RarRes
Downy Woodpecker	*Picoides pubescens*	RarRes
Hairy Woodpecker	*Picoides villosus*	UncRes
Northern Flicker	*Colaptes auratus*	RarRes
Red-naped Sapsucker	*Sphyrapicus nuchalis*	UncRes
Three-toed Woodpecker	*Picoides tridactylus*	UncRes
Flycatchers		
Hammond's Flycatcher	*Empidonax hammondii*	UncSuRes
Olive-sided Flycatcher	*Contopus borealis*	UncSuRes
Western Wood-Pewee	*Contopus sordidulus*	UncSuRes
Larks		
Horned Lark	*Eremophila alpestris*	RarSuRes
Swallows		
Tree Swallow	*Tachycineta bicolor*	RarSuRes
Violet-green Swallow	*Tachycineta thalassina*	RarSuRes
Corvids		
Clark's Nutcracker	*Nucifraga columbiana*	ComRes
Common Raven	*Corvus corax*	ComRes
Gray Jay	*Perisoreus canadensis*	ComRes
Steller's Jay	*Cyanocitta stellar*	UncRes
Chickadees		
Black-capped Chickadee	*Parus atricapillus*	RarRes
Boreal Chickadee	*Parus hudsonicus*	ComRes
Mountain Chickadee	*Parus gambeli*	ComRes
Nuthatches and Creepers		
Brown Creeper	*Certhia americana*	RarRes
Red-breasted Nuthatch	*Sitta canadensis*	ComRes
Wrens		
Winter Wren	*Troglodytes troglodytes*	ComRes
Kinglets and Thrushes		
American Robin	*Turdus migratorius*	ComSuRes
Golden-crowned Kinglet	*Regulus satrapa*	ComRes
Hermit Thrush	*Catharus guttatus*	UncSuRes
Mountain Bluebird	*Sialia currucoides*	RarSuRes
Ruby-crowned Kinglet	*Regulus calendula*	UncMig
Swainson's Thrush	*Catharus ustulatus*	RarSuRes

Common Name	Scientific Name	Status
Townsend's Solitaire	*Myadestes townsendii*	RarRes
Varied Thrush	*Ixoreus naevius*	RarSuRes
Pipits		
American Pipit	*Anthus rubescens*	UncSuRes
Waxwings		
Bohemian Waxwing	*Bombycilla garrulous*	RarMig
Cedar Waxwing	*Bombycilla cedrorum*	RarSuRes
Vireos		
Solitary Vireo	*Vireo solitarius*	UncSuRes
Warbling Vireo	*Vireo gilvus*	RarSuRes
Warblers		
MacGillivray's Warbler	*Oporornis tolmiei*	UncSuRes
Northern Waterthrush	*Seiurus noveboracensis*	RarSuRes
Orange-crowned Warbler	*Vernivora celata*	UncSuRes
Townsend's Warbler	*Dendroica townsendii*	UncSuRes
Wilson's Warbler	*Wilsonia pusilla*	RarSuRes
Yellow-rumped Warbler	*Denroica coronate*	ComSuRes
Sparrows		
Chipping Sparrow	*Spizella passerina*	RarSuRes
Dark-eyed Junco	*Junco hyemalis*	ComRes
Fox Sparrow	*Passerella iliaca*	UncSuRes
Lincoln's Sparrow	*Melospiza lincolnii*	RarSuRes
Song Sparrow	*Melospiza melodia*	UncSuRes
Western Tanager	*Piranga ludoviciana*	UncSuRes
White-crowned Sparrow	*Zonotrichia atricapilla*	UncSuRes
Blackbirds		
Brown-headed Cowbird	*Molothrus ater*	UncSuRes
Rusty Blackbird	*Euphagus carolinus*	RarSuRes
Finches		
Common Redpoll	*Carduelis flammea*	UncWiRes
Evening Grosbeak	*Coccothraustes vespertinus*	UncRes
Pine Grosbeak	*Pinicola enucleator*	UncRes
Pine Siskin	*Carduelis pinus*	ComRes
Red Crossbill	*Loxia curvirostra*	ComRes
White-winged Crossbill	*Loxia leucoptera*	RarVis

Primary references include Cannings *et al.* (1987), Campbell *et al.* (1990a and 1990b) and Campbell *et al.* (1997), BSC (2018).
Symbol definitions for status are Common (Com), Uncommon (Unc), Rare (Rar), Summer (Su), Visitor (Vis), Migrant (Mig), and Resident (Res).

Mammals

Within alpine habitats, evidence of mammal use was predominantly restricted to ungulates, bears and small mammals. Considerable evidence of ground squirrel use was observed, particularly within well established alpine ski areas. One hoary marmot *(Marmota caligata)* was sighted using a small rock pile. A single mule deer buck was sighted adjacent to a forest clump, although, overall evidence of ungulate was low. Black bear use was noted, particularly within patches of succulent forbs.

Mammal use was limited near several small lakes situated in the AT with some deer tracks and suspected weasel tracks (1 animal) being observed. Foraging of browse species such as *Salix* spp. by ungulates was noted around residual stands of spruce/balsam in alpine habitats. Within the forested ESSFdc habitats, signs of red squirrel *(Tamiasciurus hudsonicus),* yellow pine chipmunk *(Tamias amoenus),* snowshoe hare *(Lepus americanus),* deer and moose *(Alces alces)* use was noted, with moose and deer use primarily occurring in riparian habitats on the west side of Big White Mountain. Although browse species abundance within all habitats surveyed was high, particularly within the ESSFdc use of these habitats by ungulates was low.

Several other mammal species may occur within the Big White study area. These species along with those known to occur are described in more detail below. General references include McTaggart-Cowan and Guiguet (1965) and Nagorsen (1990).

Shrews

Given the diversity of habitats on the subject property, a number of shrew species are expected to occur. Water shrews *(Sorex palustris)* are expected to occur in creeks and wetland habitats. Other shrew species likely include common shrew *(Sorex cinereus*) and dusky shrew (*S. monticolus)* (Nagorsen 1996).

Bats

The availability of snags and wetlands on the site provides some roosting and foraging opportunities for bats. The Big White area falls within the known geographical and elevational distribution of two bat species. These species include western long-eared myotis *(M. evotis)* and little brown myotis *(M. lucifugus)* (Nagorsen and Brigham 1993).

Snowshoe Hare and Common Pika

Signs of snowshoe hares was observed during the 2008 field survey. They are expected to be relatively common on the site in most shrub and forest habitats. Snowshoe hare populations exhibit marked cycles in abundance, ranging from an over abundance of individuals to very few individuals. Common pikas (*Ochotona princeps)* may occur in rock talus slopes and other habitats in alpine and subalpine areas.

Small Rodents

Deer mouse *(Peromyscus maniculatus)* likely occurs throughout the site, whereas southern red-backed vole *(Clethrionomys gappen)* likely only inhabits forested regions. Other small rodent species that may occur on the subject property include bushy-tailed woodrat *(Neotoma cinerea)* and meadow vole *(Microtis pennsylvanicus).*

Porcupine

Porcupine *(Erethizon dorsatum)* was not observed during the field survey but is expected to occur in moderate numbers throughout forested regions of the site.

Squirrels, Chipmunks and Marmots

Red squirrel sign and individuals were observed on numerous occasions. Signs included cone scales, middens and calls. The predominance of cone-bearing trees on the site provides an abundance of foraging opportunities.

Yellow-pine chipmunk was observed and is expected to occur throughout the study area, especially in areas with high coarse woody debris, or windthrow areas with large, dense brush piles. Columbian ground squirrel *(Spermophilus columbianus)* and possibly mantled ground squirrel *(Spermophilus lateralis)* occur in open areas in alpine and subalpine habitats and around cleared areas, and northern flying squirrel *(Glaucomys sabrinus),* a nocturnal squirrel, likely inhabits forested regions. Hoary marmot is known to occur in subalpine and alpine habitats.

Canids

Habitats of the subject property are suitable for all three canid species. Coyote (Canis *latrans*) is likely the most abundant species followed by red fox *(Vulpes vulpes*) and gray wolf *(Canis lupus*).

Cats

Because of the abundance of deer on the subject property, cougars *(Fells concolor)* are expected to occur regularly during the growing season when deer are present. Lynx *(Lynx canadensis*) and bobcat *(Lynx rufus*) likely also occur occasionally and at low numbers. Lynx numbers are closely related to the densities of snowshoe hares, their primary prey species.

Mustelids

Marten (*Martes americana*) and ermine (*Mustela erminea)* are expected to be relatively common residents of the subject property. An abundance of coarse woody debris and mature forests in the study area are preferred habitats for these species. Red squirrels and small rodents provide an abundance of prey. Long tailed weasel *(Mustela frenata),* striped skunk *(Mephitis mephitis)* and wolverine (*GuIo gulo luscus)* are expected to occur at lower densities. Wolverine is blue-listed by the B.C. Ministry of Environment (1997).

Bears

Black bear (*Ursus americanus)* signs including scats and feeding sign were observed. Black bears are common residents of the study area, especially in the spring when forbs and herbs in subalpine habitats are an attractive food source. Grasses and sedges in several of the wetlands also provide foraging opportunities for bears, Black huckleberry and oval-leaved blueberry provide foraging opportunities in the fall. Grizzly bear (*Ursus arctos),* a blue-listed species, has been reported on several occasions by Big White Ski Resort staff.

Grizzly bears are expected to occur on an infrequent but yearly basis on and in the vicinity of the proposed development area. The Kettle-Granby grizzly population unit lies to the east of the CRA and has been identified as a recovery unit. Ongoing coordinated access management planning process has been undertaken with the forest industry for this population unit

Moose

In 2008 Moose pellet groups and tracks were noted in several areas of the subject properly, but particularly in lowland areas. Dense shrub vegetation adjacent to wetlands, and in other openings provides good winter foraging opportunities.

Elk

Populations of elk are known to occur in the plateau areas east of Okanagan Lake and in the Kettle River valley (McTaggart-Cowan and Guiguet 1965). Thus, elk may occur occasionally in the Big White area.

Deer

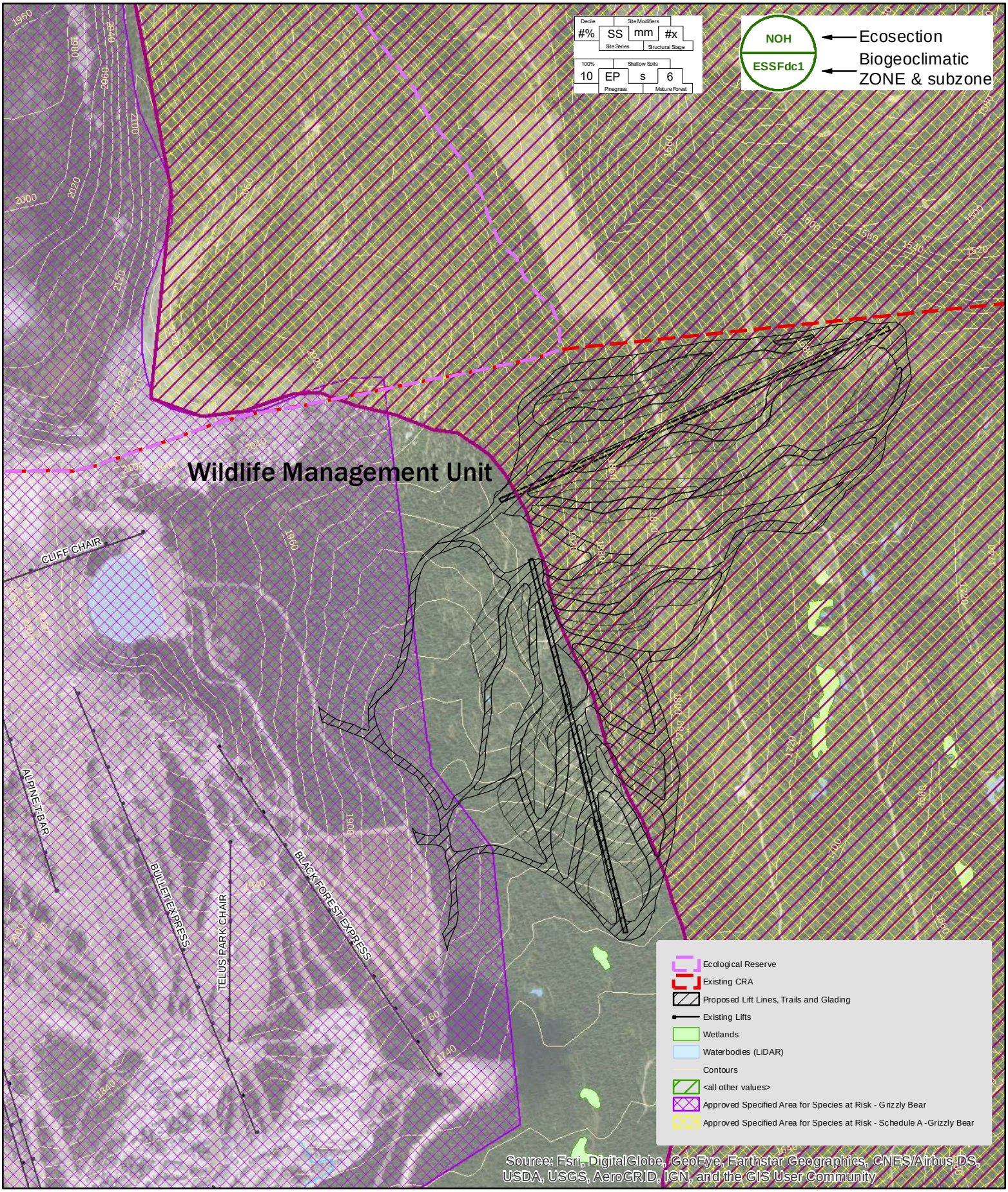
Mule deer (Odocoileus hemionus hemionus) are common summer residents of the study area. White-tailed deer also apparently occur, however, likely at lower population densities than mule deer. Deer and deer sign were observed on several occasions, especially in open clearcuts where forb and herb productivity was high. Utilization of the site in winter does not occur because of high snow depths.

Caribou

Previous reports have referred a nearby Caribou sighting however the reliability of that sighting is suspect and staff at MOE confirm that no Caribou herds currently exist near Big White Resort. Mountain Caribou management direction has been addressed within the LRMP and does not affect the Big White CRA.

Amphibians and Reptiles

No reptiles or amphibians were recorded during the site assessment. Reptile and amphibian species occurrence within or near Big White Mountain are limited by the occurrence of suitable habitats and climate. Although no data regarding the distribution or abundance of reptiles and amphibians is available, existing habitat conditions may be adequate for some species. Amphibian species likely to occur include long-toed salamander *(Ambystoma macrodactylum),* western toad *(Bufo boreas),* Pacific tree frog *(Hyla regilla)* and spotted frog *(Rana pretiosa)* (Green and Campbell 1984). Reptile species likely to occur include common garter snake *(Thamnophis sirtalis)* and western terrestrial garter snake *(T. elegans*) (Gregory and Campbell 1984).



GIS Cartographer: Nicola Church
Date: September 16, 2018
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Projection: BC Albers

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Map 6 - Wildlife Habitat Areas

Big White. Kelowna
British Columbia

2.4.3.3 Rare and Endangered Species

The occurrence of endangered and threatened (red-listed), vulnerable and sensitive (blue-listed) birds, mammals, amphibians and reptiles within subject area was investigated through several sources. The CDC iMap indicates a known occurrence polygon (Shape ID 74373) for the red listed American badger (*Taxidea taxus*) within the subject area. Four hundred and ninety-eight sightings of badgers are represented by the polygon between 1995 and 2012 the polygon is large representing the habitat from the U.S. border to north of Okanagan Lake. Although no CDC occurrences have been noted within the database, staff of Big White have reported sighting the occasional blue listed grizzly bear (*Ursus arctos)* within alpine and forested habitats surrounding Big White Mountain and the vicinity of the subject area

Table 9 indicates the red, blue and yellow-listed species that may potentially occur within the subject area based on their habitat requirements and on the biogeocilmatic distribution within the ESSF zone. This list does not imply that the species are known to occur within the study area.

Table 9: Rare and Endangered Wildlife Potentially Occurring in the Subject Area

Common Name *Scientific name*	**Status**		**Habitat Requirements**	**Potential Occurrence**
	BC List	**SARA**		
White-throated Swift *Aeronautes saxatalis*	Blue		Primarily mountainous country, especially near cliffs and canyons where breeding occurs; forages over forest and open situations in a variety of habitats. Nests in rock crevices in cliffs and canyons. Sometimes nests in buildings, and on seacliffs.	**Possible**
Lance-tipped Darner *Aeshna constricta*	Blue		Rare at small ponds and open, warm, nutrient-rich marshes dominated by cattails and bulrushes; sometimes develops in waters that dry up in summer	**Possible**- Wetlands within subject area
Western toad *Anaxyrus boreas*	Yellow	Special Concern	Various upland habitats around ponds, lakes, reservoirs, and slow-moving rivers and streams.	**Possible-** slow moving streams in subject area.
Immaculate Green Hairstreak *Callophrys affinis*	Blue		*allophrys affinis* is known to occur in dry gullies within sagebrush and meadow habitats brushland, woods and scrub.	Unlikely-no meadows or sagebrush habitat within subject area
Common Nighthawk *Chordeliles minor*	Yellow	Threatened		
Evening Grosbeak *Coccothraustes vespertinus*	Yellow		Coniferous (primarily spruce and fir) and mixed coniferous- decidouous woodland, second growth, and occasionally parks; in migration and winter in a variety of forest and woodland habitats, and around human habitation.	**Possible-** coniferous woodland and around human habitation.

Common Name *Scientific name*	**Status**		**Habitat Requirements**	**Potential Occurrence**
	BC List	**SARA**		
Olive-sided flycatcher *Contopus cooperi*	Blue	Threatened	Mixed coniferous-deciduous forest with old growth snags along forest edges. Known to occur in the Whistler area.*	**Possible**- mixed coniferous-deciduous forest forest on site.
Black Swift *Cypseloides niger*	Blue		Nests behind or next to waterfalls and wet cliffs, on sea cliffs and in sea caves.	Unlikely- subject area not near ocean or waterfalls
Monarch Danaus plexippus	Blue	Special Concern	Monarch's migrate north into low-elevation areas of southern BC , The Monarch's larval foodplant in BC is the showy milkweed (*Asclepias speciosa*).	Unlikely-subject site at high elevations
Alkali Bluet Enallagma clausum	Blue		Lakes, ponds ,open water	**Possible**
Rusty Blackbird *Euphagus carolinus*	Blue	Special Concern	Wetlands, lakes, ponds forages on ground and shallow water	**Possible**
Prairie Falcon Falco mexicanus	Red		Primarily open situations, especially in mountainous areas, steppe, plains or prairies Typically nests in pot hole or well-sheltered ledge on rocky cliff or steep earth embankment, 10 to more than 100 meters above base	**Possible**-Subject area is mountainous with nearby cliffs
Wolverine *Gulo gulo luscus*	Blue	-	A range of habitat types from valley bottoms to alpine meadows, strongly associated with the presence of large ungulate prey.	**Possible**-large range area around subject area
Barn swallow *Hirundo rustica*	Blue	-	Open areas, fields, ponds with vertical nesting habitat, especially buildings.	Unlikely- subject area mainly forested limited open areas
Lilac-borderd Copper *Lycaena nivalis*	Blue		Habitat includes dry flowering meadows and forest clearings in the mountains, streamsides and sage flats in the interior valleys of British Columbia.	**Possible**
Magnum Mantleslug *Magnipelta mycophaga*	Blue	Special Concern	Under moist logs, pieces of bark, in depressions in moist earth and within talus in cool, moist coniferous forests	**Possible**

Common Name *Scientific name*	**Status**		**Habitat Requirements**	**Potential Occurrence**
	BC List	**SARA**		
Little brown mytosis Myotis lucifugus	yellow	Endangered	Wide range of habitats and often use human-made structures for resting and maternity sites; they also use caves and hollow trees. Foraging habitat requirements are generalized; foraging occurs over water, along the margins of lakes and streams, or in woodlands near water.	**Possible**
Sinuous Snaketail *Ophiogomphus occidentis*	Blue		Sunny stream banks and sandy lakeshore beaches at low elevations	Unlikely-stream banks vegetated with riparian cover
Mountain goat *Oreamnos americanus*	Blue	-	Alpine and subalpine habitat; steep grassy talus slopes, grassy ledges of cliffs, or alpine meadows. Usually at timberline or above. May seek shelter and food in stands of spruce or hemlock in winter.	**Possible**
Big Horn Sheep *Ovis canadensis*	Blue		Bighorn sheep occur in mesic to xeric, alpine to desert grasslands or shrub-steppe in mountains, foothills, or river canyons. Many of these grasslands are fire-maintained. Suitable escape terrain (cliffs, talus slopes, etc.) is an important feature of the habitat.	**Possible**
Fisher *Martes pennanti*	Blue	-	Low to mid-elevation large tracts (>100 ha) dense forests <2500 m in elevation.	Unlikely-as subject site in higher elevations
Common Sootywing *Pholisora catullus*	Blue		Very seldom in any kind of natural setting in most of its range, most typically weedy backyards, vacant lots, landfills, edges of croplands; any place where its weedy annual foodplants grow in the open.	Unlikely-subject area in natural state.
Eared Grebe *Podiceps nigricollis*	Blue		Nests in areas with seasonal to permanent water: marsh, marshy section of lake, sewage pond, fishpond, newly flooded area, reservoir, river backwaters. Nests over water in shallow eutrophic wetlands that are particularly vulnerable to yearly fluctuations in water levels, including periodic natural lowering due to drought	Unlikely-no significant lakes or ponds within subject area
Checkered Skipper *Pyrgus communis*	Blue		A generally transient species in a great variety of dry disturbed situations and some more natural ones such as short grass prairies. Low vegetation, flowers, and patches of bare ground are probably important. Strays can turn up in almost any open situation	**Possible**

Common Name *Scientific name*	**Status**		**Habitat Requirements**	**Potential Occurrence**
	BC List	**SARA**		
Caribou (southern mountain population) *Rangifer tarandus pop. 1*	Red	Threatened	The most important ecological requirement of Mountain Caribou is large tracts of old forest. Old forest is necessary for the provision of abundant arboreal lichen, and may also positively influence the forage value of understory forage plants	**Possible**
California Hairstreak *Satyrium californica*	Blue		Open woodland and edges, brushland, chaparralis and is found at willows surrounding water reservoirs and natural lakes and along meandering streams.	**Possible**
Mormon Fritillary, erinna subspecies *Speyeria mormonia erinna*	Red		In the southern BC it is usually found at high elevations above 1,250 m, with the males hill topping to 2,300 m.	**Possible**- subject area at high elevations
American Badger *Taxidea taxus*	Red	Endangered	Grasslands and dry open forests associated with suitable soils for digging burrows. Badgers will use mid-elevation and alpine areas where open habitats that contain prey and suitable burrowing soils exist.	**Confirmed**- CDC shapefile 74373 overlaps subject area.
Grizzly Bear *Ursus arctos*	Blue	Special Concern	Non-forested or partially forested sites with a wide range of foraging opportunities and choice of habitats	**Confirmed**- confirmed sightings of species in area in by Big White Staff.

(from BC Ministry of Environment 2018)

2.4.3.4 Valued Ecosystem Components

Wildlife Trees

Wildlife trees include significant standing snags, veteran trees, and trees with broken tops. These trees are important as perching areas for raptors such as red-tailed hawk (*Buteo jamaicensis*) and bald eagle (*Haliaeetus leucocephalus*), and foraging and nesting sites for woodpeckers, small owls and other cavity nesters. Outside of harvest blocks and forest service roads there has been a significant period since the last disturbance, therefore there is an abundant supply of wildlife trees snags and veteran trees.

Mid Elevation Young/Mature Forests

Typically, mature and young seral forest at middle elevations, as well as subalpine meadows at higher elevations, represent productive wildlife habitat in the ESSF biogeoclimatic zone (Meidinger and Pojar, 1991). The ESSF is also noted as one of the most productive zones for grizzly bears, particularly where avalanche activity serves to maintain abundant forage in a seral state preferred by both grizzly and black bears (Meidinger and Pojar, 1991).

The mid elevation slopes of the study area are mainly comprised of mature climax forest and with pole sapling forest regenerating cut block areas.

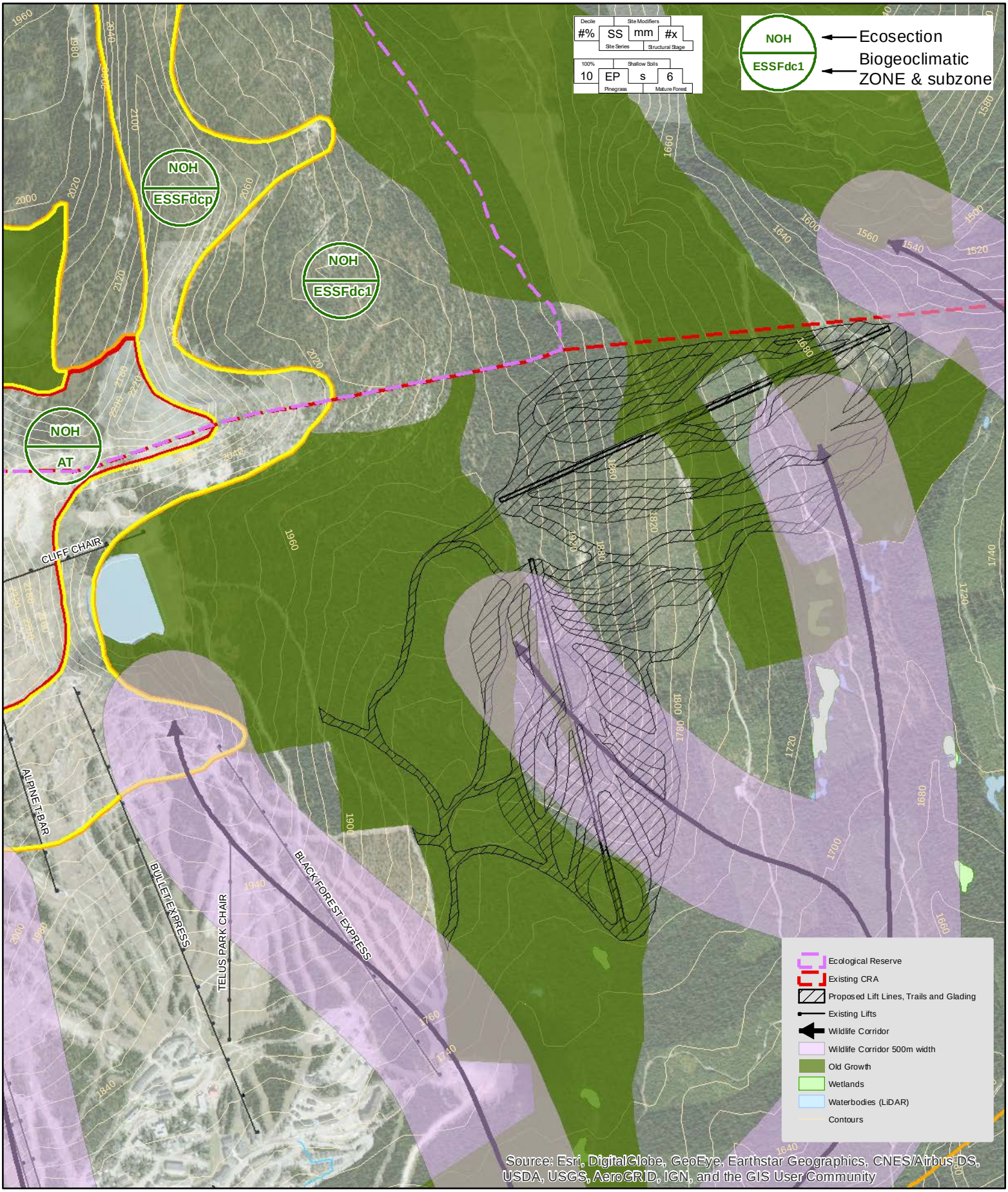
Creek and Riparian Areas

Riparian habitats are attractive to numerous bird, mammal, and amphibian species. Creek and wetland habitats are utilized as drinking and preening areas for wildlife, and breeding areas for frogs and salamanders. Permanent cascade-pool tributaries to fish-bearing creeks run through the study area.

Wildlife Movement Corridors

Creeks, riparian habitats, and wetland areas are natural movement corridors for wildlife. These corridors connect habitats within the subject property to adjacent forested areas while providing wildlife with thermal cover and security.

Noted wildlife corridors in the subject area include Trapping Creek to the east and south, West Kettle River and its major tributaries to the north and west, and the Big White Road corridor along the western boundary of the site (Timberland Consultants, 1995). Additional wildlife movement is noted along an elevational gradient between the Big White Road and the northwest edge of the existing ski area, and within the eastern portion of the Ecological Reserve to the north of the ski area (Map 7).



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Map 7 - Wildlife Corridor

Big White. Kelowna
British Columbia

3 Environmental Impacts

3.1 Cultural Environment

No impacts to the cultural environmental are anticipated from the construction and operation of the two proposed chairlifts.

3.2 Physical Environment

3.2.1 Climate

No climatic impacts are anticipated from the construction and operation of the two proposed chairlifts.

3.2.2 Geology

Caution should be taken in locating ski runs and traffic areas below cliffs faces. The integrity of the rock mass should be assessed by trail crews and any concerns should be addressed by a professional engineer (P.Eng.). Any geotechnical issues associated with potential development of the site are addressed in a separate report (Chiocca, 2018).

3.2.3 Geomorphology

The thin soils present on the ski runs are highly susceptible to surface erosion. This condition is exacerbated by summer grooming techniques which may disturb the upper soil layers or remove larger material.

3.2.4 Hydrology

Three creeks were encountered during the 2018 site visit. Cutting a clearing for ski runs could result in surface erosion which is likely to deposit sediment in the local stream channels over the first few seasons until revegetation has stabilized the soil. Debris flows/torrents in larger creeks are possible if sedimentation is excessive.

3.2.5 Aquatic Environment and Water Quality

Any changes to water quality or development within the riparian areas adjacent to the drainages on site could affect the fisheries potential of Trapping Creek which drains into the West Kettle River downstream, and the fisheries potential of Whitefoot and Copperkettle Creeks, draining into the Kettle River.

The water quality of the creeks within the study area is generally of drinking water quality. While the quality of the water in itself does not present any environmental constraints, the maintenance of the good water should be given high priority. Given that the study area is at the headwaters Trapping, Whitefoot and Copperkettle Creeks, any impacts on water quality could impact downstream users.

3.3 Terrestrial Environment

3.3.1 Soils

Rock and mineral soil removal near the bottom of the Sun Run/Spruce Trail is evident, likely as a means of preventing rock damage to grooming machines on these lower slopes. Previous reports also indicate that a significant amount of topsoil in the Big White village area has been either removed during construction or lost to surface erosion associated with road and infrastructure development (Klaus, 1995). The displacement and removal of mineral soil represents a concern which requires management attention.

Given that the predominantly shallow, rocky soils in the study area represent an obvious limiting factor for plant and tree growth, damage to or loss of these soils will negatively affect the fertility of the area and the ability to successfully replant. Vegetation

Based on the cursory field investigation and communication with the B.C. Conservation Data Centre, there are no known development constraints or particular concerns are associated with rare or endangered vegetation in the study area. Vegetation constraints relate to the habitat provided and the need to maintain biodiversity in the Big White Resort Area.

3.3.2 Wildlife and Wildlife Habitat

The expansion and development of Big White into a four-season destination resort will alter wildlife use of the area. The greatest modification of habitat use will likely be associated with changes in vegetative cover as a result of run cutting in areas used by wildlife for cover and forage. Clearing of habitats at the proposed golf course development site will displace wildlife species currently utilizing these habitats. Increased levels of human presence and recreational activity in the summer months may also affect the summer migration of a number of wildlife species, but particularly larger mammals such as grizzly bears. The highway presently appears to serve to delineate the boundary between the undisturbed Riparian Area / Wildlife Migration Corridor and Big White Ski Resort (GeoAlpine, 1996).

The number of wildlife species sighted reflects the intensity and timing of the field survey. Although, ESSFdc habitats are not generally considered to contain as high wildlife diversity as lower elevation biogeoclimatic zones, it is clear from the previous species discussions that large numbers of wildlife species may occur.

ESSFdc habitats supports few bird species, likely attributed to the lack of structural diversity of forested habitats.

Determining the direct and indirect impacts of the proposed ski facility expansion on resident and migratory wildlife species is constrained by the availability of accurate data on the extent of existing habitat alienation within similar habitat types throughout the region and the current and potential use of those habitats by wildlife. Furthermore, an equally important factor not considered in this review is the impact of recreational activities on wildlife, particularly during summer.

3.3.2.1 Birds

Modification and permanent removal of forest cover and understorey vegetation for Big White Ski Resort may have a positive or negative impact on bird communities. For example, the development of physical structures within the base area, will result in the permanent loss of forest cover and understorey vegetation and subsequent loss of use of these areas by birds. However, ski facility developments such as downhill runs, where some forest cover is removed, but vegetation, such as grasses and forbs, remain, may benefit other bird communities that are attracted to more open vegetation.

3.3.2.2 Rare and Endangered Species

Grizzly Bear

The Kettle-Granby grizzly bear population unit (GBPU), shown on Map 6, covers over 650,000 hectares and is estimated to support up to 87 individuals (FPB, 2017). Habitat effectiveness modeling conducted in 2005 (Gyug) finds that of the 3000 hectares of overlap between the proposed CRA expansion and the GBPU over 99% of that habitat is rated as “Low effectiveness” while less than 0.5% is rated as “Medium effectiveness”.

Recently a Grizzly Bear Wildlife Habitat Area (WHA) was authorized under the Forest and Range Practices Act within the existing CRA (Map 6). The “General Wildlife Measures” (GWM’s) of this WHA

are relevant to Big White Resort and Interfor (who owns the timber rights within the CRA), however they are not expected to be cumbersome. There are five GWM's described of which three should not have any effect on resort development:

1. Forest harvesting along avalanche tracks, that are at least 40 meters in width, will result in forest stands that are at least 15 meters in height for: 100 meters on one side of the avalanche track or 50 meters on both sides of the avalanche track.
2. Timber harvest and site preparation practices… will not inhibit *Vaccinium* spp productivity
3. Planting of tree seedlings in harvested riparian site series will result in stocking densities that are consistent with maintaining plant communities that produce bear forage. Areas that did not have forest cover before timber harvesting was carried out will not be subject to planting of trees

Two GWM's may have a small effect on resort development activities

1. No cutting of non-merchantable stems within 20 meters of main haul roads
2. Forest practices will result in at least 10% of each management unit containing forest stands that exhibit a height of at least 19.5 meters, in patches that are at least 5 hectares in size. Management units are defined as the area of each BEC subzone within each landscape unit.

Interpretation of these last two GWM's follows: The first impacting GWM (preventing cutting within 20 meters of main haul roads) is likely a measure instituted to maintain visual barriers for the bears to protect habitat. In the case of Big White Resort nearby high quality habitat is largely absent (Gyug 2005) except where created by clearing, and in the interest of reducing bear/human conflict it may be considered beneficial to allow clearing to the edge of main roads.

3.3.2.3 Valued Ecosystem Components

Valued Ecosystem Components within the Big White CRA, particularly in the proposed lift expansion area, include wildlife trees, wildlife movement corridors and riparian areas associated with identified watercourses.

Riparian Areas

Riparian areas within 30 meters of a permanent water course are subject to assessment in accordance with the Riparian Area Regulation (RAR) of the B.C. Fish Protection Act. Any intrusion in the resulting riparian setback contravene the BC *Riparian Protection Act*. Any disturbance within the top of bank for a watercourse may require permitting under Section 11 of the BC *Water Sustainability Act*, and/or approval under Section 35 (2) of the Federal *Fisheries Act*.

Wildlife Movement Corridors

Wildlife movement corridors are important for protection of wildlife populations in the area. While no corridors are designated, a number of corridor opportunities are identified and merit consideration for protection.

Wildlife Trees

Wildlife trees that contain dens or breeding cavities may be constraining to development during the breeding season of the animal. Song birds were evident visually and acoustically but are typically summer breeders and not permanent residents.

4 Mitigation Measures

4.1 Geology

Caution should be taken in locating ski runs and traffic areas below cliffs faces. The integrity of the rock mass should be assessed by trail crews and any concerns should be addressed by a professional engineer (P.Eng.). Geotechnical issues associated with potential development of the site should be addressed in the geotechnical report (Chiocca 2018).

Prompt revegetation of disturbed soils can mitigate surface erosion (section 4.7).

4.2 Hydrology

Visual inspections of the creek systems should be conducted by summer crews prior to the fall to monitor any accumulations of debris. Any wetlands encountered in the study area should be considered as constraining to development and avoided.

4.3 Aquatic Environment and Water Quality

The potential impacts to water quality from development within riparian areas can be minimized by avoiding contamination of the water courses during operation of the present ski resort and during any future development at Big White, through sound, environmentally prudent construction techniques, and by respecting appropriate buffer strips adjacent to Trapping, Whitefoot and Copperkettle Creeks, as well as their tributaries.

4.4 Terrestrial Environment

4.4.1 Soils

Sound forest harvesting practices, trail development practices, proper water management, and prompt revegetation of exposed soils will help to minimize surface erosion potential.

A comprehensive sediment and erosion plan for construction of the expansion area is included in this report as a mitigation measure to minimize sediment release into surrounding watercourses in the area.

Any issues associated with soils and potential development of the site are addressed in a separate geotechnical report (Chiocca 2018).

4.5 Vegetation

Large tree islands should be preserved between ski runs to provide adequate shelter for resident fauna and to prevent excessive windthrow. Larger tree islands will allow for preservation of standing wildlife snags while maintaining safe distances from ski runs, trails and roads.

As a result of the climatic constraints imposed on growth of vegetation, maximizing preservation of existing vegetation should always be a priority in development planning.

There are no constraints to development identified because of vegetation; however, veteran trees within the protected riparian setback may present safety concerns arising from windthrow potential.

4.6 Wildlife and Wildlife Habitat

4.6.1 Wildlife

Several benefits of habitat modification resulting from glading and thinning of trees and clearing of ski trails have been identified and generally pertain to opportunities for increasing the structural diversity of

forested habitats and providing an increase in foraging opportunities for species such as bears and ungulates. Additionally, opportunities may exist for enhancing habitats surrounding several existing or proposed developments including the creation of rock piles on the edge of ski runs. These rock piles were evident on several existing ski runs and are being used by such species as ground squirrels and marmots.

If, at any point during development, breeding areas are discovered, Best Management Practices (BMPs) should be adhered to.

If tree removal is anticipated during the nesting bird season of April 1 to August 31, a nest survey must be completed in the proposed clearing area. Discovery of active nests during surveys would impose development constraints until the chicks have fledged the nest ((*Wildlife Act*, 1996)).

4.6.2 Rare and Endangered Species

Grizzly Bear

If Big White determines that there is a desire to clear forest to the edge of a main road an exemption may be possible through the delegated decision maker (MOE regional manager). The second impacting GWM would only become an issue if any major clearing was to occur within the WHA. If clearing is planned a brief assessment would need to be conducted to ensure that impacts to mature forest do not exceed the allowable levels.

4.6.3 Valued Ecosystem Components

Riparian Areas

Any planned development requiring permitting within 30 m of a watercourse may require a Riparian Area Assessment conducted by a Qualified Environmental Professional. Protection of riparian vegetation buffers can mitigate delivery of eroded soil into watercourses.

Wildlife Movement Corridors

As planning for the expansion of the resort proceeds, design should consider maintaining and protecting wildlife movement corridor opportunities.

Cutting of ski runs and construction of ski lifts will be conducted in a timely manner as to not disrupt mapped wildlife corridor in the expansion area. This can also be mitigated by restricting human access to the areas during times of wildlife movement or occupation during sensitive seasons (i.e. rutting, calving).

Wildlife Trees

Wildlife trees that contain dens or breeding cavities and that pose a safety risk on the subject site may need to be removed outside of the breeding season.

Wildlife trees should be retained wherever possible. A Danger Tree Assessment of all wildlife trees in close proximity of development should be surveyed by certified Danger Tree Assessor for safety integrity too surrounding development

4.7 Sediment and Erosion Control

The objective of the Sediment and Erosion Control Plan is to minimize site erosion and protect downstream water quality and fish habitat during the construction and operation of the proposed Black Forest Connector and Backcountry chairlifts. The following describes the measures that will be used to minimize site erosion and the transport of sediments into streams. The effectiveness of the plan will be assessed on an ongoing basis through a water quality monitoring program, and modifications to the plan will be made as required.

4.7.1 Sediment Erosion Potential

Factors determining site-specific erosion potential include soil type, slope steepness, and length of slope. Table 10 and Table 11 illustrate the relationship between soil type and soil erodibility, as well as the effect of slope gradient and slope length on erosion potential.

Table 10: Comparison of Soil Types and the Potential Erodibility

Soil Type	Soil Erodibility
Heavy Clay	Low
Clay	Low
Silt clay	Medium
Sandy clay	Low
Silty clay loam	Medium
Clay loam	Medium
Sandy clay loam	Medium
Silty loam	High
Loam	High
Sandy loam	Medium
Silt	High
Loamy Sand	Low
Sand	Low

Table 11: Effect of Slope Gradient and Slope Length on Erosion Potential

Slope Gradient	Slope Length	Erosion Potential		
		Low	Medium	High
Gentle	Moderate	Low	Low	Moderate
	Long	Low	Moderate	High
Moderate	Moderate	Low	Moderate	High
	Long	Moderate	High	High
Steep	Moderate	Moderate	High	High
	Long	Moderate	High	High

*Notes: Slope Gradient; Gentle = 0-10%, Moderate = 10-15%, Steep = >15%
**Slope Length; Moderate = < 70 m, Long = > 70 m.

In general, erosion potential of the soil types expected on the subject site (Orthic Humo-Ferric Podzols) varies from low to medium (sandy loam to loamy sand) (SIFT, 2018). The erosion potential of all these soils increases with the steepness of the slope and the length of the exposed surface on which they occur. The average fall line gradient of the Backcountry Lift and ski slopes (Area A) is 22% and 16% for the Black Forest Connector (Area B) lift and ski slopes, generally steep slopes. The sediment and erosion control plan takes into account soil erodibility, slope length and slope steepness.

4.7.2 Sequence of Construction and Mitigation Measures

Map 8 provides a comprehensive view of the erosion and sediment control plan for the project. The Backcountry chairlift and ski runs are contained within one polygon, while the Black Forest Connector chairlift and ski runs comprise a second polygon. This section discusses the erosion control measures sized for each polygon. The erosion and sediment control plan summary (

Table 12) outlines specific mitigation measures to be undertaken during construction to minimize erosion and sediment transport. Also included in the plan are operation and maintenance measures to be undertaken during and after the project to ensure that the specific mitigation measures are effective.

The general approach of the erosion and sediment control plan is to 1) retain soils in place where possible by preventing erosion, 2) trap sediment as close to initiation as possible with sediment trapping devices such as check dams and silt barriers and 3) treatment of sediment-laden seepage prior to discharge to adjacent watercourses.

Table 12: Erosion and Sediment Control Plan

TASK	MITIGATION MEASURES	OPERATION & MAINTENANCE
General Construction	• Avoid disturbance to vegetation & soil, • Monitor weather forecasts daily and halt weather related work if heavy rain persists, • Provide silt barriers between creeks and area of disturbance (as shown on plan), • Install cut-off ditching as shown on plan, • Install check dams on cut-off ditches as required, • Collect and treat discharge from site with sediment control ponds.	• Inspect cut-off ditches, silt barriers, sediment check dams and sediment control ponds daily, • Repair silt barriers and remove and dispose of sediment trapped in check dams and ponds, • Monitor water quality of discharge from sediment control pond.
Works in and about Streams and Wetlands	• Work in isolation of stream flows • Avoid disturbance to vegetation & soil, • Monitor weather forecasts daily and halt weather related work if heavy rain persists, • Provide silt barriers between creeks and area of disturbance (if required), • Collect seepage in work areas and direct to sediment control ponds, • Cover disturbed areas adjacent to watercourses with polyethylene sheeting or straw mulch, until areas are revegetated. • Ensure that any riprap used is clean and free from deleterious substances. • Comply with stipulations in all permits and approvals.	• Monitor seepage control systems to ensure seepage flow containment. • Inspect silt barriers for damage and excessive sediment build-up, repair barriers and remove sediment as required. • Repair silt barriers and remove and dispose of sediment trapped in check dams and ponds, • Inspect polyethylene sheeting daily and repair as required.

4.7.3 Sedimentation Pond Requirements

A sedimentation pond will be constructed at the base of each of the proposed chairlift and ski areas to treat surfaces flows directed to the ponds. The sedimentation pond is designed to capture medium silt size sediment 0.02 mm diameter and larger.

Table 13 outlines the sedimentation pond design parameters, with Table 14 showing specific pond size.

Ditches directing water to the sedimentation pond are designed to carry a 2-year storm event, with pond discharge ditches designed to carry 100-year storm event flows. To simplify ditch construction, all ditches will be a minimum of 60 cm deep. This depth will provide passage of the above noted design events.

Table 13: Sedimentation Pond Design Parameters

Design Parameter	Value	Source Guideline*
Design Particle Side (medium Silt)	0.02 m	Land Development Guidelines (LDG)
Design Particle Settling Velocity (V_s)	2 X10^{-4} m/s	LDG
Design Flow (Q)	2-year Event	CERG/LDG
Design Settling Area (A=1.2Q/V_s)	142 m^2	LDG
Minimum Effective Flow Path Ratio (L/W)	5:1	LDG
Minimum Freeboard	0.3 m	LDG
Minimum Settling Depth Above Sediment	0.5 m	LDG
Minimum Sediment Storage Depth	0.5 m	LDG
Minimum Side Slopes	2H:1V	LDG
Emergency Spillway Capacity	Armored for 100-year Event	CERG/LDG/Puget Sound Manual

* Land Development Guidelines for the Protection of Aquatic Habitat (MoELP & DFO, 1993)
** Stormwater Management Manual for the Puget Sound Basin (Dept. of Ecology, State of Washington, 1991)

Table 14: Sediment Control Pond Dimensions

Construction Polygon	Design Flow (m^3/s)	Area (m^2)	Length (m)	Width (m)
Area A	2.809	1731	18.6	93.0
Area B	2.302	1418	16.8	84.2

The Backcountry ski area (Area A) is estimated to require a 1731 m^2 sediment detention pond and the Black Forest Connector ski are will require a 1481 m^2 sediment detention pond (

Table 14, Map 8). Cross ditches should be dug across each ski run every 50 m to a depth of 45 cm. The grade of each ditch should not exceed 8%. Side ditches will run to kickout that terminate at the exit of the cross ditches. New ditches will begin downslope of each kick-out (Map 8). This design is a guide and will require field fitting.

4.7.4 Sediment and Erosion Control Procedures during Construction

The following mitigation measures should be adopted to minimize soil erosion and impacts to water quality, fish and fish habitat downstream of construction. These measures are standard erosion control practices in British Columbia and are based on guidelines and recommendations from the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al., 1992) and Section 3 of Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia (MOE, 2014).

Soil exposed or stockpiled during land clearing activities is subject to erosion and transportation by water and wind. The amount of erosion shall be mitigated by proper planning of construction activities, covering

disturbed soils, re-vegetating slopes and by minimizing the amount of exposed soil available on site. The Contractor shall be responsible for the continued effectiveness, maintenance and stability of erosion control devices.

Exposed, erodible soils and stockpiled materials shall be protected from erosion by one or more of the following methods:

- Installation of perimeter silt fence.
- Grading to achieve low angle and less susceptible slopes.
- Surface roughening with machine tracks or woody debris.
- Covering with a suitable material such as polyethylene plastic liner, or geotextile.
- Installation of erosion bars, anchor logs, rip rap, rock check dams, water diversion structures, catch basins and settling ponds.
- Establishment of a temporary cover of vegetation.
- Application of a soil binding spray or mulch.
- Establishment of permanent vegetation.

4.7.5 Clearing, Grubbing and Stripping

Erosion and sedimentation processes during clearing, grubbing, and stripping of the ski run areas will be mitigated by employing best management practices as outlined below:

- The perimeter of the target forest polygon will be flagged out in the field, identifying the grubbing and stripping limits prior to the commencement of work to ensure that vegetation in adjoining areas is not disturbed.
- The grubbing and stripping of all soils shall be limited to that which is necessary for the construction of the ski runs and lift lines.
- Wherever practicable, cleared vegetation will retain a shrub layer.
- Grubbing must not proceed more than five days in advance of any subsequent activity without the installation of appropriate surface drainage control.
- Grubbing shall be suspended during and immediately after intense rainstorms that have resulted in excessive run-off. Intense rainstorms are defined as those predicted to have rainfall intensities greater than 50 cm/24 hours). The trail contractor is responsible for monitoring weather predictions.
- In areas that are temporarily disturbed by clearing and grubbing activities, the native topsoil and organic debris will be removed, separated, and stock piled onsite for future use in restoration efforts.

4.7.6 Operation and Maintenance

Typical operation and maintenance of erosion and sediment control measures are described

Table 12 of this plan. In addition to these measures, the following operation and maintenance activities should be planned for:

Surface Drainage Control

- Cross ditches should be dug every 50 m to a depth of 45 cm with the spoil pile forming the swale on the downhill ide of the ditch. Cross ditch gradients should not exceed 8%

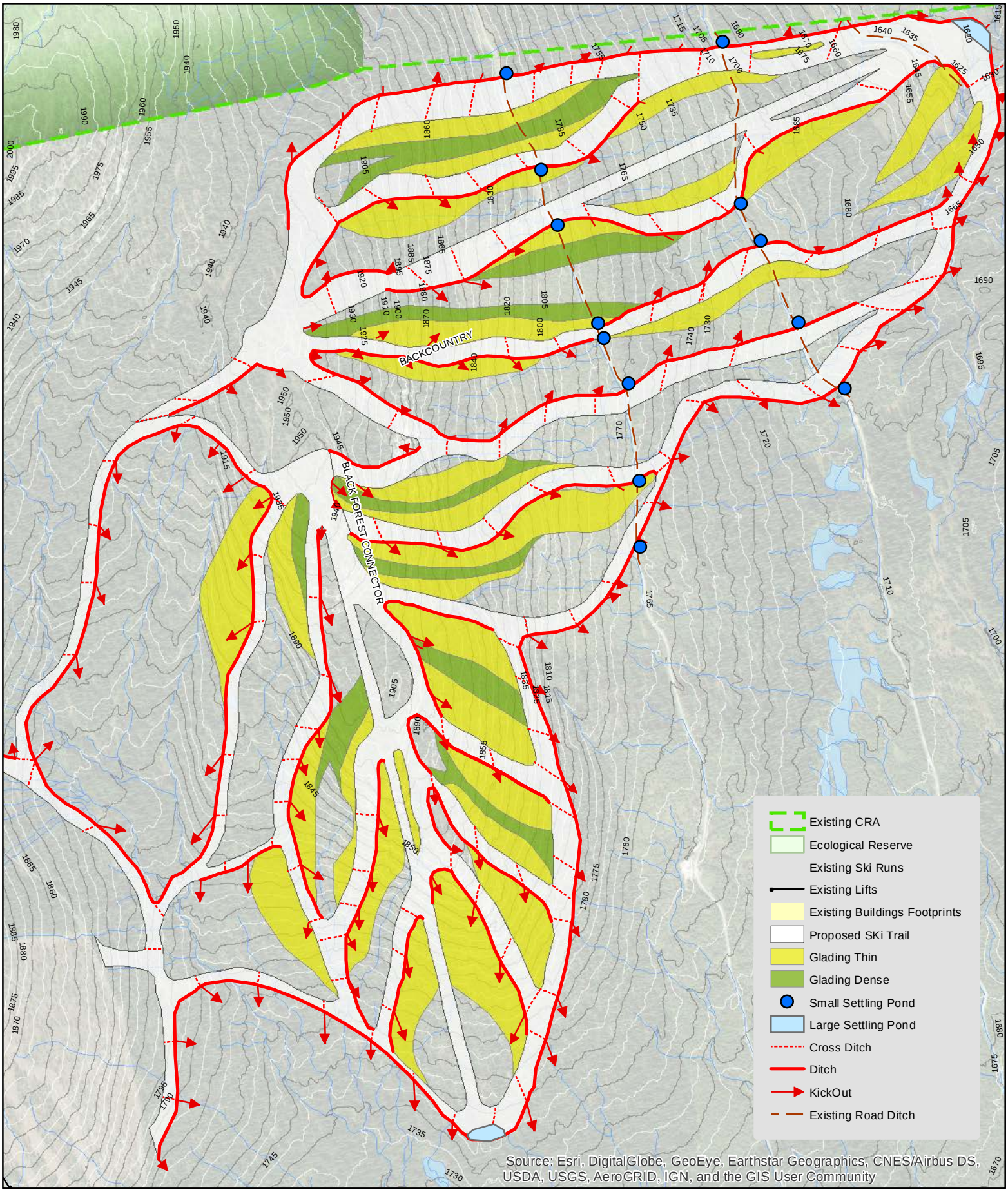
Ditches and Culverts

- Inspect erosion control and cut-off ditches and culverts daily for signs of wear, leakage, and infilling. Repair as required.

Sedimentation Ponds

- Inspect pond inlet and outlet for signs of plugging or other malfunction. Clear and repair as required.
- Remove sediment from pond if storage level exceeds design limits. Remove material to an approved disposal site.
- Inspect and repair pond side slopes and repair erosion protection as required.
- Inspect emergency overflow spillway and channel. Repair as required.

Operation and maintenance of environmental protection measures should be reviewed weekly to ensure compliance and allow for adjustment to maintenance procedures.



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Map 8 - Sediment and Erosion Control Plan

Big White. Kelowna
British Columbia

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7.2 SITKUM CONSULTING LIMITED – TERRAIN STABILITY ASSESSMENT

SCL 18-1449 September 27, 201 Big White Expansion

Terrain Assessment Summary Memo

Big White Ski Resort Backcountry and Black Forest Chair Expansion
Whitefoot Creek

A site assessment of the above listed area was completed by Olindo Chiocca P.Eng. accompanied by Ms. Heather Moore, Ski Patrol Centre Manager of Big White Ski Resort, on September 20, 2018. The purpose of the assessments was to review specific terrain concerns of the development immediately downslope of the proposed expansion towards Whitefoot Creek.

A preliminary office review was also completed by Mr. Wayne Miller, P.Geo. Eng.L. Engineering Geologist and Mr Olindo Chiocca, P.Eng. Geotechnical Engineer to determine areas requiring a field review

The area assessed was based on the 1:14,210 scale 'Lift Layout Ortho Map' and associated data provided by Cabin Forestry, dated August 29, 2018.

The discussions presented below are preliminary summarized descriptions of the field assessment and office review, are not expected to vary significantly from the detailed final TSA submitted by SCL. **Based on the site review and the discussions below, no changes to the proposed development boundaries and roads alignments assessed are anticipated.**

Taking into account the observations presented below, the likelihood of a drainage related downslope landslide is estimated as Low to Very Low. The likelihood is estimated as Low along the moderately steep to very steep gully sidewalls of Whitefoot Creek. The remainder of the development area is estimated to have a Very Low likelihood of a drainage related downslope landslide. These rating are based on the assumption that all recommendations presented in this memo along with generally accepted good development and maintenance practices are implemented.

Based on the office review by Mr. Wayne Miller, P.Geo., Eng.L of SCL, most of the development was located on benign terrain with a Very Low likelihood of slope instabilities. There were three terrain polygons mapped as potentially unstable located in the first lift run placement to the south but are more likely to be classified as stable (very low likelihood of a slope instability) due to the exposed bedrock and overall gentle to moderate gradient terrain with short (<20m) moderately steep bedrock controlled slopes.

The area above Whitefoot creek and downslope of the proposed ski lift station was targeted due to its adjacency to an area that was deemed and mapped as higher likelihood of landslides than Very Low. Terrain traversed included the gully sidewall of Whitefoot Creek, terrain in the vicinity of the proposed access road Cabin Option 1 (Spur 1), the existing road (Spur 2) and the un-named tributary of Whitefoot Creek (S5-1) immediately to the east of the development. Spur 1 was not ribboned in the field and its location was estimated in the field based on georeferenced mapping provided by Cabin. Refer to Figure 1 for the traverse route.

Terrain immediately upslope of Whitefoot Creek is mapped as P, potentially unstable. Whitefoot Creek is located 300 m to 500 m to the north of the development boundary. Refer to Figure 1.

The existing road, Spur 2 which accesses the northern end of the development was traversed by SCL. It is approximately 4 m to 5 m wide, in and out-sloped, and lightly overgrown with a ditchline and numerous crossditches and or waterbars. The crossditches/waterbars are in variable states of repair, some are shallow and worn and many are not deep enough to drain the ditch run. The proposed future use for this road was unknown at the time of the assessment by SCL. Based on its location along the lower end of the development, Spur 2 directs and controls the volume and direction of surface water drainage from the development towards the downslope terrain, which is described below.

Terrain to the north of the development, below Spur 2, for approximately 200 m to 250 m, prior to the Whitefoot Creek gully sidewall slope break consists of slightly irregular broken terrain with lateral swales, gullies and local high points. Slope gradients are flat to moderate and typically <25% with isolated, rare areas up to 45%, but these areas are generally less than 25 m in slope length. A significant portion of this area has been previously harvested.

Surficial material consists of a predominantly well to moderately well drained till comprised of a gravelly sand with a trace of silt, cobbles and boulders with a coarse fragment content of 35%. Areas of imperfect to very poorly drained soils were observed along flat terrain (<10%), consisting of shallow standing water and mud located within a local depression (bog).

Two streams observed in the vicinity of the bog; one within a broad swale with a 1.2 m wide mud and gravel channel and gradient of 25%. The other stream has a 30 cm wide channel and empties into the bog area (described above).

Surface water drainage from the development in some cases may not run directly towards the northeast and Whitefoot Creek uninterrupted due to numerous cross-slope drainage features and localized high points.

The currently proposed alignment of Spur 1 is situated along uniform to slightly irregular, flat to moderately sloped terrain , typical of 5% to 25%, but ranging from 0% to 45%. Based on terrain in the immediate vicinity and LiDAR mapping, the steeper sections are infrequent and short (<25m.). Surficial material is generally well drained, but areas of imperfect to poor drainage were observed adjacent to the alignment in some areas, as mentioned above.

Stream S5-1 is located just to the east of the development. At approximately 1630 m in elevation the stream is situated within a well-defined gully with sidewalls 5-7 m long with slope gradients of 55%. The channel consists of cobbles and boulders with a step pool morphology, some woody debris and a channel gradient of 15%. The gully becomes more incised and the channel gradient increases with the loss of elevation with a channel gradient of 40% below 1580 m in elevation. A debris slide impacting the creek at lower elevations has the potential to develop into a channelized debris flow and impact Whitefoot Creek.

Downslope of the gully sidewall slope break, terrain is slightly irregular to irregular with some gullies and a convex downslope configuration. Slope gradients break towards Whitefoot Creek from approximately 45% to up to 90%, creating a gentle over steep terrain scenario in some instances. Surficial material in the areas traversed is moderately well to well drained with a texture similar to that described above.

Whitefoot Creek is confined within a broad, well-defined gully with moderate to moderately steep sidewalls. Based on TRIM, the channel gradient averages 10% for the approximately 6 km downstream to the confluence with Damfino Creek.

Based on SCL Report dated December 9, 2015, a debris slide was observed along the south aspect gully sidewall of Whitefoot Creek. The slide was located… *'immediately downslope of the culvert at Hub 66 of existing Copperkettle FSR. The cause was likely road drainage related but could not be confirmed as the road appears to have been relocated since the slide occurred. This slide is approximately 100 m long and did not impact Whitefoot Creek directly. A GE review indicates that yet another slide may have occurred a further 600 m up Copperkettle FSR and 60 m below the road which does appear to have deposited material in Whitefoot Creek. This slide was not confirmed in the field.'* Refer to Figure 1.

Based on the December, 2015 SCL report, soil and terrain conditions along the south aspect gully sidewall are similar to those observed by SCL in 2018 along the north aspect slopes and may have similar sensitivities to redirected water and the potential for downslope instabilities. There also appears to be possible undercutting by Whitefoot Creek along the slope toe of the north aspect slopes as observed on Google Earth orthomosaic imagery.

General Recommendations:

Recommendations which have been presented in this summary are in addition to the generally accepted good development practices and careful drainage management. Based upon the layout and design provided to SCL by Big White and CFS the recommendations within this memo are not expected to differ from the the final geotechnical stability report

Spur 2

If the existing road ***is not to*** be used for accessing the development during construction or during the ski hills seasonal operations

- pull back and fully re contour the road to the natural state of the surrounding terrain, or
- improve all the crossditches by increasing their depth to ensure that they capture water within the ditch and discharge it downslope. Armour the downslope outlets of the cross-ditches.

If the existing road ***is to be*** used for accessing the development during construction or during the ski hills seasonal operations,

- grade and crown the road;
- remove all existing crossditches and replace with appropriately sized and spaced culverts as recommended by a qualified professional[1] in order to reduce the risk of water concentration downslope.

Cabin Option 1 Road (Spur 1)

- Install frequently spaced and adequately sized culverts along the proposed road alignment as recommended by a qualified professional[1] in order to reduce the risk of water concentration downslope. The proposed culverts should align with the upslope crossditches or culverts located along Spur 2.
- Particular attention should be paid to avoid redirecting water towards the slope break along the northern end of the development. Although terrain within this area is flat to

[1] A qualified professional may include a registered forest technologist with experience in road drainage layout, Registered Professional Forester with similar qualifications (Cabin Forestry staff likely would have someone) or a P.Geo/P.Eng.

gentle, the isolated areas of sensitive, imperfect to poorly drained soil may result in machine rutting and water concentration.

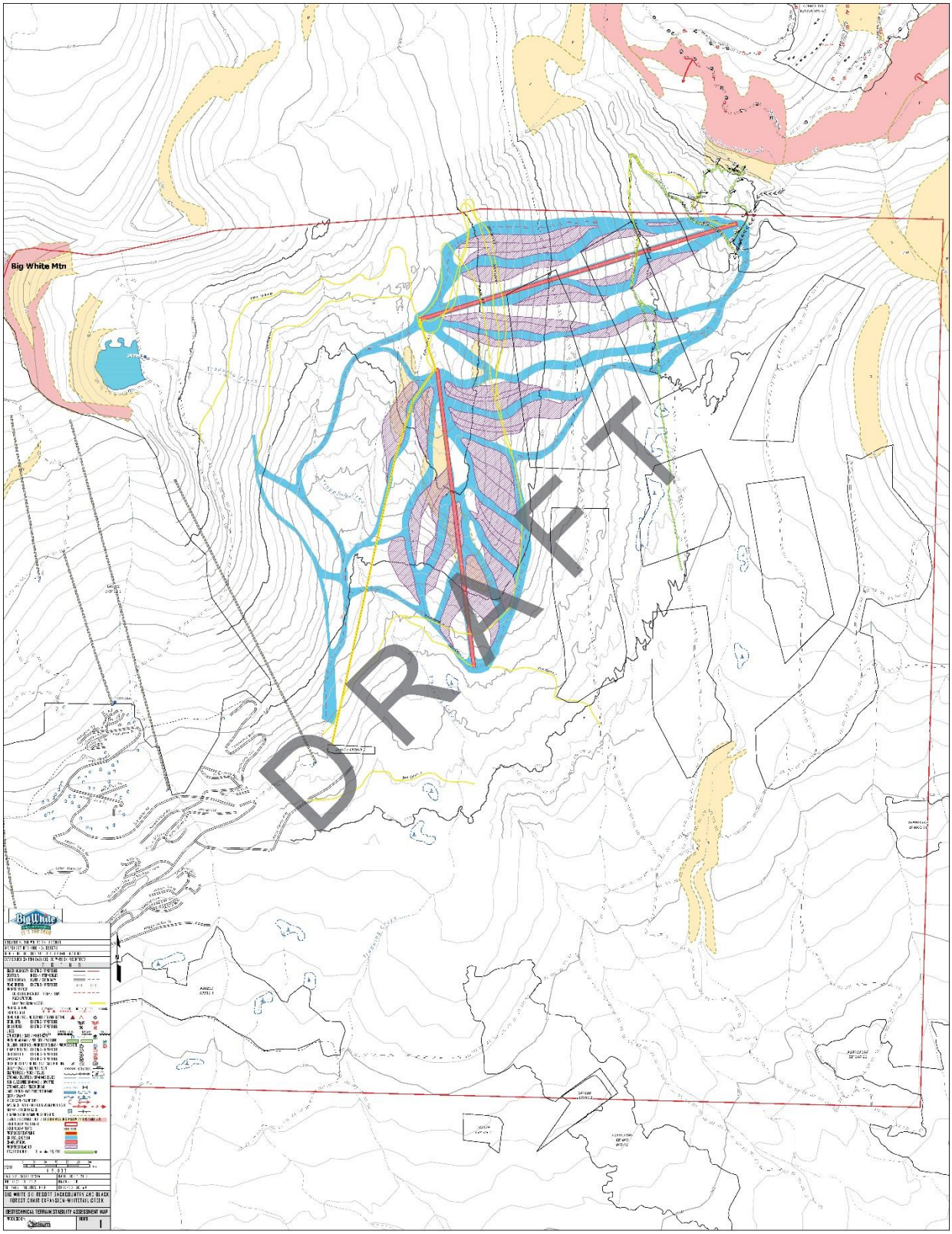
All existing and proposed road and trail drainage systems should be maintained and kept clear of debris during and subsequent to development operations, including at and downslope of culvert or crossditch discharge locations.

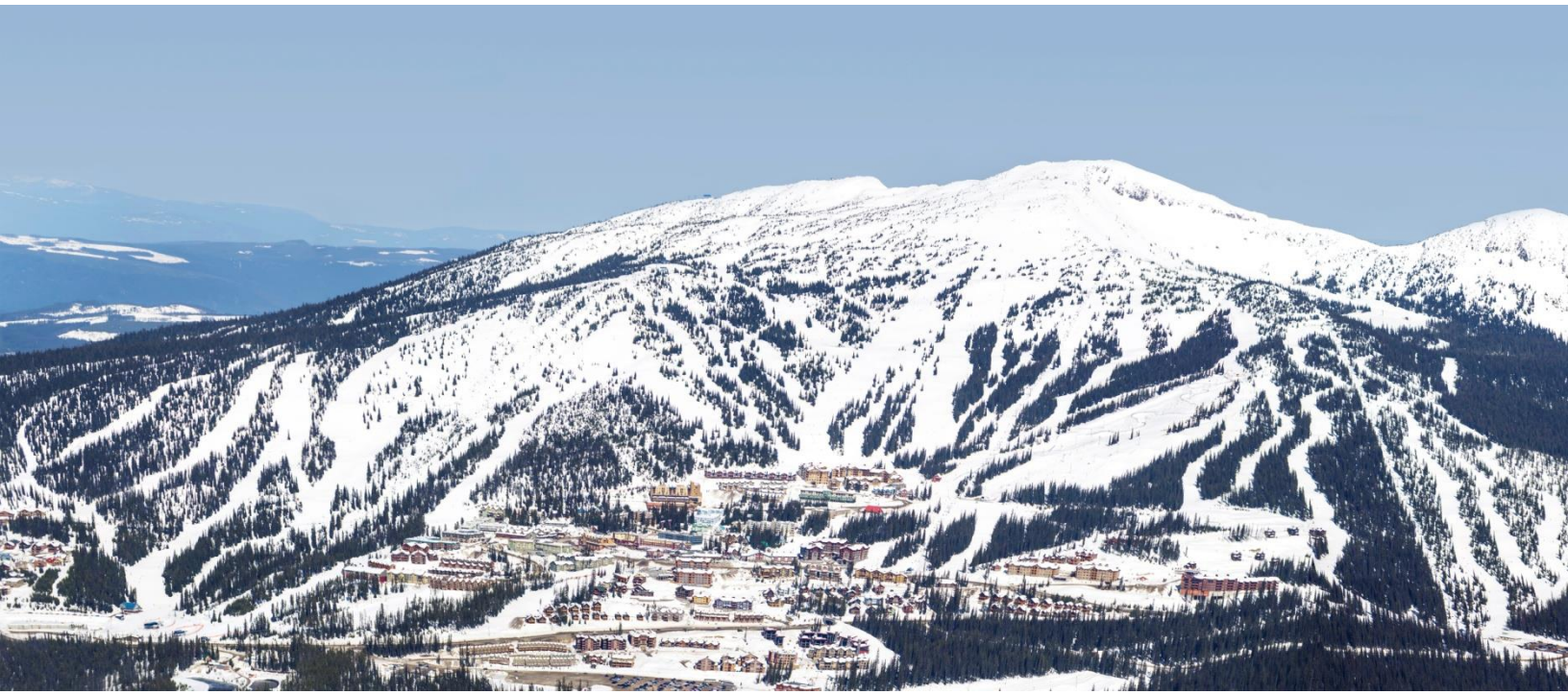
Drainage structures on both roads should be inspected seasonally during the spring freshet to ensure all drainage structures are operating as intended.

I hope this information is sufficient for the time being. If you have any question or would like to discuss this memo, do not hesitate to call.

Regards,

Olindo R. Chiocca P.Eng.
C 250 551-5734


Big White Mtn
DRAFT



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