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Wildlife Corridors for Smith Creek: An Evaluation

Submitted to:
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REPORT

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDIX A

1.0 INTRODUCTION

The Bow Valley from the Town of Banff to where the Bow River exits the mountains east of Canmore is a key component of Alberta's Rocky Mountain ecosystem. It is generally a wide, low-elevation valley that supports a diverse array of wildlife, including a number of iconic large mammals such as grizzly bears, wolves, elk, and cougars. Along with its considerable ecological importance, the Bow Valley provides substantial socio-economic value for Albertans. Tourism and recreation have been prevalent in the Bow Valley at least since Banff National Park was established in 1885, and the valley has become one of the most desirable locations in Alberta for people to work, live and play.

Because of high demand by people for property to use in conjunction with the considerable recreational opportunities available in the Bow Valley, residential and commercial development has been growing, especially in the Town of Canmore. In 1992 the Natural Resources Conservation Board (NRCB) granted approval to redevelop the former coal mining lands, which included both open pit and underground operations, now known as the Three Sisters Mountain Village (TSMV) properties in south-east Canmore (NRCB#9103-1992 Approval No.3; hereafter referred to as NRCB 1992). The NRCB approval permitted development of recreational opportunities such as golf courses or trails, hotels, public spaces, residential neighbourhoods, plus local and tourist orientated commercial infrastructure on TSMV properties.

Although development had been given approval, the NRCB placed conditions on the approval, including a provision that wildlife corridors be maintained around or through development property to facilitate wildlife movement and reduce the overall environmental impacts of the project. Specifically, Clause 14 of Appendix C in the 1992 NRCB Decision states:

> *"Three Sisters shall incorporate into its detailed design, provision for wildlife movement corridors in as undeveloped a state as possible, and prepare a wildlife aversive conditioning plan, both satisfactory to Alberta Forestry, Lands and Wildlife."*

From 1992 through to 2008 development of Three Sisters proceeded in stages. The Province and Three Sisters worked diligently to designate and protect wildlife corridors on TSMV property and on Crown land and much of the wildlife corridor network in the vicinity of TSMV has been finalized. However, designated wildlife corridors in the vicinity of the eastern portion of TSMV property have not been defined to date.

In 2015, QuantumPlace Developments (QPD) was retained by the Three Sisters Mountain Village Properties Ltd. to develop Area Structure Plans (ASPs) for the undeveloped portions of TSMV property. In collaboration with the Town of Canmore, QPD is developing an ASP for what is known as Smith Creek. The Smith Creek ASP includes TSMV properties formerly known as Sites 7, 8, and 9, for which only a partially complete wildlife corridor was formally approved in 1998 south of Sites 7 and 8. Although substantial studies have occurred and proposed wildlife corridors have been discussed, the final link to Wind Valley and the G8 wildlife underpass on the TransCanada Highway has not been approved to date in any form.

Prior to development in the Smith Creek ASP proceeding, Alberta Environment and Parks (AEP) must approve a wildlife corridor that completes the connection between the current approved Along Valley Corridor and the Wind Valley Habitat Patch. The boundaries of this wildlife corridor will define areas available for development as part of the Smith Creek ASP as its delineation and mitigations reviewed herein preclude the need for any additional "buffers" adjacent to the corridors.

In collaboration with stakeholders, feedback from open houses, input from a local community advisory group, and incorporating input from a variety of sources, TSMV (through QPD) has developed a wildlife corridor proposal to compete the wildlife corridor network in south Canmore in the vicinity of TSMV properties. Golder Associates Ltd. (Golder) was retained by QPD on behalf of TSMV to prepare an evaluation of the efficacy of the proposed wildlife corridors. The purpose of Golder's evaluation is to provide QPD, TSMV, and the Province with an understanding of whether the proposed corridors are likely to support wildlife movement. The evaluation is based on the 1992 NRCB decision, available science and site specific field work by Golder and others and is intended to be submitted along with the wildlife corridor proposal to AEP for their consideration and to help inform their decision.

This document presents Golder's evaluation of the wildlife corridors proposed by TSMV. After these introductory materials, the evaluation is structured as follows:

- **Section 2: Wildlife Corridors and the 1992 NRCB Decision** – This section provides a brief history of the 1992 NRCB decision and describes the requirements for wildlife corridors as a result of that decision. This section also outlines what is required to complete the wildlife corridor network in the south Canmore region by TSMV and meet the requirements of the 1992 NRCB Decision.
- **Section 3: Corridor Proposal** – This section presents TSMV's wildlife corridor proposal and explains how TSMV developed the proposed corridor alignment.
- **Section 4: Corridor Evaluation** – This section presents the methods and results of Golder's evaluation of TSMV's wildlife corridor proposal.
- **Section 5: Additional Considerations** – This section presents some additional considerations that are not part of AEP's mandate to define the spatial boundaries of the wildlife corridor, but are nevertheless related to
- corridor function. Additional considerations include mitigations that can be applied to increase the probability that wildlife will use corridors and reduce the probability of negative interactions between wildlife and people.
- **Section 6: Conclusions** – This section presents an overall summary and conclusions of Golder's evaluation.

2.0 WILDLIFE CORRIDORS AND THE 1992 NRCB DECISION

This section presents background information about wildlife corridors in the Bow Valley and the 1992 NRCB decision, providing important context for Golder's wildlife corridor evaluation. The section begins by describing the importance of habitat connectivity in the Bow Valley and identifying wildlife corridors and habitat patches that have been formally designated prior to 2016. Next, the requirements of the NRCB for wildlife corridors associated with TSMV are described. The requirements of the NRCB represent the only legal criteria for wildlife corridors with respect to TSMV. Finally, development and wildlife corridor designation on TSMV property is discussed and the areas for which wildlife corridor designation is still required are presented.

2.1 Wildlife Corridors and Habitat Connectivity in the Bow Valley

The Bow Valley from the Town of Banff to where the Bow River exits the mountains east of Canmore is an important component of Alberta's Rocky Mountain ecosystem. This generally wide, low-elevation valley provides essential winter habitat for deer (*Odocoileus species*), elk (*Cervus elaphus*), and bighorn sheep (*Ovis canadensis*), and supports large carnivores such as wolves (*Canis lupus*) and cougars (*Puma concolor*) that rely on these prey species. During spring through fall, the Bow Valley also contains high-quality habitat for black bears (*Ursus americanus*) and grizzly bears (*Ursus arctos*). In addition to supporting iconic large mammals, the Bow Valley maintains a diverse array of medium and small-sized mammals, along with a variety of birds, amphibians and fish.

Indeed, with the exception of extirpated bison (*Bison bison*), the Bow Valley is home to a full assemblage of native species (White et al. 2007).

In recognition of its ecological importance and natural beauty, much of the Bow Valley and the mountain ranges to the north, south, and west are protected by provincial and federal legislation. The western portion of the Bow Valley falls within Banff National Park and so is conserved under the Canada National Parks Act. East of the Banff National Park boundary, substantial portions of the Bow Valley and adjacent mountain valleys are protected by the Province of Alberta within a network of Provincial Parks and Protected Areas, including Bow Valley Wildland Provincial Park, Don Getty Wildland Provincial Park, Canmore Nordic Centre Provincial Park, Bow Valley Provincial Park and Spray Valley Provincial Park. South of the Bow Valley, these parks fall within Improvement District #5 (Kananaskis Country).

In addition to its ecological value, the remarkable biodiversity and the natural splendour of the mountain landscape means that the Bow Valley also holds substantial value for people. Tourism and recreation have been prevalent in the Bow Valley since Banff National Park was established in 1885. As a result of its immense popularity, Banff is among the most frequently visited national parks in the world (Banff-Bow Valley Study 1996). The park is accessed by the Trans-Canada Highway, which bisects the Bow Valley along its length. Historically, the Bow Valley east of Banff National Park around the Town of Canmore was used extensively for logging and coal mining, but by 1979 low demand for coal caused the mines to close. After hosting the Nordic events during the 1988 Winter Olympics, Canmore's economy shifted away from resource extraction and became firmly entrenched in tourism and recreation.

Canmore's position at the gateway of Banff National Park, combined with scenic mountain views, excellent opportunities for outdoor recreation and close proximity to the City of Calgary (current population >1.2 million), make it a desirable location for people to work, live and play. In addition to construction of new golf courses, residential areas, hotels, commercial and industrial areas and public infrastructure, Canmore's population more than doubled between 1993 and 2014, increasing from 6,621 to 13,077 permanent residents in 2014. The population count increases to over 17,000 when non-permanent second home owners are included (Town of Canmore 2014).

Human development can negatively impact the ecological function of landscapes, and development interests are not always compatible with maintaining viable ecosystems (Hilty et al. 2006). Roads and buildings reduce habitat quality for many species and can impede wildlife movement (Huck et al. 2010). Without effective movement corridors, wildlife populations can become isolated, potentially creating genetic bottlenecks and reducing population viability (Fahrig and Merriam 1985). Existing developments in the Bow Valley include the Trans-Canada Highway, which is fenced to reduce vehicle-wildlife collisions to the east and west of Canmore, although the highway is not fenced within Canmore itself, the Canadian Pacific Railway, and the towns of Canmore and Banff. These developments already reduce habitat quality and/or increase mortality risk for many wildlife species and also present potential obstacles to wildlife movement. Consequently, human development must be carefully managed in the Bow Valley to maintain the area's ecological integrity.

Within the Bow Valley, development is permitted only on approved development properties. Even where development is permitted, substantial consideration has been given to ecological integrity, particularly with respect to wildlife. As development in the Bow Valley began to progress rapidly during the 1990s, a number of habitat patches were identified and set aside to provide for the needs of a variety of wildlife species (BCEAG 1999a). There also was clear recognition that to be effective, these habitat patches must be linked to one another so that wildlife could move freely between them (BCEAG 1999a). This is especially true for large mammals, for which several habitat patches in the Bow Valley are too small to meet all of an individual animal's requirements (BCEAG 1999a), and population viability depends on connectivity among patches (Weaver et al. 1996). Consequently, a

network of corridors and highway crossing structures was developed to link disparate habitat patches to one another.

The wildlife corridor network in the Bow Valley is nearly complete. However, wildlife corridors have yet to be formally designated on the south side of the Trans-Canada Highway near the Wind Valley. This is the same area where Three Sisters Mountain Village Properties Ltd. (TSMVPC) owns property which was approved for development by the NRCB in 1992. Linkages between the Wind Valley Habitat Patch and other habitat patches in the Bow Valley will not be secure until approved wildlife corridors are identified and protected in this region. Specifically, linkages between the approved portion of the Along Valley Corridor and the Wind Valley Habitat Patch and between the Bow Flats Habitat Patch and the Wind Valley Habitat Patch via the G8 Legacy Underpass (which permits wildlife passage under the Trans-Canada Highway) will be necessary to ensure connectivity among habitat patches in the Bow Valley.

Notably, under the NRCB Decision #9103, TSMV is only required to link to Wind Valley because they do not own property leading to the recent G8 Underpass, and no land affected by NRCB decision is east of George Biggy Sr. Road. The linkage between the Wind Valley and the G8 Underpass is a Provincial responsibility because the corridor will occur on Crown land. However, a proposal for a wildlife corridor that connects the Wind Valley Habitat Patch with the G8 Underpass on Provincial land and a proposed Along Valley Corridor are included together in this application because the addition of corridors on Provincial land will ensure the continuity of corridors on lands adjacent to TSMV, as recommended in the 1992 NRCB Decision (NRCB 1992, p.10-38, 10-51)

2.2 The 1992 NRCB Decision and Requirements for Wildlife Corridors on TSMV Properties

In the late 1980s, Three Sisters Golf Resorts Inc. acquired lands in the Bow Valley south of the Bow River for development purposes. Much of the land acquired by Three Sisters had ecological value, and in 1994 Three Sisters signed a land exchange agreement with the Province, relinquishing 1,330 acres of sensitive wildlife lands in the Wind Valley and Wind Ridge areas. In 1991, the Province approved an annexation order and the Town of Canmore annexed 13,318 acres including most of the Three Sisters lands from the Municipal District of Bighorn and Improvement Districts 5 and 8.

In late 1991, Three Sisters submitted an application to the Province for a recreation and tourism project to redevelop the former coal mining lands which included both open pit and underground operations in the Bow Valley. In 1992, after completion of a detailed full environmental impact assessment, extensive public hearings and balancing economic and technical considerations, the NRCB granted approval to Three Sisters to develop their lands with the exception of Wind Valley (NRCB 1992). In addition to golf courses, trails and other recreational amenities, the approval permitted residential development and supporting local and tourist oriented commercial infrastructure. In its decision, the NRCB was keenly aware that human development had the potential to disrupt wildlife populations and ecosystem function, and the approval for development was balanced with conditions designed to protect wildlife.

Importantly, the portion of the initial application requesting development of the Three Sisters property in the lower portion of the Wind Valley was denied, and a subsequent land exchange agreement in 1994 saw Three Sisters transfer another 525 acres in the Wind Valley to the Province. On the remaining lands approved for development, the economic and social benefits of the project were deemed sufficiently great that the development of Three Sisters property remained in the public's interest despite potential environmental impacts (NRCB 1992).

Although development had been given approval, the NRCB placed conditions on the approval, including a provision that wildlife corridors be maintained around or through development property to facilitate wildlife movement and reduce the overall environmental impacts of the project. Specifically, Clause 14 of Appendix C in the 1992 NRCB Decision states:

> *"Three Sisters shall incorporate into its detailed design, provision for wildlife movement corridors in as undeveloped a state as possible, and prepare a wildlife aversive conditioning plan, both satisfactory to Alberta Forestry, Lands and Wildlife."*

Alberta Forestry, Lands and Wildlife is no longer a named branch of government in Alberta, and decision making authority with respect to Clause 14 now rests with Alberta Environment and Parks (AEP). It is important to note that the NRCB decided that development should proceed because the overall benefits were balanced with potential impacts. Accordingly, the NRCB did not require that wildlife corridors overrule all other considerations, but must be integrated with other aspects of the approved development, like the feasibility of development.

Because TSMV is an approved development and the statutory document governing its implementation is the November 1992 NRCB Decision Report, decision making concerning wildlife corridors with respect to TSMV must take direction from that document. Both TSMV and the Province (AEP) have confirmed that the 1992 NRCB Decision Report, which required wildlife corridor designation prior to TSMV development, constitutes the basis for decision making with respect to the wildlife corridor proposal submitted by TSMV to AEP and also confirmed that BCEAG Guidelines are explicitly not applicable to TSMV.

The NRCB (1992) clearly recognizes the importance of wildlife corridors by imposing conditions on development by TSMV which require the approval of wildlife corridors by AEP. The NRCB (1992) makes clear that the primary purpose of wildlife movement corridors is to ensure that development will not prevent animals from moving between habitat patches within the Bow Valley or at broader regional scales. Specifically, the NRCB requires the following with respect to corridors:

- corridor designation should occur at a regional scale and corridors on private and provincial lands must be linked (NRCB 1992 pp. 10-38);
- primary wildlife corridors should not be narrower than 350 m, except under unusual circumstances (NRCB 1992 pp. 10-38);
- width and location of corridors should be reviewed with the full range of wildlife species expected to use them in mind (NRCB 1992 pp. 10-38);
- roads, pathways and utility lines should be bundled (i.e., cross corridors in the same place) to minimize corridor fragmentation (NRCB 1992 pp. 10-38);
- corridors should correspond with known movement routes of animals (NRCB 1992 pp. 10-38); and
- wildlife corridors should be legally designated by the Province (NRCB 1992 pp. 10-38).

The criteria listed above are the only criteria identified by the NRCB (1992) for wildlife corridor designation with respect to TSMV. They are the requirements that must be met for corridor designation, although the developer may propose corridors that exceed these requirements. Other criteria for corridor designation have been developed by the Bow Corridor Ecosystem Advisory Group (BCEAG). However, these criteria explicitly do not apply to TSMV (BCEAG 1999a, 2012).

After publication of the Golder (2002) report and the Regional Wildlife Corridor Study (2002), TSMV again was under public pressure to respond, which it did. In a letter dated April 6, 2004 (Appendix A), the NRCB wrote TSMV developers to inform them that the Board was "satisfied that the progress made toward the establishment of wildlife corridors within the Three Sister's lands is consistent with the provisions of NRCB Approval". Corridor designation continues to be a significant issue generating substantial debate in the Bow Corridor.

2.3 Wildlife Corridor Designation and Development on TSMV Property

Formal wildlife corridor designation was an important component of TSMV development from the moment the project was approved by the NRCB (1992, Clause 14), and the Board decision dictated that development must accommodate wildlife corridors in as undeveloped a state as possible. However, other than general guidelines described above, the NRCB decision did not provide specific direction for corridor design or placement. This vagueness would create challenges for both developers and environmental organizations and become the source of substantial controversy and disagreement (Kennett 2005).

In 1998, a primary wildlife corridor known as the 'Along Valley Corridor' was approved by the Province. Portions of the primary corridor were protected with conservation easements on TSMV and other private property. The Stewart Creek and Tipple Across Valley Corridors were also formally designated at that time. The Stewart Creek Across Valley corridor has since been amended to center on the wildlife underpass at the Trans-Canada Highway.

In 1995, the Bow Corridor Ecosystem Advisory Group (BCEAG) was established and immediately set about looking into their recommendations for appropriate locations and designs of wildlife movement corridors in the Bow Valley. The approach taken by the BCEAG was to review scientific literature and evaluate results of local research (primarily on large carnivores) in order to come up with a better understanding of parameters for effective corridors. In 1997, the BCEAG published the first version of their recommendations, *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley,* which was followed shortly after by updated versions in 1998 and 1999. The intent of this document was to establish recommendations that might be followed to aid wildlife corridor design. BCEAG guidelines dictate that primary wildlife corridors must be a minimum of 350 m wide, between 1 km and 8 km long, consist of slopes <25˚, maintain effective hiding cover of >40%, and have no human use. As suggested in the title, the document also described the attributes of habitat patches and provides a framework for developing a network of patches linked by corridors to ensure the needs of wildlife in the Bow Valley are protected in perpetuity. These criteria were used to produce a map identifying regional and local habitat patches and a series of connecting movement corridors in the Bow Valley (BCEAG 1999); however BCEAG guidelines are specifically and explicitly exempted from applying to NRCB approved projects like TSMV.

In 2002, the Province and TSMV agreed upon the Along Valley Corridor location adjacent to Resort Centre based on Golder (2002). This was a "desk-top" study, and although some of its recommendations differed from BCEAG guidelines, criteria for corridor efficacy such as slope and hiding cover were derived from them and not from new information sources (Golder 2002). In addition, the recommendations in Golder (2002) were expressly developed for TSMV lands designated DC sites 1 and 3 and district R and were not meant to be applied elsewhere.

In November of the same year, the Regional Wildlife Corridor Study (2002) was released. This study, based on wildlife occurrence data including backtracking, pellet count, track pad and TransCanada Highway mortality data, delineated a proposed corridor connecting the Wind Valley Habitat Patch to the Along the Valley Corridor and the Bow Valley Habitat Patch east of the approved Along Valley Corridor. The 2002 proposed corridor resulted in a disconnect with the approved Along Valley Corridor because the approved and proposed corridors did not align along their northern boundary. The proposed corridor was placed almost entirely on TSMV land and although this

corridor did not receive official designation, it is often depicted on maps as if this were the case (e.g., Heuer and Lee 2010).

As directed by the NRCB, there is a requirement to identify and designate a wildlife movement corridor (or series of corridors) to ensure that wildlife movement along on the south side of the Bow Valley is retained. On the current landscape, this means connecting the eastern end of the approved Along Valley Corridor to the Wind Valley Habitat Patch and the Bow Flats Habitat Patch to the Wind Valley Habitat Patch via the G8 Legacy Underpass.

3.0 CORRIDOR PROPOSAL

3.1 How was the Corridor Alignment Determined?

A corridor proposal was developed by TSMV and their team using input from professional biologists, Provincial input, input from Canmore stakeholders, and considering physical or topological constraints to meet the requirements of the 1992 NRCB decision. Other than providing some advice about corridor design principles, Golder was not involved in delineating the proposed wildlife corridor, but was instead retained by QPD to evaluate the final wildlife corridor proposal that TSMV would present to AEP. The manner in which the corridor alignment proposed by TSMV was determined is described in the following paragraphs.

TSMV recognizes that designing and evaluating wildlife corridors can be challenging. Wildlife corridors must not simply be “plunked down willy-nilly on landscapes that have already been carved up for other purposes” (Chetkiewicz et al. 2006, 318). This does not mean that corridors cannot be designed in ways that accommodate development interests, but points instead to the importance of careful planning to ensure that when corridors are defined on a landscape, they will fulfill their intended purpose.

TSMV also recognizes that available expert opinion and science about what constitutes a functional wildlife corridor in the Bow Valley varies widely. For example, corridor topography has received much attention in the Bow Valley, and some documents suggest that slopes >25° render corridors less effective (BCEAG 1999a). Although particular species may show preferences for flatter terrain, wildlife movement does occur on steeper slopes. For example, Chetkiewicz and Boyce (2009) identified multi-species least-cost movement routes upslope from currently designated wildlife corridors on TSMV lands, with substantial portions of these paths crossing slopes >25°.

Similarly, data are sometimes lacking to clearly define some attributes of effective corridors. For example, multi-species corridor widths of 350 m (NRCB 1992, BCEAG 1999a, BCEAG 2012) and 635 m (Golder 2002) have variously been recommended for the Bow Valley. However, neither prescription for effective width carries more scientific merit than the other, and narrower corridors are used by a diverse array of wildlife, including large carnivores in the Bow Valley (Golder 2002). The original 350 m corridor width prescription of the BCEAG 1999a guidelines were upheld by BCEAG 2012, not because scientific support for a 350 m cut-off was found, but because little evidence to either support or refute this cut-off was identified. Because experts may disagree, setting minimum corridor width where expert opinion is applied remains an important challenge for land managers (Beier et al. 2008).

Recognizing this complexity, TSMV (through QPD) engaged the community in Canmore to provide input into the design of the Smith Creek ASP including helping to define the wildlife corridor boundaries taking into account balancing wildlife needs with other factors. The community engagement focused on input into a corridor design that balanced the needs of the community, the planning and servicing requirements of the Town, the needs of

wildlife for movement as per NRCB decision, and the requirement to have an economically feasible development. Engagement included a community advisory group (CAG) that included the following members:

- Wanda Bogdane (Canmore resident with a strong interest in recreation and wildlife);
- Kyla Conner (Canmore resident with a strong interest in affordable housing and families);
- Ken Davies (Canmore resident with a strong interest in recreation);
- Pat Kamenka (Canmore resident with a strong interest in wildlife and has tracked wildlife and hiked TSMV lands for years);
- Sean Krausert (Town Councillor);
- Paul Lessard (Canmore resident with a strong interest in business and the environment);
- Andrew Nickerson (Canmore Business and Tourism); and
- Karsten Heuer[1] (Canmore resident with a strong interest in wildlife).

In addition, Chris Ollenberger (TSMV representative), Jessica Karpat (QPD), and Tracy Woitenko (Town of Canmore) were involved in CAG meetings.

The CAG focused on the following considerations and needs and understood the difficulty of balancing them all:

- **Affordability**: To provide a variety of housing types, including affordable housing;
- **Connectivity**: To design a transportation system that supports multiple modes (walking, biking, transit and vehicles) and connects Smith Creek to existing development while supporting an emerging transit system and providing for a safe and livable community;
- **Sustainability**: To design efficient servicing that minimizes long terms costs on the municipality and the impact of grading required to develop the land;
- **Wildlife and Environment**: To provide movement corridors for wildlife as required by the NRCB 1992 and minimize the impact of development within Three Sisters Mountain Village on the environment;
- **Economic**: To have an economically feasible, successful and responsible project; and
- **Recreation**: To offer safe living conditions and high-quality recreational opportunities to the community, without compromising the integrity of the access to amenities.

Between July 2015 and August 2016, representatives from QPD and the Town met with the Smith Creek CAG to discuss the project and extensively review a variety of potential alignments of the wildlife corridor. Through this process, it was evident that consensus among the members of the CAG, and the broader communities they represent, would be difficult to achieve. Some members of the CAG were concerned with recreation, while others were concerned about affordable housing and the continuum of seniors housing provision within Canmore, while

[1] Mr. Heuer resigned from the CAG on March 10, 2016

still others were concerned about wildlife and the environment. These interests did not always align, but some consistent messages relating to wildlife corridors emerged.

Key input provided by the CAG pertaining to wildlife corridors included the following:

1) Keep the existing Stewart Creek Across Valley underpass across the TCH, if possible. Make the proposed Stewart Creek Across Valley Corridor wider in order to flare access to this part of the corridor from the proposed Along Valley Corridor to incorporate the existing and proposed underpass; however, the CAG acknowledged TSMV's requirement that there be no net loss of developed land by retaining the existing underpass as an "extra";

2) Reduce the proposed development area in the Wind Valley corridor in the curved portion above Thunderstone so development encroached into the 2002 Unapproved Corridor no further than 150 meters as topography posed a barrier to wildlife movement in area proposed for development;

3) CAG generally, but not unanimously, accepted that fencing along wildlife corridors was an important mitigation to address both wildlife entry into development and better direct human use of wildlife corridors.

TSMV worked diligently to address the concerns raised by the CAG as much as possible when preparing the corridor proposal, while also balancing other considerations like physical, fiscal, technical, recreational and housing cost considerations.

The Province is responsible for approving wildlife corridor proposals, and TSMV (through QPD) also engaged in discussions regarding potential wildlife corridor locations with the Province. Although the CAG provided balanced input into TSMV's corridor proposal, ultimately TSMV determined the width, length and position of the proposed corridor in consultation with AEP. In December 2016, TSMV arrived at a potential corridor alignment that balanced input from the CAG and the Province with input from the Town and development requirements. This is the corridor alignment presented in the next section for Provincial approval and was the focus of Golder's evaluation.

3.2 Description of TSMV's Corridor Proposal

The Smith Creek Along Valley Wildlife Corridor proposed by TSMV is depicted in Figure 1. The proposed wildlife corridor is divided into three components. The first amends and adds to the previously approved Along Valley Corridor, creating connections between the previously approved Along Valley Corridor and the Wind Valley Habitat Patch (Figure 1). This proposed primary wildlife corridor increases the overall width of the existing corridor in Sites 7/8 and extends the approved Along Valley Corridor by approximately 1.5 km through Site 9 (Figure 1). The narrowest overall part of the Along Valley Corridor south of Sites 7/8 previously approved in 1998 by the Province was 350 m. The new corridor expands that width to 620 m at the narrowest overall point by proposing to designate 63.48 ha of Site 7/8 as Along Valley Corridor. The remainder of the corridor through Site 9 also exceeds 620 m overall. The proposed extension of the Along Valley Corridor would complete the primary wildlife corridor with respect to connecting to the Wind Valley Habitat Patch.

The overall width of the corridor within Sites 7/8 has been increased relative to the approved Along Valley Corridor. In addition, the width of corridor north of a generally continuous 25° slope line has become 470 m at the narrowest and in all areas of the primary corridor the width exceeds 350 m. TSMV has listened to community input indicating that wildlife corridors should be placed on flatter terrain, even though wildlife can and do move on steep slopes. In

response, TSMV has increased the width of the corridor below the 25° slope line at least 120 m wider than the 350 m width prescribed by the NRCB Decision (1992).

The Province has previously confirmed to TSMV that across valley corridors are considered secondary wildlife corridors. Confirmation of this designation was provided as part of a Conservation Easement agreement signed between Three Sisters Mountain Village Ltd. and Brad Piclanny, Deputy Minister of Sustainable Resource Development on May 26, 2003. Consequently, TSMV proposes two across valley corridors as secondary wildlife corridors.

The first of the secondary corridors is the proposed Pigeon Mountain Across Valley Corridor. The proposed Pigeon Mountain Across Valley Corridor is primarily located outside of TSMV lands, but is considered beneficial to create a connection from the Wind Valley Habitat Patch to the Bow Flats Habitat Patch via the G8 Legacy Underpass (Figure 1). A portion of the proposed Pigeon Mountain Across Valley Corridor is found on Site 9 (Figure 1). Including both the proposed Smith Creek portion of the Along Valley Corridor and the portion of the proposed Pigeon Mountain Across Valley Corridor occurring on Site 9, a total of 111.18 ha of Site 9 would be designated as wildlife corridor.

The second secondary across valley corridor is a proposed optional realignment of the Stewart Creek Across Valley Corridor (Figure 1). The existing Stewart Creek Across Valley Corridor was formally designated by the Province in 1998, and amended in 2014. However, TSMV's wildlife corridor proposal recommends moving the Stewart Creek Across Valley Corridor approximately 300 m to the east, centring the corridor on the location of a new wildlife crossing under the TransCanada Highway. The alignment was altered based on discussions with the Town of Canmore regarding potential steep creek hazards identified by the Town, drainage grade separation of the Parkway, wildlife movement and public input. If this option proceeds, the existing wildlife crossing structure near Stewart Creek may be retained and could be linked to the western edge of the new Across Valley Corridor.

The optional new alignment of the Stewart Creek Across Valley Corridor is not a requirement to develop the Smith Creek ASP and the current alignment approved in 1998 and amended in 2014 is appropriately located. However, moving the Stewart Creek Across Valley Corridor is the preferred option being explored by QPD/TSMV and the Town for the Smith Creek ASP as a response to the Town of Canmore and public feedback. If relocated, the existing Stewart Creek Across Valley Corridor would be rescinded and become developable land without need for "buffers".

The secondary across valley corridors proposed by TSMV are narrower at their narrowest point than the proposed Along Valley Corridor extension: 293 m (354 m wide on average over its approximately 600 m length) for the proposed realignment of the Stewart Creek Across Valley corridor, and 352 m (442 m wide on average over its approximately 1.8 km length) for the Pigeon Mountain Corridor (Figure 2). However, the NRCB 1992 does not require that secondary wildlife corridors maintain the same 350 m minimum that is applied to primary wildlife corridors. Moreover, the narrowest point in the proposed Pigeon Mountain Across Valley Corridor cannot be adjusted because it is constrained by pre-existing developments unrelated to TSMV or the NRCB Decision (i.e., Thunderstone Quarry and Banff Mountain Gate).

The realigned Stewart Creek Across Valley Corridor is also optional with respect to Provincial approval. If not approved by the Province, the original approved location of the Stewart Creek Across Valley Corridor will be maintained. In this case, only the proposed Along Valley Wildlife Corridor Extension and Pigeon Mountain Across Valley Wildlife Corridor would be required to complete the corridor network with respect to TSMV.

The proposed wildlife corridors complete the connection between the Wind Valley Habitat Patch and the Bow Flats Habitat Patch and creates a contiguous wildlife corridor on the south side of Canmore through and adjacent to TSMV properties. In total, these designations would mean that 63% of Site 7/8 and 74% of Site 9 will be designated as wildlife corridors. Designation of the proposed corridors would bring the land that TSMV has committed to wildlife corridors to approximately 386 ha including conservation easements and land exchanges with the Province.

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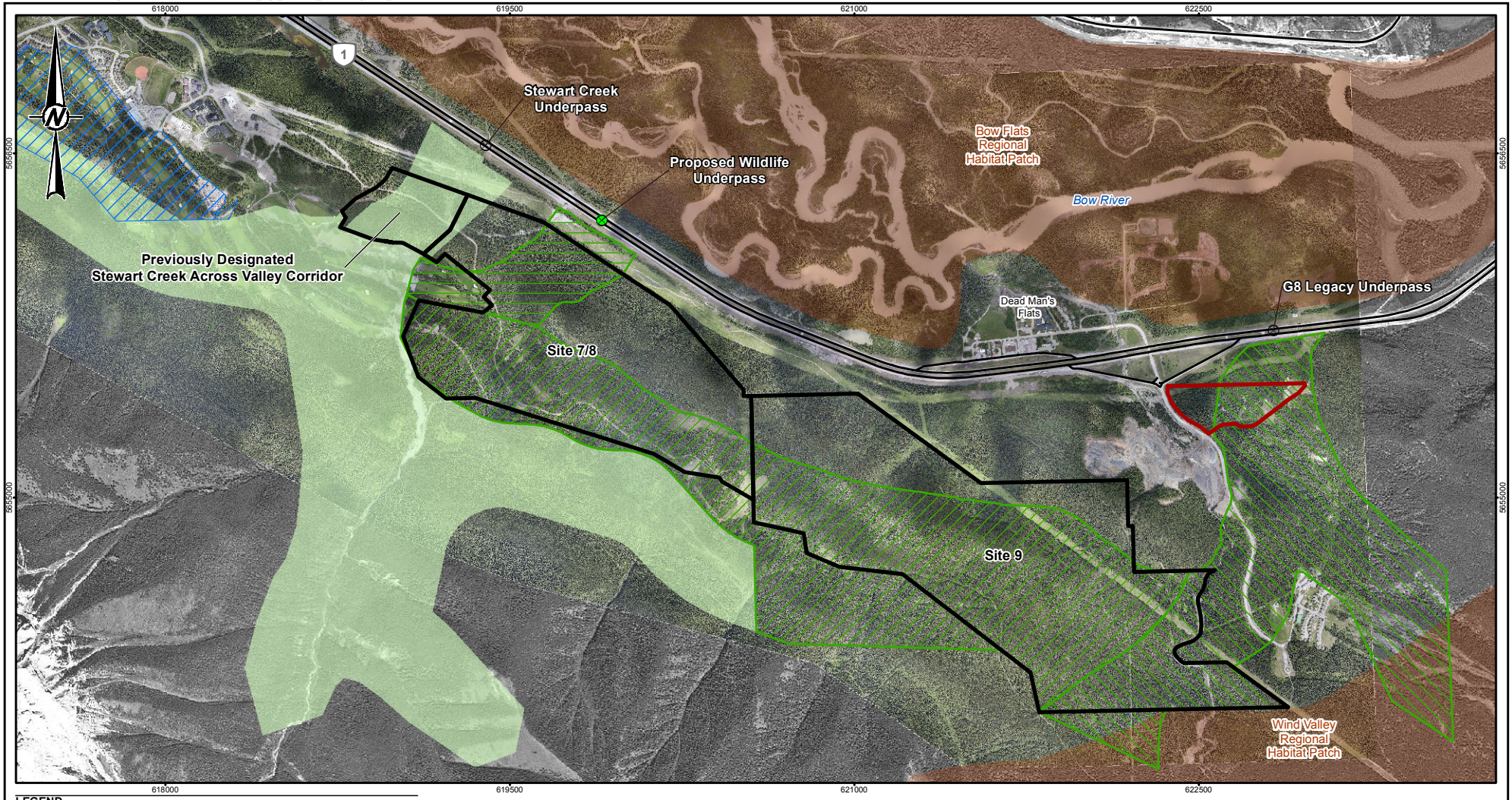

LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- HABITAT PATCH
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

0 500 1,000

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REFERENCES

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-01-23
DESIGNED	TSMV
PREPARED	AB
REVIEWED	KK/MGJ
APPROVED	TSMV

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

TITLE
PROPOSED SMITH CREEK WILDLIFE CORRIDORS AND OPTIONAL STEWART CREEK CORRIDOR REALIGNMENT

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	3	1

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4.0 CORRIDOR EVALUATION

This section presents the methods and results of Golder's evaluation of the wildlife corridor proposal put forward by TSMV in Section 3. The section begins by providing a definition of an effective wildlife corridor. Next, the criteria used to evaluate the efficacy of proposed corridors are provided, the methods used to evaluate each of those criteria are identified, and the results of the evaluation are presented.

4.1 What Constitutes an Effective Wildlife Corridor?

Human development fragments wildlife habitat, reducing habitat quality and potentially restricting animal movements. Corridors are crucial conservation tools for maintaining connectivity and ecological function in developed landscapes (Beier and Noss 1998, Tewksbury et al. 2002). The NRCB Decision Report (1992) makes clear that the primary purpose of wildlife movement corridors with respect to TSMV is to ensure that development will not prevent wildlife movement at broader regional scales without being forced to cross developed areas (NRCB 1992 pp. 10-51).

Although BCEAG (1999a) guidelines are explicitly not applicable to TSMV, they provide a practical definition of wildlife corridors that distinguishes wildlife corridors from habitat patches. In contrast to a wildlife habitat patch, which is defined as a place that meets a wide spectrum of habitat requirements for wildlife, a wildlife corridor is "*an area of land designed to provide connectivity among habitat patches*" (BCEAG 1999a pp. 5). As such, "*wildlife corridors are generally not designed to fulfill any of the requirements of habitat patches other than some elements of security without which animals would not use them*" (BCEAG 1999a pp. 5). In other words, habitat within corridors does not need to meet a wide range of ecological requirements for wildlife, so long as wildlife are willing to use the corridor to travel between habitat patches.

The BCEAG guidelines found substantial support for their definition in the literature (e.g., Herrero and Hamer 1983, Matson 1993, Harrison 1992, Noss 1992, Beier and Loe 1992, Beier 1995, and Gibeau et al. 1996; as cited in BCEAG 1999a). More recent literature also supports this definition (Chetkiewicz et al. 2006, Beier et al. 2008). For instance, Beier et al. (2008 pp. 837) define a *corridor* as "a swath of land intended to allow passage by a particular wildlife species between 2 or more wildland areas". Beier et al. (2008) go on to define *linkages* as multi-species corridors that are designed to promote movement in some cases, but also can be designed to promote more complex biological processes, depending on the biological goals set for the linkage. In the case of corridors and TSMV, the biological goal for the linkage is clearly to allow passage, or using the language of the NRCB (1992), to "prevent blockage" (NRCB 1992 pp. 10-51). Consequently, an effective wildlife corridor is defined for the purposes of this evaluation as a corridor that permits movement of wildlife from one habitat patch to another (Taylor et al. 2006).

Wildlife corridors in the Bow Valley fulfill several important biological processes, including maintaining meta-populations, achieving genetic connectivity, and connecting habitats within the home ranges of individual animals inhabiting the Bow Valley. Corridors designed within a meta-population framework permit animals to disperse from their natal area and travel to new habitat patches reducing extinction risk in fragmented landscapes (Beier 1995). Corridors also can be designed to maintain the genetic diversity of wildlife. In such cases, corridors need only be used infrequently, perhaps only a handful of times in a generation (Mills and Allendorf 1996). Although population-level corridor functions clearly are important in the Bow Valley, a third motivation for wildlife corridors in the Canmore area is to achieve connectivity at a local spatial scale and over short periods of time (i.e., within valley movements by individual animals at seasonal temporal scales or finer; BCEAG 1999a).

4.2 Evaluation Criteria

Both TSMV and the Province (AEP) have confirmed that the 1992 NRCB Decision Report, which required wildlife corridor designation as a part of TSMV development, constitutes the basis for decision making with respect to the wildlife corridor proposal submitted by TSMV to AEP. Consequently, the evaluation criteria set to define corridor efficacy are linked, in part, to the NRCB requirements for wildlife corridors described in Section 2.2. These are the only criteria provided by the 1992 NRCB decision to define wildlife corridor efficacy. As noted in Section 2.2, other criteria for corridor designation that have been developed for other parts of the Bow Valley, i.e., the BCEAG guidelines, explicitly do not apply to TSMV (BCEAG 1999a, 2012).

However, many conservation-minded advocates oppose the exclusion of BCEAG guidelines for TSMV, arguing that these guidelines represent an application of the best available science in corridor design (e.g., letter to ESRD Minister Knight from the Alberta Wilderness Association dated July 18, 2011). A science-based approach to evaluate the efficacy of wildlife corridors is both objective and defensible. Moreover, a science-based approach permits a clear evaluation of whether the proposed wildlife corridors will be effective, as defined in Section 4.1. Although 1992 NRCB decision is silent about the use of science to facilitate corridor designation or to ensure that corridors will be used by wildlife for movement, support for the use of science is provided in a letter to TSMV from the NRCB dated April 6, 2004 (Appendix A) which states that the Board was satisfied with the "*application of more recent scientific thought in relation to wildlife corridor design*".

In addition to requirements for corridors established by the NRCB in 1992, therefore, this wildlife corridor evaluation incorporates more recent science to determine corridor efficacy. This includes considering the scientific underpinnings of the BCEAG guidelines. Golder (2012) provided an evaluation of BCEAG prescriptions for wildlife corridors. Each prescription provided by the BCEAG was reviewed and was either retained or rejected, depending on its scientific merit. Although Golder's review found support for many of the principles underlying the BCEAG guidelines, a number of specific prescriptions were not supported by available published scientific literature and were rejected.

To fully consider corridor efficacy for wildlife as defined in Section 4.1 and incorporate more recent available science, the evaluation criteria listed in the following bullets were identified and applied to Golder's evaluation of TSMV's Smith Creek corridor proposal. These criteria were based on the requirements of the NRCB identified in Section 2.2, available published science, and previous work summarizing the available science (including grey literature) with respect to corridor efficacy in the Bow Valley (e.g., BCEAG 2012, Golder 2012, MSES 2013) and site-specific field monitoring of TSMV lands. Each evaluation criterion is posed as a question that will be answered in the results of the corridor evaluation.

- **Does the corridor link to other corridors on private and provincial lands at a regional scale?** – In fragmented landscapes such as the Bow Valley, meeting all of the biological functions identified in Section 4.1 requires wildlife corridor planning at the regional scale. Regional wildlife corridors are crucial conservation tools for maintaining connectivity and ecological function (Beier and Noss 1998, Tewksbury et al. 2002). The NRCB also requires that corridor designation should occur at a regional scale and corridors on private and provincial lands must be linked (NRCB 1992 pp. 10-38).
- **Does the corridor follow the most direct route?** – Shorter corridors will prove more effective than longer ones, especially if corridors are narrow (Beier 1995, BCEAG 2012). Consequently, the most direct route should be used to link habitat patches.

- **Are all primary wildlife corridors at least 350 m wide?** – The 1992 NRCB decision requires that primary wildlife corridors should not be narrower than 350 m, except under unusual circumstances (NRCB 1992 pp. 10-38). Corridors must not be too narrow or animals will not use them (Gillies and St Clair 2008). Although corridor width might have important implications for the ability for wildlife to move effectively among habitat patches (Haddad 1999), published scientific tests of the relationship between corridor width and efficacy are only available for very few wildlife species and methods for empirically estimating the minimum effective width of corridors *a priori* are unavailable (Beier et al. 2008). As a result, prescriptions for corridor width are highly variable. However, in general, wider corridors are more effective than narrower ones (Golder 2012), and, at a minimum, the 350 m width prescribed by the NRCB 1992 should be met.
- **Is the proposed corridor intended for use by a large number of species (i.e., multi-species corridor)?** – The Bow Valley is home to a wide variety of species for which wildlife corridors must function to maintain connectivity (BCEAG 2012; Golder 2012). The 1992 NRCB decision requires that the width and location of corridors should be reviewed with the full range of wildlife species expected to use them in mind (NRCB 1992 pp. 10-38).
- **Does the corridor correspond to known movement routes for most wildlife species?** – To increase the likelihood that movement corridors will achieve connectivity at a local spatial scale and over short periods of time (i.e., within valley movements by individual animals at seasonal temporal scales or finer; BCEAG 1999a), corridors should correspond with known movement routes of animals. This is a requirement of the NRCB (NRCB 1992 pp. 10-38). There is no requirement from the NRCB that a designated corridor provide the preferred movement route, provided that development does not block wildlife movement. Nevertheless, if wildlife corridors also encompass preferred routes, the likelihood that movement corridors will achieve connectivity at local spatial scales over short periods of time increases.
- **Can the corridor be used in all seasons?** – Corridors in the Bow Valley should function for multiple species and in multiple seasons. Habitat use can change substantially in different seasons. For example, elk in mountainous landscapes frequently exhibit seasonal shifts in use of elevation, preferring lower elevations in winter and moving to higher elevations during summer (Serrouya et al. 2000, Hebblewhite et al. 2008). Snow depth may inhibit movement during winter in some places and for some species in mountainous landscapes.
- **Does the corridor contain topographical features that would create barriers to movement?** – If wildlife corridors contain topographical features that create barriers to movement, efficacy of the corridor may be reduced or eliminated. For example, cliffs or other physical barriers may prevent movement. Steep slopes have also been identified in the Bow Valley as a potential factor (BCEAG 2012). However, wildlife in the Bow Valley can and do use steep slopes even though they show a preference for shallower terrain.
- **Is the corridor in the least developed state possible?** – Development within wildlife corridors can lead to reduced probability of use by wildlife and/or lead to increased negative wildlife human interactions (BCEAG 2012, Golder 2012). In recognition of this, the NRCB requires that corridors remain in as undeveloped a state as possible (NRCB 1992, Clause 14), and that roads, pathways and utility lines should be bundled (i.e., cross corridors in the same place) to minimize corridor fragmentation (NRCB 1992 pp. 10-38).

The role of AEP defined in the 1992 NRCB decision is to evaluate and make a determination about wildlife corridor proposals that define the spatial extent of corridors with respect to TSMV properties. Other aspects of TSMV development that may affect corridor function (e.g., mitigations put in place on development property to limit negative wildlife-human interactions near corridor boundaries) are not part of AEP's decision making mandate as defined by the NRCB and are not a focus of this evaluation. Nevertheless, minimizing human use of designated corridors and reducing negative human wildlife interactions in developed areas adjacent to wildlife corridors is critical for wildlife conservation in the Bow Valley and for the long-term efficacy of designated wildlife corridors (Golder 2013). These issues are discussed in Section 5, which presents additional considerations that are likely beneficial to the effectiveness of wildlife corridors evaluated herein.

4.3 Evaluation Methods

The criteria defined in Section 4.2 were evaluated using:

- a review of the requirements for wildlife corridors with respect to TSMV property as outlined in the 1992 NRCB Decision Report issued for "Application #9103 – Three Sisters Golf Resorts Inc. Application to Construct a Recreational and Tourism Project in the Town of Canmore, Alberta";
- a review of scientific literature and other relevant reference materials pertaining to wildlife movement and wildlife corridors, with a particular emphasis on the Bow Valley recognizing BCEAG guidelines are explicitly not applicable;
- Site-specific reports summarizing wildlife data collected on TSMV properties;
- LIDAR data providing information about slope and elevation;
- measurements of corridor width and other distances obtained from a GIS; and
- empirical Resource Selection Function (RSF) models developed for grizzly bears, wolves, elk, and cougars from telemetry data (Golder 2012).

4.4 Evaluation Results

This section presents the results of the wildlife corridor evaluation for each of the criteria identified in Section 4.2.

4.4.1 Does the Corridor Link to Other Corridors on Private and Provincial Lands at a Regional Scale?

YES.

The proposed corridors integrate areas of private and public land to create linkages at regional scales and will complete the south Canmore corridor network. The proposed Smith Creek extension to the Along Valley corridor will connect the east end of the 1998 approved Along Valley Corridor to the Wind Valley Habitat Patch (Figure 1). Either the proposed re-alignment of the Stewart Creek Across Valley Corridor or the current Stewart Creek Across Valley Corridor will maintain a connection between the Along Valley Corridor and the Bow Flats Habitat Patch in the vicinity of Stewart Creek (Figure 1). The Pigeon Mountain Across Valley Corridor will create a formal connection between the Wind Valley Habitat Patch to the Bow Flats Habitat Patch via the G8 underpass (Figure 1). These connections represent the final pieces of the regional wildlife corridor network on the south side of the Bow valley in the Canmore area. Designating these corridors will mean that all designated habitat patches in the Bow Valley are linked to one another with formally designated corridors.

4.4.2 Does the Corridor Follow the Most Direct Route?

YES.

The proposed corridors provide the most direct links through TSMV lands between the ends of existing approved corridors and habitat patches (e.g., proposed Stewart Creek Across Valley Corridor realignment and proposed Smith Creek Along Valley Corridor or between habitat patches (i.e., proposed Pigeon Mountain Across Valley Corridor). Shorter and more direct links between the southern arm of the existing approved Along Valley Corridor and the Wind Valley Habitat Patch are available, but these routes occur on Crown land and could be designated at the discretion of the Province. Consequently, they were not included in TSMV's proposal, which dealt with corridors interacting with some portion of TSMV lands.

In the case of the realignment of the Stewart Creek Across Valley Corridor, the presence of the most direct (i.e., shortest and straightest) route assumes that a new underpass is built for the relocated Stewart Creek corridor, as identified in Figure 1.

The straightest possible route for the proposed Pigeon Mountain Across Valley Corridor was used. The presence of existing development (e.g., Thunderstone Quarry and Banff Mountain Gate) constrained the alignment of this corridor.

4.4.3 Are all Primary Wildlife Corridors at Least 350 m Wide?

YES.

With respect to TSMV properties, the NRCB (1992) directs that primary wildlife corridors must be at least 350 m wide. The proposed extension of the Along Valley Corridor (i.e., the primary wildlife corridor) is substantially wider, exceeding 620 m at its narrowest point (Figure 2). Importantly, the southern boundary of the proposed Along Valley Corridor extension will remain undeveloped. The area south of this line has substantial observed wildlife movement for some species such as cougars, grizzly bears, black bears, bighorn sheep, and mule deer (Chetkiewicz and Boyce 2009; Golder 2012). Other species, such as elk and wolves use the area south of the proposed corridor less frequently relative to other areas, but use has been documented (Golder 2013). Consequently, movement opportunities for wildlife extend south of the proposed corridor boundary and the effective functional corridor width is substantially wider than 620 m. In addition, as noted in Section 3.2 and shown on Figure 2, even measuring below a generally continuous 25° slope, the proposed corridor exceeds 350 m in all areas, with a minimum distance of 470 m below 25°.

The secondary across valley corridors proposed by TSMV are narrower at their narrowest point than the proposed Along Valley Corridor extension: 293 m (354 m wide on average over its approximately 600 m length) for the proposed realignment of the Stewart Creek Across Valley corridor, and 352 m (442 m wide on average over its approximately 1.8 km length) for the Pigeon Mountain Corridor (Figure 2). However, the NRCB 1992 does not require that secondary wildlife corridors maintain the same 350 m minimum that is applied to primary wildlife corridors. Moreover, the narrowest point in the proposed Pigeon Mountain Across Valley Corridor cannot be adjusted because it is constrained by pre-existing developments unrelated to TSMV or the NRCB decision (i.e., Thunderstone Quarry and Banff Mountain Gate).

Recommended widths of corridors designed for large carnivores presented in the literature vary between 100 m and several kilometres depending on the length of the corridor and its intended function (Harrison 1992, Beier 1995). The original 350 m corridor width below 25° slope prescription of the BCEAG 1999a guidelines were upheld by BCEAG 2012, not because scientific support for a 350 m below 25° slope cut-off was found, but because little evidence to either support or refute this cut-off was found. Multi-species corridor widths of 350 m (NRCB 1992, BCEAG 1999a) and 635 m (Golder 2002) have variously been recommended for corridors in the Bow Valley. However, neither prescription carries more scientific merit than the other and secondary corridors of lesser width are used by large carnivores in the Bow Valley (Golder 2002), highlighting substantial uncertainty about what constitutes a minimum effective width. Nevertheless, the literature is clear that wider corridors are generally better than narrower ones for maintaining connectivity (Beier 1995, Beier et al. 2008, Gillies and St Clair 2008).

In the case of the proposed Smith Creek Along Valley Corridor, available telemetry and camera data clearly demonstrate that the effective width (i.e., the area used regularly for movement) extends south from the proposed boundary by up to 2 km for many species, especially grizzly bears, cougars, and deer (unpublished Provincial data; Golder 2012). The width of this corridor is therefore substantial and expected to continue to maintain along valley movement.

In the case of the proposed Pigeon Mountain Across Valley Corridor, corridor width is the maximum possible between pre-existing provincially approved developments on the west arm (Figure 2). Like the southern boundary of the proposed Smith Creek Along Valley Corridor extension, the eastern boundary of the proposed Pigeon Mountain Corridor is unconstrained by development, and movement has been demonstrated for many species east of the proposed boundary (unpublished Provincial data; Golder 2012). Functional width of this corridor is therefore substantial and is expected to continue to maintain movement.

In the case of the proposed realignment of the Stewart Creek Across Valley Corridor which averages 354 m over its 600 m, it does in isolated places measure narrower than the 350 m minimum needed for primary wildlife corridors, and like the Triple Across Valley Corridor, will have development on both sides. Risk to maintaining wildlife movement is higher for this Across Valley Corridor than the Along Valley Corridor because of human development on both sides of the Across Valley Corridor. As such, mitigations should be directed at controlling human use in the corridor.

Widening the corridor will not increase effectiveness if human use is not managed. Corridor effectiveness will depend substantially on how human use within the corridor is managed after development occurs. If human use is managed well, potentially through mitigation such as fencing, the corridor width should be functional, but the corridor may be at risk of reduced function otherwise. Importantly, however, function of the proposed re-alignment of the Stewart Creek Across Valley Corridor is unlikely to be different from the functionality of the already approved Stewart Creek Across Valley Corridor once development occurs on both sides, but could be improved through implementation of mitigation like wildlife fencing.

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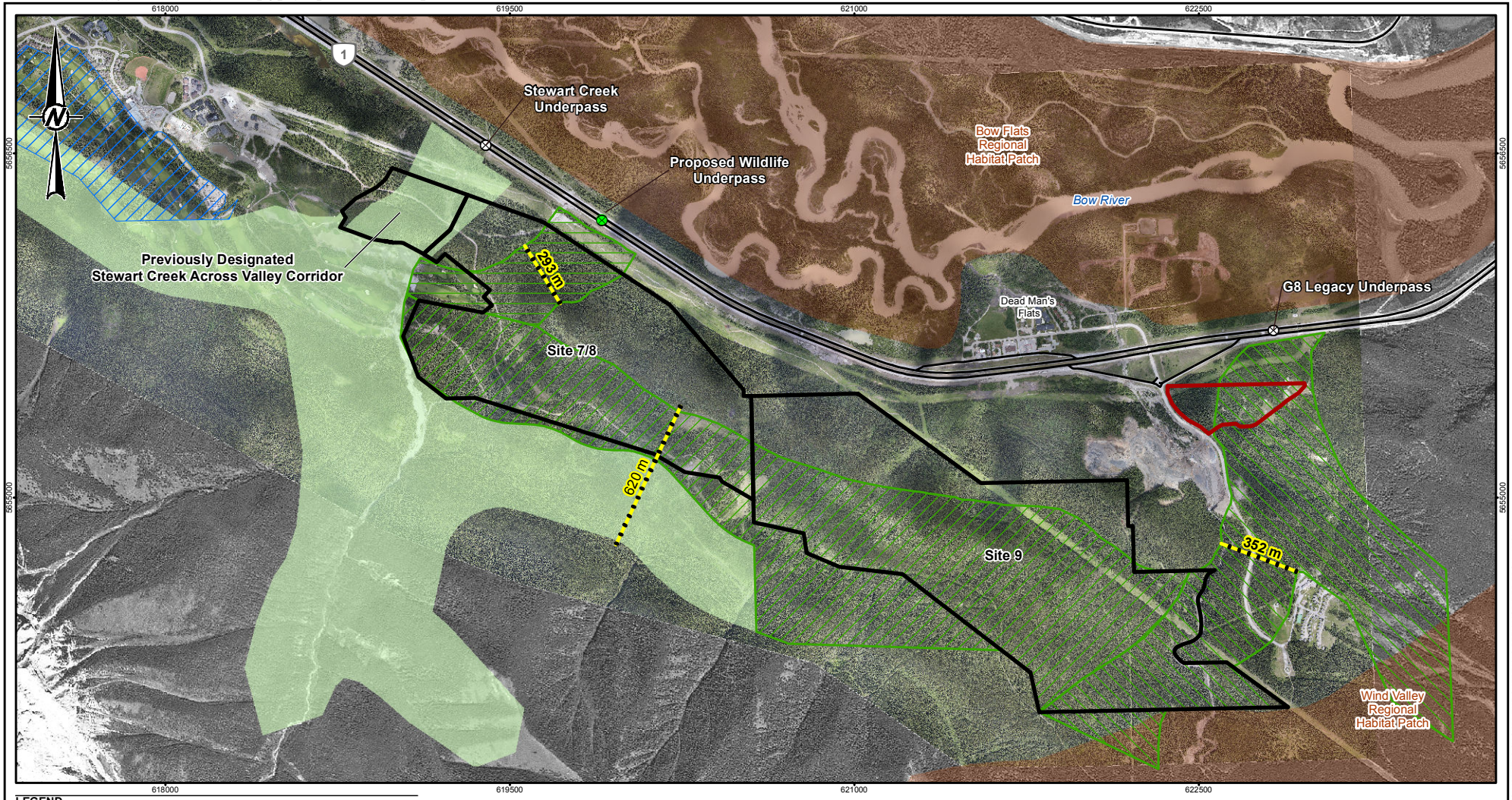

LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- NARROWEST WIDTH ACROSS WILDLIFE CORRIDOR
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- HABITAT PATCH
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

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CONSULTANT
Golder Associates

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DESIGNED	TSMV
PREPARED	AB
REVIEWED	KK/MGJ
APPROVED	TSMV

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

TITLE
MINIMUM WIDTHS FOR PROPOSED WILDLIFE CORRIDORS

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4.4.4 Is the Proposed Corridor Intended for Use by a Large Number of Species (i.e., multi-species corridor)?

Yes.

Data from the approved Along Valley Corridor indicate that all key wildlife species in the Bow Valley are using the corridor (Jacques Whitford AXYS 2008, Garrow and Everett Environmental Services 2009). In addition, the areas in which the Smith Creek Along Valley Corridor has been proposed by TSMV have demonstrated use by a wide variety of wildlife (Regional Wildlife Corridor Study 2002, unpublished Provincial data, Golder 2013). Consequently, the proposed corridors are both intended and expected to continue to function as multi-species corridors.

4.4.5 Does the Corridor Correspond to Known Movement Routes for Most Species?

Yes.

Data from a number of studies, including unpublished Provincial data, demonstrate the proposed corridors align with known movement routes for a wide variety of species. For example, remote cameras deployed throughout the south Canmore region show that deer and elk use a variety of areas, both inside and outside of the proposed corridors, with the highest use at lower elevations, including substantial use within the proposed movement corridors (camera data presented in Golder 2012; unpublished Provincial data). Additionally, almost all images obtained for black bears, grizzly bears, wolves, and cougars from remote cameras were either located in already approved corridors or in the area of corridors proposed by TSMV (camera data presented in Golder 2013; unpublished Provincial data).

The proposed Smith Creek Along Valley Corridor alignment has been ground-truthed numerous times, including visits with members of the CAG and the Town of Canmore and with AEP representatives. The alignment makes good use of existing old roads, wildlife trails and natural breaks that contour along the slopes, creating natural movement routes for wildlife.

The proposed Smith Creek Along Valley and Pigeon Mountain Across Valley corridors also overlap substantially with those proposed by the Regional Wildlife Corridor Study (2002), which delineated corridors based on winter backtracking, with carnivore backtracking taking precedence over ungulate backtracking during corridor designation. The exception is around the small ridge extending east from Cairnes Creek. The Three Sister's Resort (TSR) Corridor proposed by the 2002 Regional Wildlife Corridor Study skirts around this area because it had a low utilization based on winter backtracking data. Low utilization in this area may be caused by biases in snowtracking resulting from tracking sessions that always started along pre-defined survey routes (Regional Wildlife Corridor Study 2002). For example, the most commonly-tracked carnivores during winter were cougars and the proposed TSR corridor was therefore strongly influenced by cougar movements. Other more recent data sources (e.g., cougar telemetry and remote cameras) clearly show movements by cougars and other carnivores through and above the Cairnes Creek ridge. Therefore, this part of TSMV's proposed Smith Creek Along Valley Corridor actually corresponds to known movement routes.

In addition to proposed corridors representing known movement routes for a wide variety of wildlife species, the results of RSF modelling derived from telemetry data (Golder 2012) indicate that the proposed corridors also correspond to areas associated with a relatively high probability of selection by grizzly bears, elk (winter model), cougars (winter model), and wolves (winter model). The RSF results only indicate places where animals exhibit higher or lower probability of selection, and in isolation do not represent wildlife movement. However, habitat selection has commonly been used to infer movement potential, including in the Bow Valley (Chetkiewicz et. al. 2006; Chetkiewicz and Boyce 2009). Each RSF output was interpreted according to five equal area bins. These bins were validated using k-fold cross validation and are interpreted in terms of whether habitats within each bin are used more or less than expected based on availability on the landscape. Habitat bins were classified as:

- **Selected** – observed proportion of telemetry locations in this bin greater than the proportion that would be expected if habitats were used as available.
- **Used as available** – observed proportion of telemetry locations in this bin at or near the proportion that would be expected if habitats were used as available.
- **Somewhat avoided** – observed proportion of telemetry locations below the proportion that would be expected if habitats were used as available.
- **Strongly avoided** – observed proportion of telemetry locations in this bin much less than the proportion that would be expected if habitats were used as available.
- **Rarely Used** – observed proportion of telemetry locations in this bin near zero.

For additional details and results of K-fold cross validation as recommended by Boyce et al (2002) refer to Golder (2012, Section 1.5.1.1.2.1, p.44).

In the case of grizzly bears, most of the corridors are made up of habitats that are either selected or used as available, i.e., habitats consistent with preferred movement routes (Table 1, Figure 3). However, the pattern of habitats represents a mosaic. Some areas of somewhat avoided and strongly avoided habitat are present in both the proposed Smith Creek Along Valley Corridor extension and proposed Pigeon Mountain Corridor, and very small areas of somewhat avoided, strongly avoided and rarely used habitat are present in the proposed optional Stewart Creek Wildlife Corridor relocation (Table 1, Figure 3).

In the case of elk, almost all of each proposed corridor segment is made up of habitats that are either selected or used as available (Table 1, Figure 4). The proposed corridors therefore represent both known movement routes and probably also represent preferred movement routes.

In the case of cougars, most of the proposed Along Valley Corridor extension and all of the proposed Pigeon Mountain Across Valley Corridor are comprised of habitats that are selected or used as available (Table 1, Figure 5). The proposed optional Stewart Creek Wildlife Corridor relocation has some somewhat avoided and strongly avoided habitats associated with the existing Stewart Creek Golf Course, but the proposed realignment results in an improvement compared to the existing location of the approved Stewart Creek Across Valley Corridor.

In the case of wolves, most habitats within the corridors somewhat avoided, interspersed with habitats that are used as available (Table 1, Figure 6). Habitats on the south side of the Bow River tend to be less strongly selected by wolves than the south facing slopes on the north side. Within this context of generally reduced probability of selection south of the Bow River, the proposed corridors capture large areas of the most selected habitats by wolves available in the vicinity of TSMV property and therefore likely consist of the most preferred routes available (Figure 6). In 2016, there was camera evidence of wolves using the proposed corridors.

Table 1: Habitat Classes for Grizzly Bears, Elk, Cougars, and Wolves within each Segment of the Corridors Proposed by TSMV

Corridor Segment	Habitat Class	Grizzly Bear	Elk	Cougar	Wolf
Proposed Along Valley Corridor Extension	selected	67.12 ha (37%)	78.19 ha (44%)	24.27 ha (14%)	0 ha (0%)
	used as available	74.34 ha (41%)	100.47 ha (56%)	133.93 ha (75%)	73.74ha (41%)
	somewhat avoided	22.08 ha (12%)	0.53 ha (<1%)	15.91 ha (9%)	105.45 ha (59%)
	strongly avoided	15.64 ha (9%)	0 ha (0%)	4.90 ha (3%)	0 ha (0%)
	rarely used	0.01 ha (<1%)	0 ha (0%)	0.18 ha (<1%)	0 ha (0%)
Proposed Stewart Creek Across Valley Corridor Realignment	selected	18.06 ha (76%)	23.89 ha (100%)	0.20 ha (<1%)	0 ha (0%)
	used as available	1.40 ha (6%)	0 ha (0%)	14.87 ha (62%)	0 ha (0%)
	somewhat avoided	1.56 ha (7%)	0 ha (0%)	4.50 ha (19%)	23.89 ha (100%)
	strongly avoided	1.75 ha (7%)	0 ha (0%)	4.13 ha (17%)	0 ha (0%)
	rarely used	1.12 ha (5%)	0 ha (0%)	0.19 ha (<1%)	0 ha (0%)
Proposed Pigeon Mountain Across Valley Corridor	selected	28.20 ha (23%)	90.23 ha (72%)	62.77 ha (50%)	0 ha (0%)
	used as available	54.5 ha (43%)	35.03 ha (28%)	62.39 ha (50%)	48.53 ha (39%)
	somewhat avoided	36.63 ha (29%)	0 ha (0%)	0.11 ha (<1%)	76.74 ha (61%)
	strongly avoided	5.95 ha (5%)	0 ha (0%)	0 ha (0%)	0 ha (0%)
	rarely used	0 ha (0%)	0 ha (0%)	0 ha (0%)	0 ha (0%)

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

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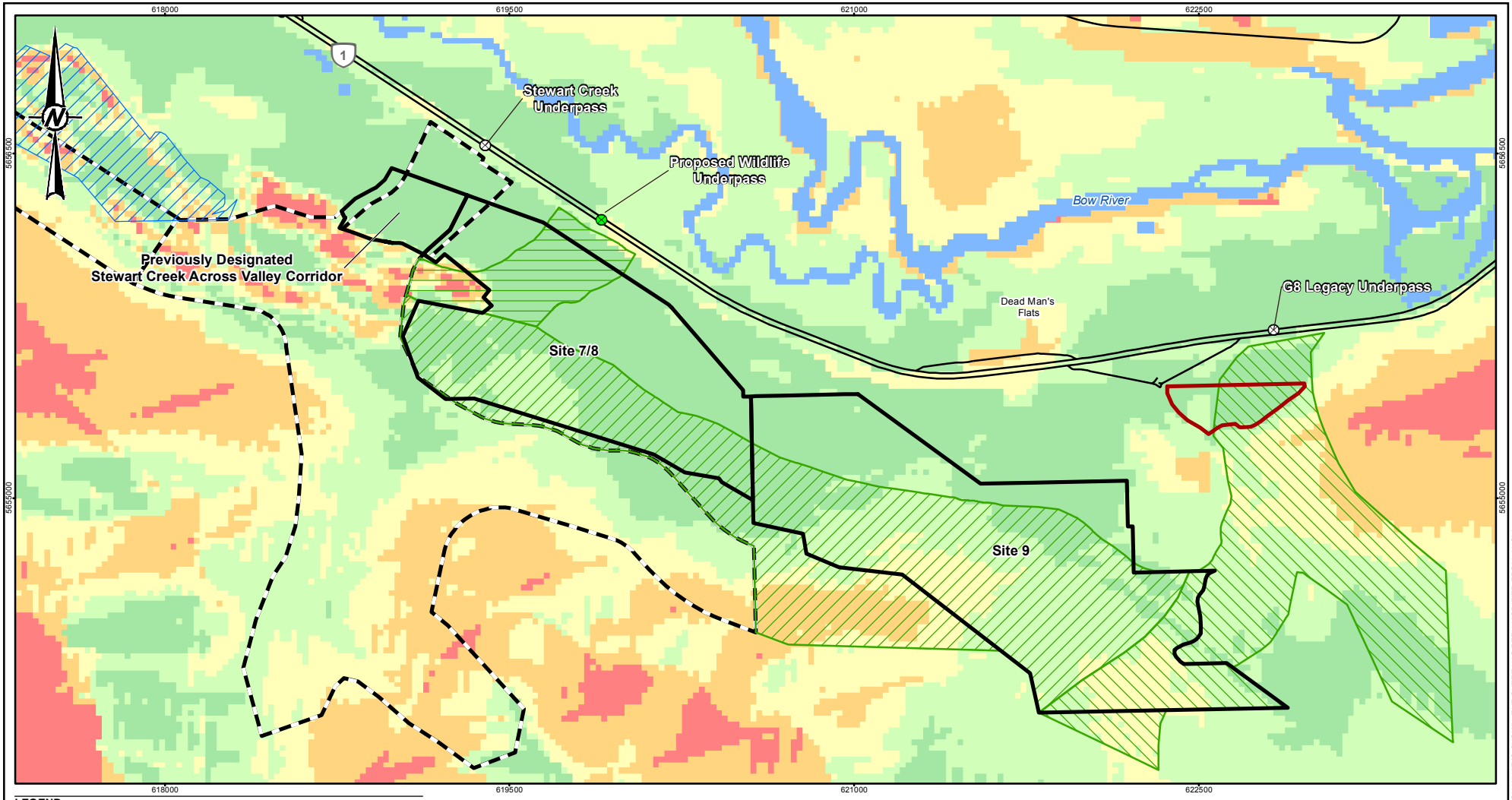

LEGEND

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- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

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TSMV C/O QUANTUMPLACE DEVELOPMENTS

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-03-03
DESIGNED	TSMV
PREPARED	SG
REVIEWED	KK
APPROVED	MJ

PROJECT

PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

TITLE

SUMMER GRIZZLY BEAR RESOURCE SELECTION FUNCTION

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	4	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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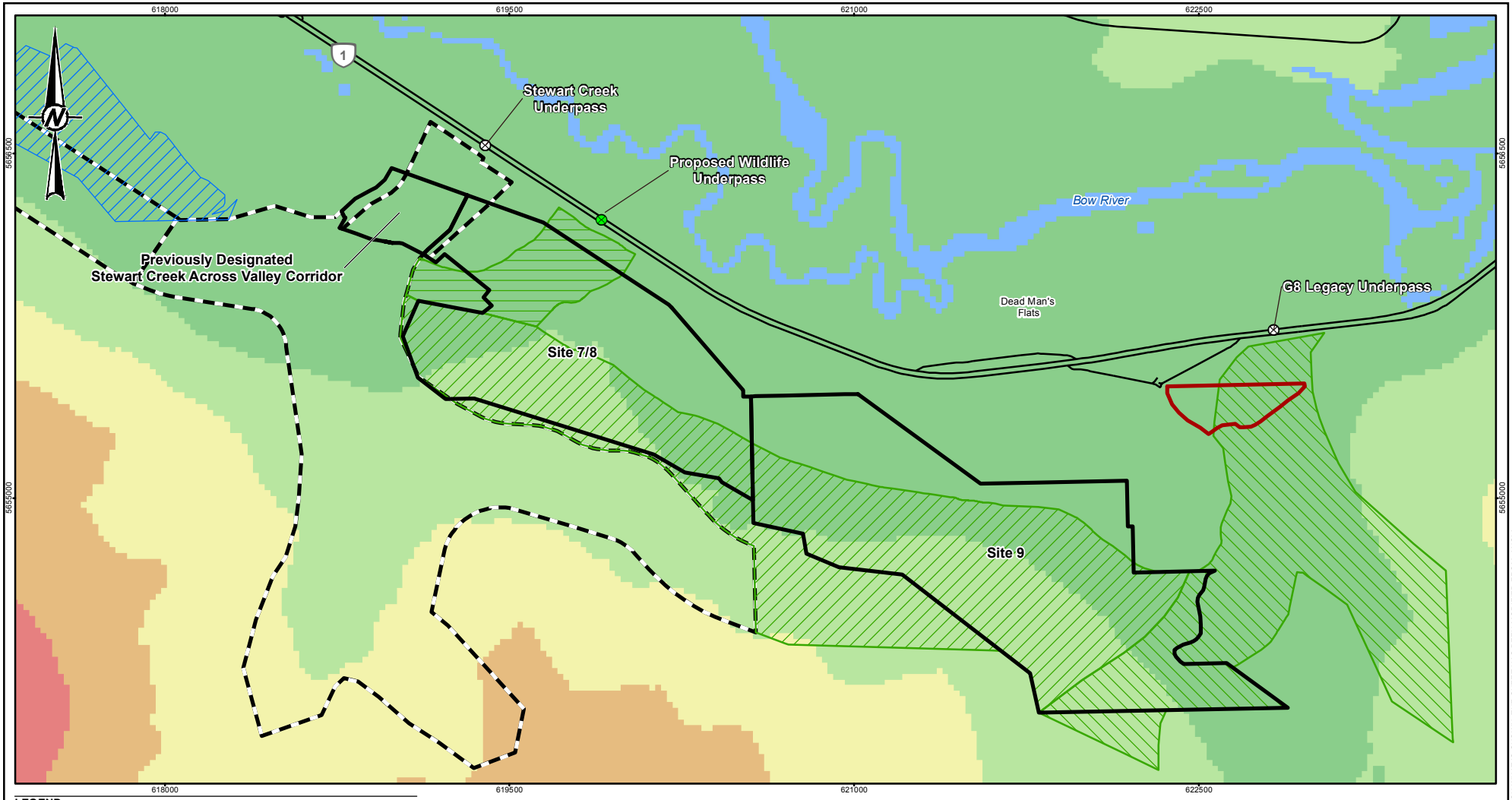

LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 500 1,000

1:25,000 METRES

REFERENCES

1. TRANSPORTATION OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. APPROVED WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-03
DESIGNED	TSMV
PREPARED	SG
REVIEWED	KK
APPROVED	MJ

TITLE
WINTER ELK
RESOURCE SELECTION FUNCTION

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	4	**4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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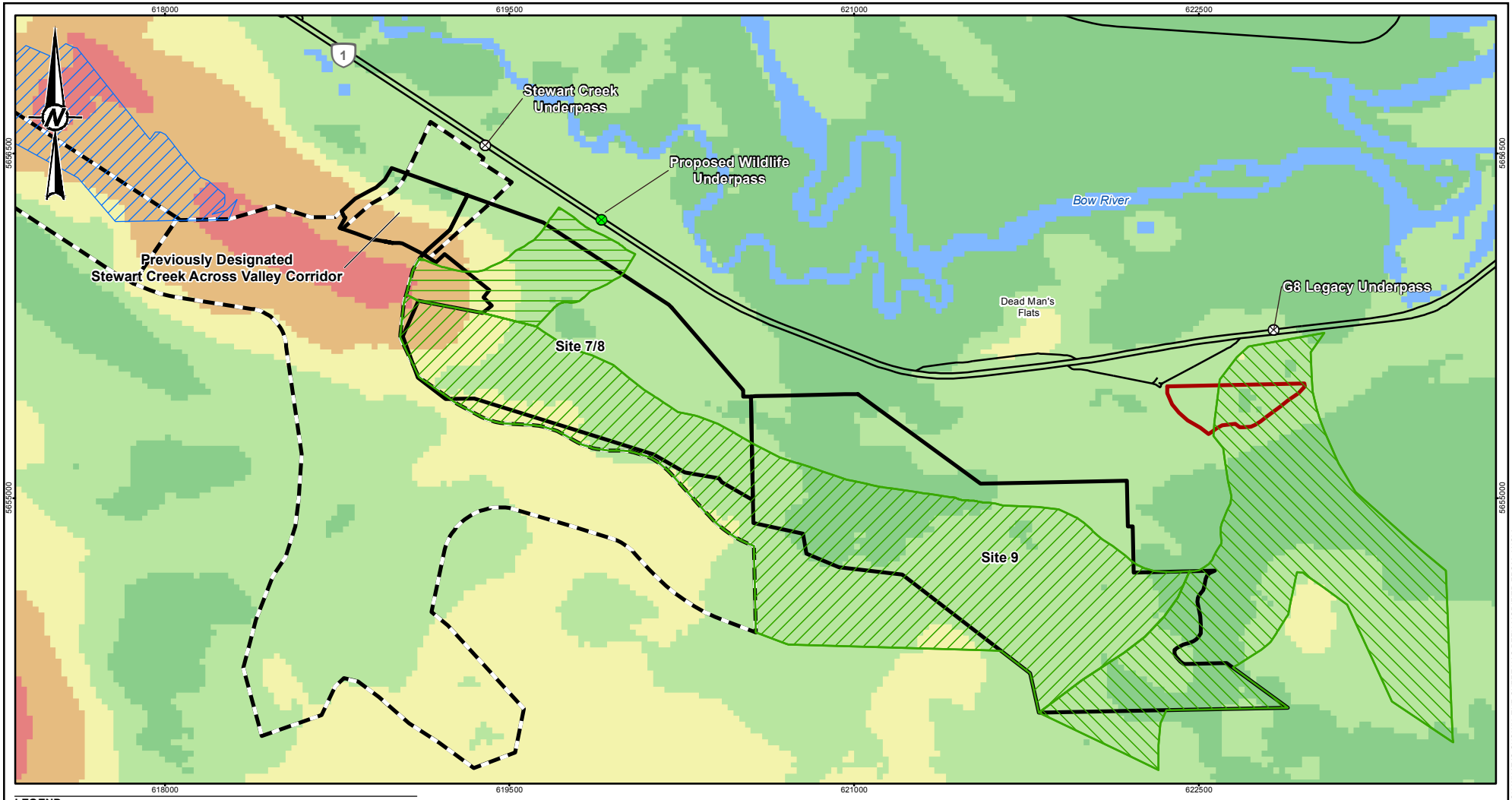
PATH: I:\2015\1539221\Mapping\MXD\WildlifeCorridorReport\1539221_Fig5_Proposed_Corridor_Cougar_Rev5.mxd PRINTED ON: 2017-03-03 AT: 3:08:40 PM



LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 500 1,000

1:25,000 METRES

REFERENCES

1. TRANSPORTATION OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. APPROVED WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-03
DESIGNED	TSMV
PREPARED	SG
REVIEWED	KK
APPROVED	MJ

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

TITLE
WINTER COUGAR RESOURCE SELECTION FUNCTION

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	5	**5**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm

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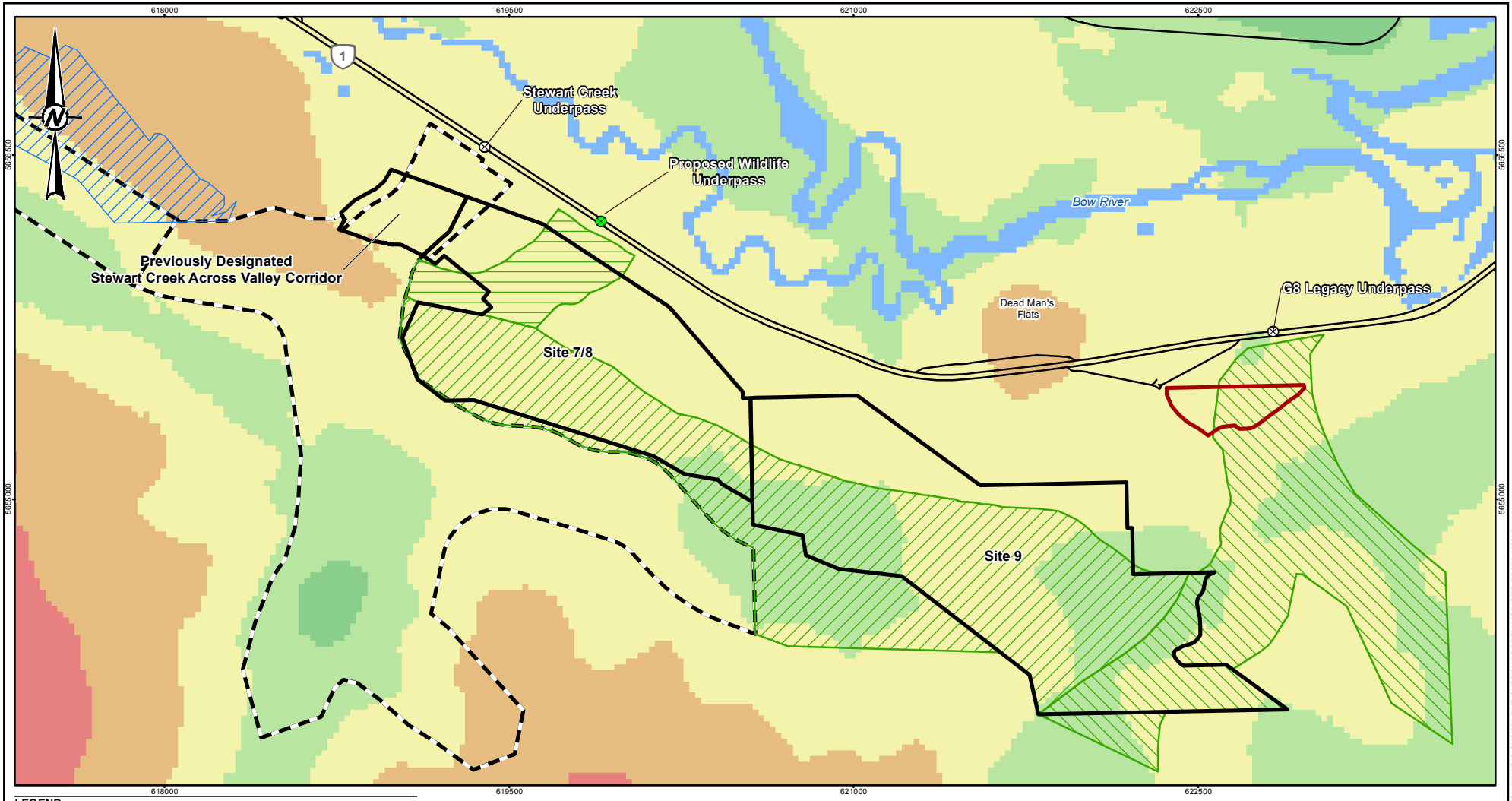
PATH: I:\2015\1539221\Mapping\MXD\WildlifeCorridorReport\1539221_Fig6_Proposed_Corridor_Wolf_Rev4.mxd PRINTED ON: 2017-03-03 AT: 3:09:44 PM



LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 500 1,000
1:25,000 METRES

REFERENCES

1. TRANSPORTATION OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. APPROVED WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-03
DESIGNED	TSMV
PREPARED	SG
REVIEWED	KK
APPROVED	MJ

TITLE
WINTER WOLF
RESOURCE SELECTION FUNCTION

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	4	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
0 25mm

4.4.6 Can the Corridor Be Used in All Seasons?

Yes.

Wildlife movement is most strongly constrained in the Bow Valley during winter because deep snow at high elevations which makes travel more difficult. The RSF model results presented in Section 4.4.5 represent winter selection for elk, cougars, and wolves. Grizzly bears spend most of each winter in their dens. The proposed corridors occur at low elevations, consist of habitat that is of a relatively high probability of selection for elk and cougars in the vicinity of TSMV during winter. In the case of wolves, the proposed corridors contain much of the habitat with the highest probability of selection available in the vicinity of TSMV. These corridors occur in locations with demonstrated movement by a variety of wildlife species during winter and summer (Regional Wildlife Corridor Study 2002, Golder 2013, unpublished Provincial data). Consequently, the corridors are expected to be used in all seasons.

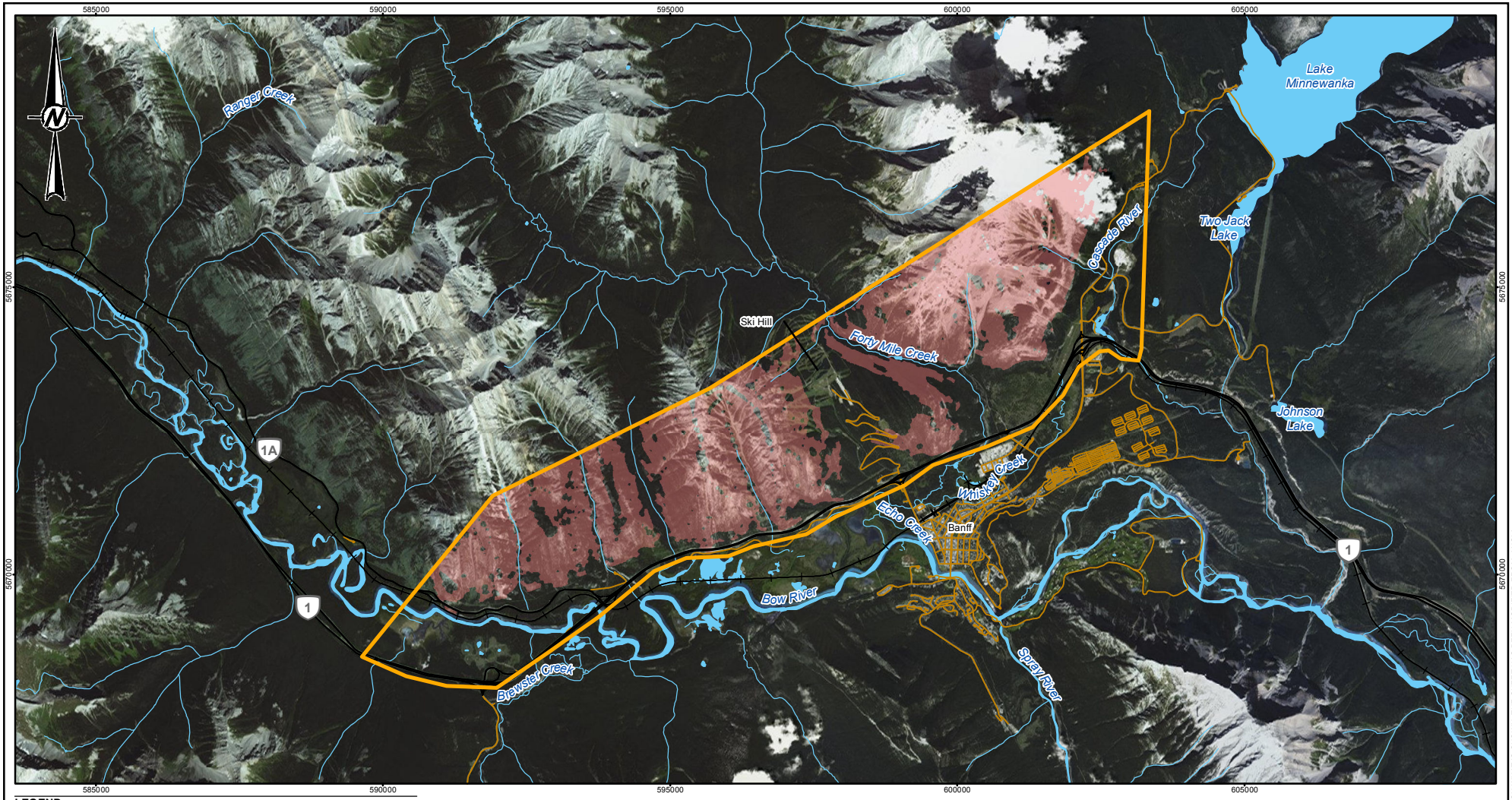
4.4.7 Does the Corridor Contain Topographical Features that would Create Barriers to Movement?

No.

The proposed corridors occur primarily in forested habitats at low elevations. No substantial cliffs or other topographical features that would create barriers to movement are present.

Slope has been identified by the BCEAG (1999a) as a potential concern affecting corridor efficacy. Specifically, the BCEAG guidelines suggest that slopes >25° render corridors less effective. Although the scientific literature clearly indicates that some wildlife species prefer shallower slopes, particularly during winter (Alexander et al. 2006), there is no scientific indication that the BCEAG guidelines represent an appropriate cut-off, that is that slopes of ≤25° represent adequate habitat while slopes >25° represent habitat inadequate for wildlife movement. The scientific works cited in the original BCEAG guidelines in support of this prescription (Heuer et al. 1998, Callaghan 2002) do not present threshold values for slope beyond which wildlife will not use corridors. Some studies clearly identify multi-season and multi-species wildlife corridors in the Bow Valley on slopes greater >25° (Chetkiewicz and Boyce 2009) and the Cascade corridor in Banff National Park is widely considered effective (Duke et al. 2001), despite having substantial area with slopes >25° (Figure 7).

PATH: I:\2015\1539221\Mapping\MXD\WildlifeCorridorReport\1539221_Fig7_Proposed_CascadeCorridor_Slope_Rev2.mxd PRINTED ON: 2017-01-24 AT: 3:44:01 PM



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- WILDLIFE CORRIDOR AREA
- SLOPE > 25° (WITHIN WILDLIFE CORRIDOR AREA)

0 2 4

1:100,000 KILOMETRES

REFERENCES

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-01-17
DESIGNED	TSMV
PREPARED	AB
REVIEWED	KK/MGJ
APPROVED	TSMV

TITLE
SLOPES GREATER THAN 25° IN THE CASCADE WILDLIFE CORRIDOR

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	1	7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

0 25mm

Wolves, for instance, are capable of adjusting their behaviour to move across steep slopes when preferred valley bottom habitat is no longer available (Duke 2001, Shepherd and Whittington 2006). Similarly, elk have been reported using slopes >30° for movement in west-central Alberta (Frair et al. 2005), and in the Bow Valley, the steep slopes on the east side of Wind Ridge are considered critical elk winter range (NRCB 1992 pp. 10-34). In fact, the importance of these steep slopes for wildlife was a primary reason that development of the Wind Valley portion of the Three Sisters property was not approved (NRCB 1992 pp. 10-39). Grizzly bears and cougars also prefer to use higher elevations and steeper slopes in some cases and are capable of moving easily across such terrain (Chetkiewicz and Boyce 2009, Golder 2013).

Because of the ongoing concern and messaging by some concerned members of the public and some environmental groups about slopes >25°, the proportion of such slopes in each corridor segment proposed by TSMV is displayed in Figure 8. Almost all of the proposed wildlife corridors consist of areas with slopes less than 25°. Isolated and discontinuous slopes >25° are found only in 14% and 9%, of the proposed Smith Creek Along Valley Corridor extension and the proposed Pigeon Mountain Across Valley Corridor, respectively. No slopes >25° occur in the proposed realignment of the Stewart Creek Across Valley Corridor. In no case do any isolated and discontinuous slopes >25° in the proposed Smith Creek Along Valley Corridor extension and proposed Pigeon Mountain Across Valley Corridor represent a barrier to movement, and in all cases available data demonstrate wildlife movement through the proposed corridors and through areas south of the proposed corridors on steeper slopes (Section 4.4.5). Moreover, the low-elevation corridors proposed by TSMV for Smith Creek are primarily made up of habitats of relatively high probability of selection for elk, wolves, and cougars during winter, including in the small areas with slopes >25° (Section 4.4.5). In addition, as shown on Figure 8, the minimum distance between a corridor boundary and generally continuous slopes >25° is 470 m which is 120 m greater than the 350 m prescribed by the NRCB as a minimum overall width.

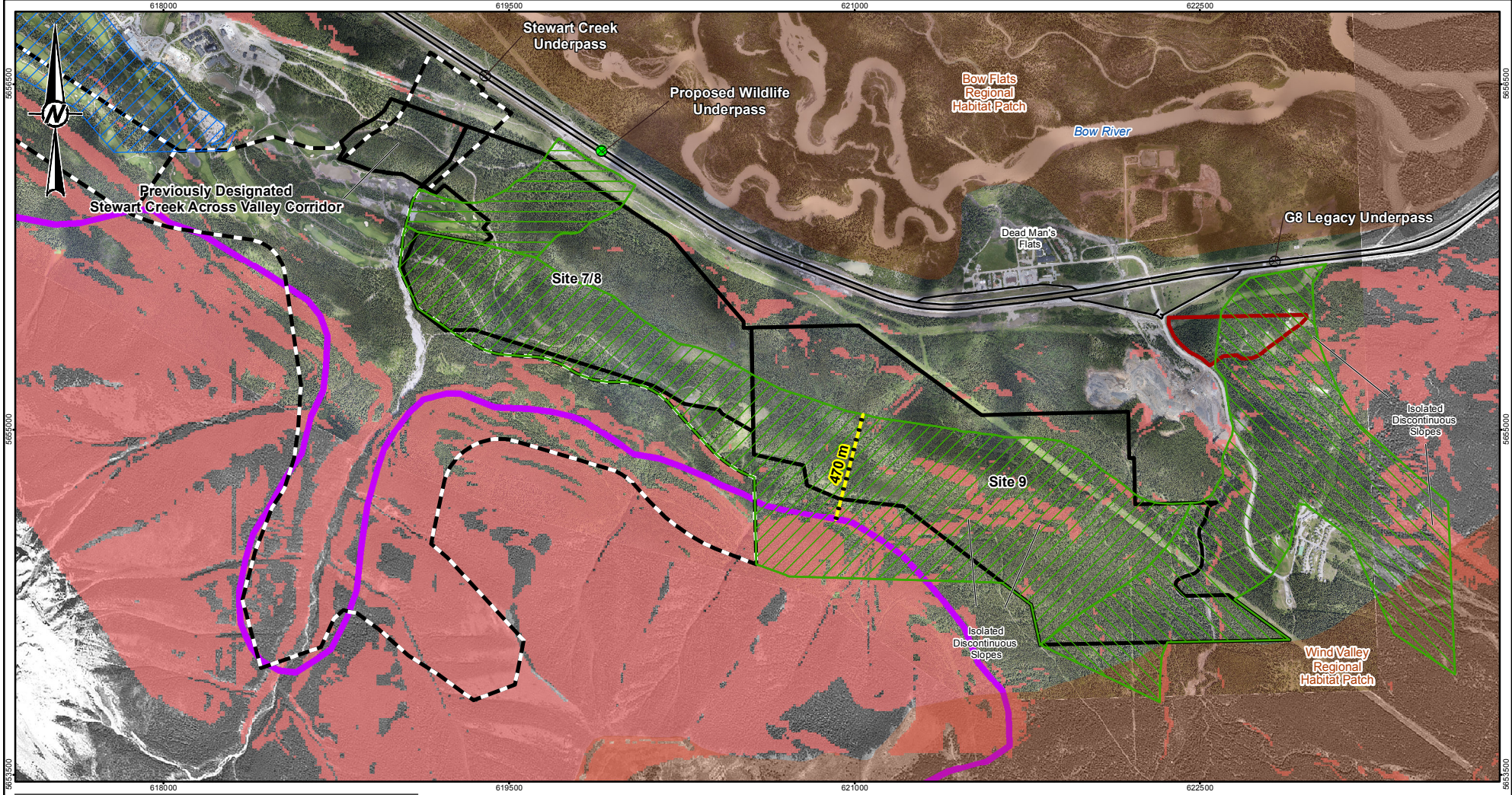
4.4.8 Is the Corridor in the Least Developed State Possible?

Yes.

Corridors occur in areas with limited existing development, although much of the Crown and TSMV property on the south side of the Bow Valley has been subject to mining, logging and other forms of disturbance for well over 100 years, and is not without human impact of any kind. In cases where development is already present such as in the vicinity of the proposed Pigeon Mountain Cross Valley Corridor, the delineation proposed by TSMV minimizes the inclusion of development (i.e., excludes Thunderstone Quarry and Banff Mountain Gate).

Importantly, the Province must take responsibility for effectiveness of proposed corridors on lands not provided by TSMV where other developments and activities may occur. For example, TSMV cannot address public land use that may hamper corridor functionality, such as the Kananaskis Gun and Archery Club whose shooting range lease in the Pigeon Mountain Cross Valley Corridor was recently renewed by Province and Town of Canmore, or the provision of freehold title versus a previous lease arrangement for Banff Mountain Gate development.

PATH: I:\2015\1539221\Mapping\MXD\WildlifeCorridorReport\1539221_Fig8_Proposed_Corridor_Slope_Rev4.mxd PRINTED ON: 2017-03-03 AT: 3:11:43 PM



LEGEND

- EXISTING HIGHWAY WILDLIFE UNDERPASS
- PROPOSED HIGHWAY WILDLIFE UNDERPASS
- APPROXIMATE CONTINUOUS SLOPE > 25°
- PRIMARY HIGHWAY
- APPROVED 1998 WILDLIFE CORRIDOR (AS AMENDED)
- HABITAT PATCH
- KANANASKIS GUN AND ARCHERY CLUB
- PROPOSED SMITH CREEK ALONG VALLEY WILDLIFE CORRIDOR
- PROPOSED PIGEON MOUNTAIN WILDLIFE CORRIDOR
- PROPOSED OPTIONAL STEWART CREEK WILDLIFE CORRIDOR RELOCATION
- SLOPE > 25°
- STEWART CREEK GOLF COURSE CONSERVATION EASEMENT
- TSMVPL PROPERTY BOUNDARY

0 500 1,000
1:25,000 METRES

REFERENCES

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3. APPROVED WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
TSMV C/O QUANTUMPLACE DEVELOPMENTS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-03
DESIGNED	TSMV
PREPARED	SG
REVIEWED	KK
APPROVED	MJ

PROJECT
PROPOSED SMITH CREEK WILDLIFE CORRIDOR EVALUATION

TITLE
SLOPES GREATER THAN 25° IN PROPOSED SMITH CREEK WILDLIFE CORRIDORS

PROJECT NO.	PHASE	REV.	FIGURE
1539221	9300	4	8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
25mm
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5.0 ADDITIONAL CONSIDERATIONS

This section presents some additional considerations that are not part of AEP's mandate to define the spatial boundaries of the wildlife corridor as outlined as a condition of NRCB Decision #9103, and may not affect decisions about the spatial location of corridors, but are nevertheless related to corridor function. Discussion of additional considerations in this section focuses on habitat enhancement and wildlife fencing. Habitat enhancement can be applied to increase probability that wildlife will use corridors and could encourage greater use away from development areas. Wildlife fencing can reduce the probability of negative interactions between wildlife and people and will likely dramatically improve the function of designated corridors occurring adjacent to development, such as the corridors proposed here that occur adjacent to TSMV properties. These additional considerations are discussed in turn in the following sections.

5.1 Habitat Enhancements

Habitat enhancements have been identified as one way to improve the efficacy of wildlife corridors (Golder 2012, Section 3.2, p.88). The NRCB also recommended such mitigation with the caveat that vegetation management be addressed at a regional scale (NRCB 1992 pp. 10-38). Concerns identified by the NRCB include placing enhancement sites too close to development, which might cause habituation by wildlife and negative human-wildlife interactions, or wildlife failing to use the enhancement sites because developments are avoided (NRCB 1992 pp. 10-35).

Enhancements that reduce forest cover can provide increased forage for ungulates, enhance habitat for large carnivores (i.e., increased prey) and provide increased berry production that would benefit bears (NRCB 1992). Enhancements have previously been created in the approved 1998 Along Valley Corridor during early phases of TSMV development and remote camera studies conducted by Chinook Co. for PwC (unpublished data) indicate that these areas are used extensively by wildlife, especially bears.

Previous modelling conducted by Golder (2012) indicates that applying deforestation as a habitat improvement technique in the existing approved Along Valley Corridor will increase probability of selection for many wildlife species, including all of the large mammal species for which Golder conducted habitat suitability modelling. Golder continues to recommend this approach to increase probability of selection by wildlife in wildlife corridors with the caution that high quality habitat directly adjacent to development be monitored to ensure habitat enhancements do not increase negative human-wildlife interactions.

5.2 Wildlife Fencing

Wildlife fencing is another important consideration that will likely materially improve corridor function as development proceeds in TSMV, both in the Smith Creek ASP and Resort Centre ASP Amendment.

Corridor efficacy should also be considered in light of negative human-wildlife interactions. The NRCB (1992) approved development with the knowledge that populations sinks (i.e., a place that animals prefer to be, but where they have high mortality risk) might be created if animals were attracted to development (NRCB 1992 pp. 10-42 and 10-43), and the Board looked to aversive conditioning to keep animals out of developed areas. Nevertheless, considering the implications of wildlife habituation and negative human-wildlife interactions for corridor efficacy is prudent given that interactions between people and wildlife are common in the Bow Valley, sometimes with significant negative consequences (Chetkiewicz et al. 2006). This is particularly important for the Province because aversive conditioning cannot be legally undertaken by citizens or businesses like TSMV without specific and special approval for such action from the Province, and therefore these actions generally fall to the Province. Second, proliferation of attractants in the overall Town of Canmore like fruit trees, barbeques, and bird feeders, create substantial incentives for wildlife to enter developed areas despite local bylaws, due to minimal enforcement activity by the Town of Canmore.

Incorporating too much high-quality habitat into corridor design where corridors occur near or within human developments can be counter-productive without appropriate mitigation; it might encourage animals to remain in places where they have an increased risk of mortality (known as an attractive sink; Delibes et al 2001, Nielsen et al. 2006). Chetkiewicz et al. (2006) point out that questions about the best types of habitat to incorporate into corridor design remain unanswered, but that habitats that are not too strongly selected may facilitate movement while preventing residency (see also Schultz 1998).

An ideal situation for corridor efficacy from the perspective of human-wildlife interactions in the Bow Valley would be for aversive conditioning and attractant management to reduce habitat suitability of developed landscapes to be near nil, for wildlife to use corridors of moderate quality near development for movement (but for animals to spend little time near development), for the amount of “soft” corridor edge bordering development to be minimized and for high-quality habitat patches to retain animals most of the time (i.e., the highest probability of selection for habitats should occur in habitat patches).

However, this situation is not likely achievable in Canmore. Although humans often view wildlife habitat in binary terms as either habitat or unsuitable “matrix” (Bender and Fahrig 2005), animals rarely use landscapes this way. Development is thought to replace habitat with unsuitable matrix and so corridors, which are often linear in nature, are set aside to connect patches of habitat fragmented by matrix. However, wildlife often enters the “matrix”.

For example, habituated elk also spend substantial time in urban areas including school yards where they pose a real human safety risk (Figure 9), and this is reflected by high use throughout Canmore by elk wearing GPS collars (unpublished Provincial data; Golder 2013). Elk in the Bow Valley are so habituated to people that in one study they only respond by moving away if people approach within 20 to 50 m, and even then did not move far without strong provocation including starter pistols, screamers, cracker shells, and actively chasing the elk by running after them (Kloppers et al. 2005). A fence was eventually installed around the school in Banff to prevent negative interactions between elk and people.

Carnivores that are tolerant of human activity such as cougars are also commonly found in habitat patches and movement corridors in the Bow Valley. Cougars are adaptable to anthropogenic landscape change (Knopff et al. 2014), and are frequently found near developed areas in the Bow Valley (unpublished Provincial data; Golder 2013). Cougars do not always move away from people and can have short flight initiation distances in developed landscapes. In one study in New Mexico, cougars moved away from researchers 66% of the time when approached within 2 to 50 m, but remained where they were (25%) or exhibited an aggressive response (9%) on other occasions (Sweanor et al. 2005).

Grizzly bear habitat relationships near anthropogenic features are more complex. Although grizzlies may generally avoid human activity and development (Apps et al. 2004), some bears are more tolerant than others and may access high quality habitats near development (Chruszcz et al. 2003; Gibeau et al. 2002a). In some parts of the Rockies, grizzly bears tend to be found close to human disturbance, such as oil and gas development (Labree et al. 2014; McKay 2014) or roads (Roever et al. 2008, Roever et al. 2010). Some bears, particularly females with cubs, may select more developed landscapes to reduce encountering mature males, which sometimes kill the cubs (Elfstrom et al. 2012).

Figure 9: Elk in a School Yard in TSMV (photo courtesy Jay Honeyman)

Grizzly bears in the Bow Valley tend to avoid high density development (e.g., downtown Canmore), but select areas near lower density urban developments with adjacent natural habitats (e.g., near Peaks of Grassi or Silvertip; unpublished Provincial data; Golder 2013). In Scandinavia, brown bears did not exhibit flight initiation until people approached between 69 to 115 m (Moen et al. 2012), although the applicability of these data to grizzly bears in the Bow Valley may be limited.

Bears, including both black bears and grizzly bears will enter developed areas in Canmore due to attractants like fruit trees or bird feeders (Figure 10).

Each year, animals are destroyed or relocated in Canmore because of negative interactions with people caused by wildlife attractants. For example, in fall 2015 a mother black bear and her two cubs had to be relocated after being found eating fruit from trees on residential properties in Canmore (Small 2015). Bears that are relocated do not always survive, and those that do may return over distances of hundreds of kilometers to the original location of the negative interaction or may cause additional negative interactions elsewhere (Linnell et al. 1997).

Figure 10: A Black Bear Eats Apples in a Back Yard in Canmore (photo courtesy Jay Honeyman)

Negative wildlife human interactions that are recorded and tracked by the provincial government are generally defined as incidents where there was a perceived threat, property damage, or incidents involving unnatural food attractants. Available Provincial data about negative interactions available for the Bow Valley were analyzed by Golder (2013) for the period 1985-2011. During this time, 2,807 negative interactions between people and carnivores were reported in and around the Bow Valley, only 353 of which occurred in zones overlapping the TSMV lands and adjacent wildlife corridors. Most conflicts (90%) involved bears and most occurred in residential areas. Places like Peaks of Grassi, the Homesteads, Rundleview, Cougar Creek, Eagle Terrace, and Silvertip where housing developments occur adjacent to wildlife corridors or habitat patches are hotspots for negative human-wildlife interactions.

Negative human-wildlife interactions may have population level consequences for wildlife, especially large carnivores, which are sometimes killed or relocated when negative interactions occur. Grizzly bears, which are designated a provincially Threatened species that are found regularly within the Smith Creek and Resort Centre Along Valley Corridors and other areas in the Bow Valley, present an illustrative example. The Bow Valley, including the towns of Canmore, Banff and Lake Louise, represents one of the most intensely developed and heavily accessed landscapes in North America where a grizzly bear population still persists (Chruszcz et al. 2003).

Tolerance for negative interactions with grizzly bears is low (Jorgenson 2012, pers. comm.) and bears in Canmore are often translocated or killed if they spend time near residential developments, or are involved in aggressive interactions with people. Most grizzly bear mortality in the Bow Valley is human-caused, with most bears dying as a result of vehicle or train strikes, or removed as problem animals (Nielsen et al. 2004; Garshelis et al. 2005).

During 1997-2015, 17 grizzly bears, 158 black bears, and 4 bears of unknown species were killed or translocated in the vicinity of Canmore (from the Banff East Gate to the Kananaskis River), averaging more than nine bears per year (AEP, unpublished data). High mortality rates near Canmore have led scientists and government wildlife managers to conclude that the Bow Valley represents a local scale population sink (Benn and Herrero 2002; Hebblewhite et al. 2003; Nielsen et al. 2004; Nielsen et al. 2006; Sawaya et al. 2012; Webb 2013, pers. comm.; Boukall 2016, pers. comm.). Sawaya et al. (2012, pg. 11) succinctly conclude that, although additional confirmatory analyses would be helpful, their results “show concordance with previous research suggesting that the Bow Valley may act as an attractive sink for grizzly bears in the Central Canadian Rocky Mountains”.

In addition to problems caused by animals entering development, available data clearly indicates that human use in wildlife corridors is high. Remote camera data are available from more than 1,000 monitoring locations in and around the existing Along Valley, Tipple and Stewart Creek wildlife corridors and on Resort Centre, Stewart Creek, Smith Creek and Wind Ridge. These data were collected by Chinook Company Environmental Ltd. (Chinook Co.) during 2009-2012, Corvidae Environmental Consulting Inc. (Corvidae) during 2014-2016, and the Town of Canmore and AEP. Analysis of these combined datasets indicates that use by people and off-leash dogs within existing wildlife corridors is substantial; the numbers of humans and their dogs are approximately double the number of wildlife recorded in existing wildlife corridors adjacent to TSMV.

Despite high levels of human use, wildlife corridors are still used by most wildlife species and appear to be generally effective. For species that are most sensitive to human activity, such as wolves, the corridors and habitat patches in the Bow Valley may only be partially effective (Lee et al. 2010, Golder 2013). But even wolves do occasionally use corridors and habitat patches in the Bow Valley (Golder 2013; Corvidae, unpublished data from 2015 and 2016). These findings are consistent with work highlighting the adaptability of large carnivores, including wolves, in human dominated landscapes (Duke 2001; Chapron et al. 2015).

Although wildlife corridors in the Bow Valley may be regularly used by most species, corridors should be places where animals can move in relative security and corridor efficacy should also be considered in light of negative human-wildlife interactions (BCEAG 2012; Golder 2013). In this sense, wildlife corridors in the Bow Valley are not as effective as they could be because high human use and off-leash dog use in the corridor leads to an increased potential for negative interactions.

Indeed, the greatest risk to wildlife associated with human use of wildlife corridors near Canmore under existing conditions does not stem from a reduced probability of corridor use by wildlife, but rather from an increased risk of negative human-wildlife interactions as animals use the corridor (Golder 2013).

Much of the human use within existing corridors that increases potential for negative human-wildlife interactions is contrary to existing regulations. For example, use in wildlife corridors is only permitted on designated trails (Government of Alberta 2002). However, undesignated trails are more common than designated trails in wildlife corridors (Golder 2013), and trails often radiate out from many backyards of residences adjacent to corridors. Moreover, the Bow Valley Protected Areas Management Plan designates the Along Valley Corridor as a P-4 Wildlife Corridor, which means that most trails are closed during December 1 to June 15 (Government of Alberta 2002). Analysis of remote camera data shows 35% of human use occurred during months when the corridor was closed to use (unpublished data, Town of Canmore, Province of Alberta). Use of corridors by people was highest in May, a time period which is critical for wildlife species such as elk, deer, and moose, which may be calving and therefore more susceptible to human disturbance.

Similarly, off-leash dog use is not permitted in wildlife corridors, and such use has been considered one of the most important factors adversely affecting wildlife use of corridors and habitat patches in the Bow Valley (BCEAG 1999b). Between 2009 and 2012, remote camera data on TSMV property and adjacent wildlife corridors identified 818 records of dogs, of which 609 or 74.5% were off-leash (unpublished data, Town of Canmore, Province of Alberta).

Because many wildlife species have adapted to human developments, risk associated with negative human-wildlife interactions can also increase where opportunities for movement into developed areas occur at the interface between wildlife habitat and human development. The design of many previous developments in Canmore likely have exacerbated this problem. For example, Golder (2002) previously recommended and BCEAG (2012) still recommends that development areas adjacent to corridors should include as much open space as possible. That is, golf courses and recreation areas are preferred over acreage lots, which in turn are preferred over high-density housing.

The intention of this “soft edge” approach was to increase the “effective width” of the wildlife corridor by reducing the effects of sensory disturbance on wildlife travelling within corridors, thereby increasing the probability that the corridor would be used. However, this approach was based on the assumption that wildlife would strongly avoid human development, and the humans would use wildlife corridors appropriately. These assumptions have since been proven false based on a number of years of site specific data, and an unintended side-effect has been an increase in negative interactions between humans and animals like elk, grizzly bears, and cougars that frequently select for soft edges (unpublished Provincial data).

Wildlife fencing (e.g., 2.5 m page wire fence with a buried apron) will help resolve future problems associated with both wildlife entering developments adjacent to the corridors proposed by TSMV and diffused human use within those corridors.

A wildlife fence option that was selected for recommendation as a mitigation measure for the Resort Centre ASP amendment and Smith Creek ASP is a 2.5 m page wire fence with a buried apron similar to those found on the TransCanada highway and in Jackson, Wyoming. A high tension wire at the top will be used to address potential tree fall. This type of wildlife conservation fence was chosen because it can address both primary wildlife issues that currently exist in the Bow Valley and will allow for development to occur adjacent to the wildlife corridor. This type of fence will substantially reduce or eliminate the ability of mammals the size of a coyote or larger to enter the development, while simultaneously reducing dispersed human use in the adjacent wildlife corridors. To achieve greatest overall efficacy, the wildlife conservation fence should encompass developments in the TSMV area and tie into the existing TransCanada Highway fence.

The wildlife fence will easily accommodate human access to existing wildlife corridors on designated trails using walk-through swing gates. The design allows human access but does not permit wildlife passage. Examples of successful deployment of such access points can be found in numerous places along the TransCanada Highway in the Bow Valley (e.g., Redearth Trail head access point) and on the enclosed portion of the Lake Louise Ski Hill to allow access to the Pipestone Trail system in the summer. Larger locked gates will also be incorporated into the fence at intervals to permit wildlife to be removed from the developed area should they get in. Experience in Banff National Park and communication with AEP employees suggest swing gates are more effective than jump-outs for this purpose (Honeyman, Gummer, Boukall 2016, pers. comm.)

The efficacy of a wildlife fence for controlling human access can be seen along the fenced portions of the TransCanada Highway, where people rarely go over the fence to access trials and vehicles tend to pull out at designated trailheads. Compare this with Highway 40, which is unfenced, where vehicles stop at a large number of locations in the ditch or on the side of the road to access various trails or further east of Canmore along the TransCanada Highway, where vehicles stop at a large number of locations in the ditch like Heart Creek or McGillvray Pond.

Although fencing will keep wildlife from entering developed areas, an important aspect of maintaining a wildlife fence is to reduce attractants within human development area so that wildlife are less likely to attempt to breach the barrier. A major attractant for carnivores like cougars are habituated elk and deer which reside within the town boundaries.

Although the exact alignment of the fence has not been finalized, it would be aligned between the Projects and wildlife corridors and will be constructed on TSMV land. If the development is built in phases, the fence should completely enclose each phase. Without this type of fence, conflict is likely to be a function of the linear exposure of development to habitats that wildlife wants to use more than a function of total footprint.

6.0 CONCLUSIONS

In 1992, the NRCB approved the development of TSMV lands with conditions including the provision of wildlife movement corridors. TSMV's proposed Smith Creek Along Valley Corridor and the proposed Pigeon Mountain Across Valley Corridor wildlife corridors complete the connection between the Wind Valley Habitat Patch and the Bow Flats Habitat Patch and creates a contiguous wildlife corridor on the south side of Canmore through and adjacent to TSMV properties (Figure 1). The corridors proposed by TSMV meet or exceed the criteria set out in the 1992 NRCB Decision Report. Specifically, as described in detail in Section 4.4, the proposed corridors meet or exceed the following criteria:

- links to other corridors on private and provincial lands at a regional scale;
- follows most direct links through TSMV lands between the ends of existing approved corridors and habitat patches;
- all primary wildlife corridors are at least 350 m wide; also at least 350 m wide below 25° slopes;
- intended for use by a large number of species (i.e., multi-species corridor);
- does not contain topographical features that would create barriers to movement; and
- in the least developed state possible.

As such, the corridors proposed by TSMV will create a contiguous wildlife corridor on the south side of Canmore through and adjacent to TSMV properties. The biophysical characteristics of these corridors are appropriate for maintaining wildlife movement between designated wildlife habitat patches in the Bow Valley around TSMV properties and for maintaining existing regional connections between Kananaskis Country and Banff National Park in the Bow Valley.

Report Signature Page

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https://capws.golder.com/sites/1539221smithcreekasp/reportsdeliverables/wildlife corridor evaluation/wildlife corridor evaluation_final_march_2017.docx

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APPENDIX A

Natural Resources Conservation Board Letter to Three Sisters Mountain Village Ltd. (April 6, 2004)

chi E

NRCB | Natural Resources Conservation Board

6 April 2004

Mr. Ron Casey
Three Sisters Mountain Village Ltd.
Suite 1000, 1520 – 4th Street S.W.
Calgary, Alberta T2R 1H5

5.7.1

Dear Sirs:

Re: Three Sisters Mountain Village Ltd.
NRCB Decision Report 9301, Approval No. 3

The NRCB Chair has requested that I respond to your 25 March 2004 letter. The Board has obtained updates from time to time from Alberta Sustainable Resource Development (SRD) concerning the status of wildlife corridor proposals related to your development. Staff from the Board contacted appropriate individuals within SRD within the last week in order to obtain the most current information available.

Based on the information obtained from SRD, the Board is satisfied that the progress made toward the establishment of wildlife corridors within the Three Sister's lands is consistent with the provisions of NRCB Approval #3. The progress made toward the finalization of the conservation easement represents a key element in the ultimate satisfaction of the condition 14 of the Approval issued in 1992. Based on meetings between NRCB staff and SRD staff, the Board is satisfied that the changes made to the corridor design from that which the Board approved in 1992 represent the application of more recent scientific thought in relation to wildlife corridor design, and that these changes will result in more effective corridors. The NRCB appreciates the efforts of Three Sisters, the Town of Canmore, and SRD to implement this change in approach to corridor design.

The NRCB also understands that Three Sisters is continuing to work with the Town and SRD to establish appropriate corridor lands on the east portion of the subject lands. The NRCB accepts as reasonable the approach that the planning of these corridor lands will continue such that the final design will precede development plans for that portion of your project.

Yours truly,

William Young Kennedy
General Counsel

cc. Brady Whittaker, NRCB Chair
Robert Powell, NRCB Director of Science and Technology
Alberta Environment, Dave Neilson
Bow Valley Wildlife Corridors Working Group
Mayor Glen Craig, Town of Canmore

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