OSIRIS WILDLIFE CONSULTING
STRATEGIC MANAGEMENT SOLUTIONS

Wildlife Impacts Associated with the Proposed Upgrades to the Trans-Canada Highway (Park Bridge to Brake Check): Preliminary Design Considerations

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December 15, 2004

Executive Summary

This highway design project consists of upgrading, redesigning and relocating 5.5 km of the Trans-Canada Highway adjacent to the Kicking Horse River 12 to 17 km east of Golden, British Columbia. The environmental analysis in this report addresses potential wildlife impacts and their mitigation at a level appropriate to the preliminary design stage of the highway project.

With appropriate mitigation measures in place, it is unlikely there will be measurable negative impacts on wildlife populations associated with direct mortality from animal-vehicle collisions, habitat fragmentation from barriers to animal movement, direct loss of habitats to the project footprint, or cumulative effects associated with other wildlife impacts in the area. Although the exact nature of the appropriate mitigation measures required cannot be determined until the detailed design stage, there are a number of reasonable and tested mitigation techniques available. Minor modifications to drainage culverts and concrete roadside barriers should address small animal concerns, and the bridge and tunnel system, if properly designed, should address large animal concerns.

Although the faster design speed and straightening of curves in the project area means vehicle traffic speed will increase with completion of the project, a combination of mitigation measures, possibly including wildlife exclusion fencing, can mitigate these impacts of direct mortality. Wildlife Accident Reporting System data from 1982 to 1993 indicates that the number of road-killed wildlife is higher at the east end compared to the west end of the project, but is still relatively low compared to sections of the highway closer to Golden. Approximately 70% of these roadkills in the project area were deer, 25% were elk and 5% were moose.

The total habitat impact associated with the footprint of the project is estimated at 36 to 38 ha, depending on the final alignment chosen. South-facing Douglas-fir habitats east of Park Bridge are considered relatively important ungulate winter ranges and summer bear foraging sites, and approximately half the project footprint (a total of 16 to 18 ha) impacts these habitat types. Wildlife habitat mapping rate most Douglas-fir habitats as class 3 and 4 (moderate and low) for deer, elk and bear, and class 4 (low) for moose and bighorn sheep. As well, the project footprint only affects between 3 and 8% of any specific habitat type within the 1 km wide “area of interest” around the Trans-Canada Highway. All the proposed alignments avoid sensitive mountain goat habitats north and south of the Kicking Horse River. The total habitat impact associated with the footprint of a potential waste rock disposal site is estimated at 11 ha. This site is entirely contained within an existing clearcut, and wildlife habitat ratings are class 3 (moderate) for elk and bear, and class 4 (low) for deer and moose.

The BC Conservation Data Centre archive did not identify any specific element occurrences (site locations) for species at risk (including COSEWIC listed species) within the project area. Breeding bird surveys were able to detect 48 species, all of which are widely distributed throughout much of British Columbia. There were no Red- or Blue-listed bird species detected during 2004 surveys in the area affected by the project footprint.

With appropriate mitigation measures, the project is not likely to jeopardize long-term survival of any local or regional wildlife populations. Most species are relatively common, and even if mitigation efforts were unsuccessful these populations are large enough to be able maintain viable populations. Only rare species have populations low enough to be negatively affected to the point of jeopardizing long-term survival of local populations. Among vertebrates, only the Blue-listed grizzly bear and wolverine could potentially be affected by unmitigated impacts resulting from animal-vehicle collisions and habitat fragmentation. With appropriate mitigation measures in place there should be no long-term negative impacts to either grizzly bear or wolverine populations.

Rare plants species are unlikely to occur within the project area, and therefore it is not anticipated that these populations will be affected by the project. The only rare plants that occur in the general area of the Western Continental Ranges Ecoregion are four red-listed plants (*Carez crawei*, *Chenopodium atrovirens, Solidago gigantea* ssp. *serotina*, and *Lomantium triternatum* ssp. *platycarpum*) and two blue-listed (*Melica smithii* and *Astragalus bourgovii*). Although the likelihood of any of these species occurring within the project area is considered remote, efforts should be made during construction to look for their presence in appropriate habitat types in order to prevent any possible negative impacts.

Among the three preliminary route alignments analysed, the Option E-6 alignment is considered to have the least potential impact on wildlife resources, because it is the most permeable to animal movements and it has more potential crossing structures and less retaining wall barriers. The Option E-6 alignment is also the closest to the existing highway east of Park Bridge so the impact to ungulate winter ranges is less than either Option 11 or 12A.

General mitigation strategies are presented for consideration. These potential mitigation measures are designed to prevent animal-vehicle collisions, improve public safety, reduce habitat fragmentation, minimize and mitigate habitat impacts associated with the project footprint, and avoid impacts associated with human disturbance.

Table of Contents

List of Figures

List of Tables

List of Appendices

Terms of Reference

The following are the terms of reference for this wildlife study with respect to requirements for Phase 2 of the Kicking Horse Canyon project:

1. Determine if habitats within the project footprint are critical to wildlife populations.

2. Determine if habitat loss and fragmentation resulting from the project is likely to cause measurable reductions in species populations.

3. Determine if project impacts combined with other unrelated impacts -- such as logging, roadways, recreation uses and hunter harvest -- are likely to cause measurable reductions in species populations.

4. Comment on the relative importance of the various other unrelated impacts.

5. If species population reductions are likely, will long-term survival of the local or regional populations be jeopardized?

6. Define in general terms appropriate mitigation measures.

7. Prepare a brief report detailing the findings of this review.

Acknowledgements

I would like to thank Chris Morley, Doug Kelly, Craig Barlow and Darcy Grykuliak for reviewing and commenting on earlier drafts of the report. Len Sielecki supplied raw WARS data used in the analysis of the distribution of animal-vehicle collisions.

Introduction

This highway project consists of upgrading, redesigning and relocating approximately 5.5 km of the Trans-Canada Highway located 12 to 17 km east of Golden, British Columbia adjacent to the Kicking Horse River. The analysis in this report addresses wildlife and habitat impacts that can be determined at this preliminary design stage. Since the project is structured using design-build-finance-operate (DBFO) model, the appropriate mitigation measures will not be obvious until a particular detailed design is developed.

This overview assessment is based on existing reconnaissance level studies, habitat mapping, animal-vehicle collision data, literature review and field reconnaissance on October 21 and 22, 2004. The purpose of this report is to provide an overview of possible wildlife impacts and mitigation measures that could be applied to design, construction and operation of this section of Segment 990 on the Trans-Canada Highway. After the final highway alignment is chosen, more site-specific potential wildlife impacts and associated mitigation measures should be identified during the detailed design phase.

General Impact Assessment

The main impacts of highway construction and operation on wildlife and wildlife populations are related to direct habitat loss, direct mortality, fragmentation of habitats, disruption of movement patterns, increased human disturbance, and associated human development (Jackson and Griffin 1998, Findlay and Bourdages 2000, van der Grift and Kuijsters 1998, Ruediger 1998). Even relatively small roads have the potential to cause negative impacts. High-speed highways pose an even greater threat to wildlife populations if mitigation measures are not included in the design. High-speed highways are more of a threat since they affect a greater variety of species; the higher speeds and traffic volumes result in more animal-vehicle collisions, and larger volumes of traffic increases public access and the wildlife problems associated with it.

Besides the effect on animal populations, automobile collisions with large animals can cause considerable vehicle damage, human injury, and even the occasional death. In British Columbia, between 5 and 10% of large animal-vehicle collisions resulted in hospital treatments for vehicle occupants (Economic Planning Group 1986). Fatalities to vehicle occupants occur in approximately 0.1 percent of collisions (Hughes *et al.* 1996) with larger ungulates (e.g. elk and moose) being much more dangerous than deer (Forman and Deblinger 1998). Animal-related motor vehicle accident claims have been increasing steadily in recent years, from $17.9 million in 1997 to $30.8 million in 2002 (Sielecki 2004).

Direct Habitat Impacts

The project occurs within the Western Continental Ranges Ecoregion, an area of high, rugged mountains and deep narrow valleys (Demarchi 1996). The Trans-Canada Highway within the project area ranges in elevation from 918 m to 1120 m above sea level. Two biogeoclimatic zones are represented in the project area, the Interior Cedar – Hemlock zone (ICHmw1 and mk1) mostly on the northern aspects, and the Montane Spruce zone (MSdk) on the south-facing aspects (Silvatech 2004; Meidinger and Pojar 1991).

The main large animal species potentially affected by the project include mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), mountain goat (*Oreamnos americanus*), bighorn sheep (*Ovis canadensis*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos*), coyote (*Canis latrans*), gray wolf (*Canis lupus)* and wolverine (*Gulo gulo*). A more complete list of potential bird and mammal species in the project area is provided by Silvatech (2004).

Impacts to Different Habitat Types

The footprint of the project has the potential to affect moderately important wildlife habitats, since it is located relatively close to valley bottom near the Kicking Horse River. The length of the project is estimated at 5.5, 5.6 and 5.8 km for options 11, 12A, and E6, respectively. The total habitat impact associated with the footprint of the project is estimated at 36.4, 37.5 and 38.1 ha for options 11, 12A, and E6, respectively (Yuzdepski 2004). The actual footprint for the project will not be known until the detailed design phase.

Douglas-fir vegetative cover types are the habitat type most affected by the project footprint (Silvatech 2004). These relatively common habitat types consist of warm dry Interior Douglas-fir ecosystems on morainal / colluvial materials (F0), talus / steep slopes (F1), open Aspen – Wheatgrass (F2), and Spruce – Pine – Aspen – juniper – pinegrass (F3) (Silvatech 2004). These south-facing habitats are considered important ungulate winter ranges and summer bear foraging sites (Silvatech 2004). Approximately half the project footprint (a total of 16 to 18 ha) impacts these Douglas-fir habitat types (Silvatech 2004). Chytyk *et al.* (2000) rate most of these habitats as class 3 and 4 (moderate and low) for deer, elk and bear, and class 4 (low) for moose and bighorn sheep. The 16 to 18 ha affected amounts to only 5 to 6% of the Douglas-fir habitats within the relatively narrow 1 km wide "area of interest" (Table 1).

The next most affected vegetative cover type involved Lodgepole Pine habitats. These are common habitat types that include Lodgepole Pine – Douglas-fir on talus / rock slopes (P1), Pine – Fir (PF) and Pine – Fir – Spruce with Aspen (PFA) (Silvatech 2004). Most of these habitats are not important for ungulates because of the steepness of slopes and closed canopy. The exception is the Pine – Fir – Spruce with Aspen (PFA) habitat type that is considered important to some wintering ungulates and birds (Silvatech 2004). The project footprint would impact approximately 5 to 10 ha of Lodgepole Pine habitats (depending on the final alignment chosen) (Silvatech 2004). Chytyk *et al.* (2000) rate these habitats as class 5 (very low) for deer, elk, moose and bighorn sheep, and class 4 (low) for bear. The 5 to 10 ha affected amounts to 3 to 5% of the Lodgepole Pine habitats within the 1 km wide "area of interest" (Table 1).

Talus habitats affected by the project are mostly the result of cuts and fills associated with the existing alignments of the Trans-Canada Highway and the Canadian Pacific Railway. The project footprint would impact approximately 2 to 3 ha of talus habitats (Silvatech 2004). Pika (*Ochotona princeps*), golden-mantled ground squirrel (*Cetellus lateralis*) and bighorn sheep would typically occupy these talus habitats. The 2 to 3 ha affected amounts to 6 to 8% of the talus habitats within the 1 km wide "area of interest" (Table 1).

Early seral habitats resulting from timber harvesting and prescribed burning are relatively common in the Kicking Horse Canyon and the project footprint will likely impact approximately 3 to 4 ha of the Cutblock / Burn (CB) and Cutblock / Burn – Open Douglas-fir – Aspen – Saskatoon Wheatgrass (CB/F2) habitat types (Silvatech 2004). These habitat types are considered important ungulate and bear foraging sites, particularly when there is adjacent old-growth forest for thermal and escape cover. Chytyk *et al.* (2000) rate most of these habitats as class 3 and 4 (moderate and low) for deer, elk and bear, and class 4 (low) for moose and bighorn sheep. The 2 to 3 ha affected amounts to 3 to 4% of the early seral habitats within the 1 km wide "area of interest" (Table 1).

The value of habitats within the project area is limited as ungulate winter range because of relatively high snowfalls at these elevations (918 to 1120 m). Further west in the Kicking Horse Canyon, lower snow depths mean habitat suitability ratings are generally higher for most ungulate species. Typical ratings for these south-facing aspects nearer to Golden are class 2 to 3 for deer (moderately high to moderate), class 3 to 4 for elk (moderate to low), and class 2 for bighorn sheep (moderately high) (Chytyk et al. 2000). Moose habitat ratings in the Kicking Horse Canyon near Golden are typically class 4 (low), which is comparable to ratings for moose habitat in the project area.

Table 1. Calculations of relative impacts of the project footprint as a percentage of total impact and as a percentage of the habitat types within the area of interest (after Silvatech 2004).

Habitat Types[1]	Option[2] 11 - % of total impact	Option[2] 12 - % of total impact	Option 11 - % of habitat in "area of interest"[2]	Option 12 - % of habitat in "area of interest"[3]
Douglas-fir types (FO, F1, F2, F3 & F4)	53%	43%	6%	5%
Lodgepole Pine types (P1, PF, PFA, PS)	15%	26%	3%	5%
Cutblocks and Burns (CB, CB/F2, CB/F3)	7%	10%	3%	4%
Transportation Corridor	16%	14%	12%	11%
Talus	9%	6%	8%	6%
Rock	0%	0%	0%	0%
Gravel Bar	0%	0%	0%	0%

1 – habitat types are described in the text and defined in detail in Silvatech (2004).
2 – Silvatech (2004) only analysed impacts for options 11 and 12.
3 – the "area of interest" is an arbitrary corridor 1 km wide that is centred on the existing alignment of the Trans-Canada Highway. The "area of interest" is 798 ha in size.

All the proposed alignments avoid mountain goat habitats north of the Kicking Horse River and west of Glenogle Creek (Demarchi and Searing 1997; Chytyk *et al.* 2000) as well as the well-documented mineral lick on the rugged bluffs immediately southeast of the existing Park Bridge (Poole and Walker 2000).

Breeding bird surveys in habitats affected by the project footprint were able to detect 48 species, all of which are widely distributed throughout much of British Columbia (Silvatech 2004).

Impacts to aquatic wildlife species and aquatic habitats associated with non-point source highway run-off pollution are not considered significant and should be adequately addressed through provincial water quality standards and fisheries mitigation measures.

Habitat Impacts Associated with a Potential Waste Rock Disposal Site

A potential waste rock disposal site is proposed for a clearcut on Mount Hunter approximately 1 km east of the Brake Check end of the project (Figures 9 and 10). This is one of several potential sites that may or may not be required during construction. The footprint of this waste rock disposal site is estimated at 11 ha and is entirely contained within an existing clearcut. Wildlife habitats are generally rated low for most species in this area, particularly for ungulates because of snowfall accumulations in late winter. Chytyk et al. (2000) rate the currently habitat suitability as class 3 (moderate) for elk and bear, and as class 4 (low) for deer and moose. Habitat values for bighorn sheep and mountain goats are very low to non-existent.

Direct Mortality

Animal-vehicle collisions have the potential to impact the viability of wildlife populations. The occurrence rate of animal-vehicle collisions is primarily a function of three factors, density of animals, traffic volume, and traffic speed. The faster design speeds of modern roads and highways, coupled with increases in traffic volumes, means the frequency and severity of animal-vehicle collisions will increase unless mitigation measures are implemented. Although the 100 kph design speed of the project is only slightly higher than the current design speed, the widening of the highway to four lanes and a wide shoulder coupled with fewer curves of increased radius means both truck and automobile traffic speed should increase substantially. Automobile traffic speed in particular should increase with the ability to pass the slower truck traffic on the steep grades.

In the Rocky Mountain Highway District, deer accounted for 79% of the 10,801 known species roadkills reported by the Wildlife Accident Reporting System from 1983 to 2002 (WARS) (Sielecki 2004). The next most common species reported by WARS was elk (13%), followed by moose (3%), bear (2%), coyote and sheep (1%). Consistent with the rest of British Columbia, the trend in the East Kootenays over the past 2 decades has been an increase in the number of wildlife-vehicle accidents (Sielecki 2004).

WARS data indicates that the number of road-killed wildlife is higher at the east end compared to the west end of the project. On the north facing slopes between sta 9+900 and 12+500 (Park Bridge) an estimated 0.9 roadkills/km/yr. Once the existing highway crosses the Kicking Horse River at Park Bridge the rate of road-kills increases to 1.3 roadkills/km/year (sta 12+500 to 14+000), and from sta 14+000 to the eastern end of the project road-kills increases again 2.3 roadkills/km/yr (WARS 1999, Ministry of Transportation 1999). Approximately 70% of these roadkills were deer, 25% were elk and 5% were moose (WARS 1999). Compared to the rest of segment 990 of the Trans-Canada Highway, the frequency of animal-vehicle collisions within the project area is below average on the north-facing slopes traversed at the west end of the project, and about average on the south-facing slopes traversed at the east end of the project (Figure 1). Animal-vehicle collisions in the project area are much less frequent compared sections of the highway nearer to Golden (Figure 1). Since WARS records only capture a small portion of the actual number of animal-vehicle collisions (Sielecki 2004), a 5 times correction factor was applied to raw data to generate the estimates presented in Figure 1.

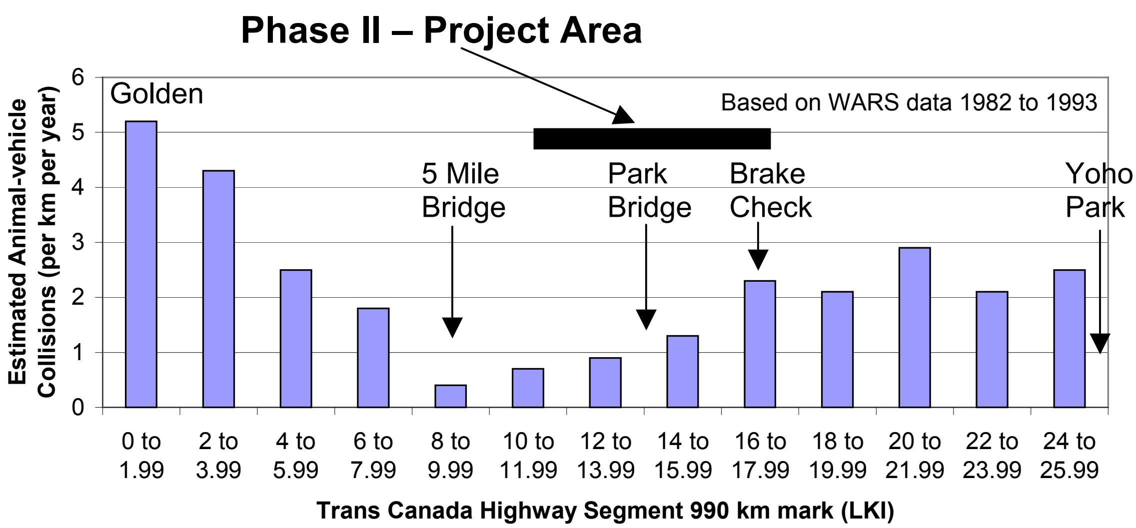

Figure 1. Relative frequency of estimated animal-vehicle collisions on segment 990 of the Trans-Canada Highway from WARS data 1982 to 1993.

Highway vegetation can attract wildlife species to the rights-of-way because of relatively higher food values associated with some plants, greatly increasing the probability of collisions with vehicles. Often grasses and forbs along highway rights-of-way are the first to green-up in the spring and remain succulent into the fall (Feldhamer *et al.* 1986).

Habitat Fragmentation and Behavioural Avoidance

Highways can act as barriers to animal movement, thus fragmenting wildlife habitats and causing significant impacts to wildlife populations (Clevenger 1998a). Some species of small mammals are reluctant to cross even small roads (Swihart and Slade 1984). Wide areas cleared for a highway right-of-way can form a significant barrier for shrews and rodents (Foresman 2004). These species are very vulnerable to predation by mammalian carnivores and raptors if they attempt to cross a highway right-of-way because of the lack of hiding cover.

Within the project area there are significant seasonal movements of large animals including ungulates, bears and other carnivores. For example, on Oct 21, 2004, numerous game trails and pellet groups associated with deer and elk movements were detected above the Park Bridge Slide and along the ridge east of Glenogle Creek (Figure 2). Although many seasonal movements could be in a generally east-west direction, Demarchi and Searing (1997) determined that local movements are still predominately north to south. Carnivores often have very large home ranges and encounters with the Trans-Canada Highway are likely frequent for some species. A movement model that simulates the movement of wolves in the winter through the project area was used to generate least resistant pathways. In turn, these least resistant pathways were used to predict areas of potential highway crossings by wolves (Callaghan *et al.* 1998). The Kicking Horse canyon may function as a regional corridor between the Columbia Valley and the Beaverfoot Valley and Yoho National Park. High quality wolf habitat is limited in the canyon. The primary, secondary and tertiary least resistant pathways all converge in the vicinity of Park Bridge because of topographic restrictions (Callaghan *et al.* 1998).

Demarchi and Searing (1997) observed 3 grizzly tracks in the vicinity of the Trans-Canada Highway along the north-facing slopes south of the river and west of Park Bridge. These were the only grizzly bear tracks observed during the summer string tracking study.

Within the area influenced by the shockwave, blasting during road building can disturb and damage bird embryos in nests, and otherwise disrupt normal breeding behaviour of bird species in the area. Blasting could also cause mountain goat at the Park Bridge mineral lick to avoid this traditional area during the spring and early summer.

Increased Human Development

New roads may create new access in remote areas and additional mortality due to hunting, trapping, poaching, and recreation (MacArthur *et al.* 1982, Findlay and Bourdages 2000, Trombulak and Frissell 2000). Because the new alignment follows the existing Trans-Canada Highway and no new highway access points are planned within the project area, this is not expected to be a potential impact of this project.

Impacts to Species at Risk

It is very unlikely that any plant or bird species at risk will be negatively affected by the project. The only species at risk that might be affect are grizzly bear, wolverine, and bighorn sheep, although significant negative impacts are not anticipated if appropriate mitigation strategies are employed.

The BC Conservation Data Centre did not locate any specific element occurrences (i.e. site specific locations) for species at risk (including COSEWIC listed species) within the project area (Silvatech 2004, Acres 1998). There are, however, a number of red- and blue-listed plant species that have been located in the broad area of the Western Continental Ranges Ecoregion and there is the remote possibility that they could occur within the project area. The red-listed plants that might occur in the study area are Crawe's sedge (*Carez crawei*), dark lamb's quarters (*Chenopodium atrovirens*), smooth goldenrod (*Solidago gigantea* ssp. *serotina*), and nine-leaved desert-parsley (*Lomantium triternatum* ssp. *platycarpum*) (BC Species and Ecosystems Explorer 2003; Silvatech 2004). The blue-listed species that might occur in the project area are Smith's Melic (*Melica smithii*) and Bourgeau's milk-vetch (*Astragalus bourgovii*). It should be emphasized that these species do not occur within the project area as far as we know. Where they do occur, Crawe's sedge and Smith's melic tend to be found in pocket wetlands or lush forest meadows (Douglas *et al.* 1998), and dark lamb's quarters and smooth goldenrod have been found on dry roadsides, mountain scree and other disturbed sites. Nine-leaved desert-parsley and Bourgeau's milk-vetch tend to occur on steep south-facing ridges.

Both grizzly bear (*Ursus arctos*) and wolverine (*Gulo gulo*) are designated as Special Concern in Canada by COSEWIC (Species at Risk Act 2004) and are expected to occur occasionally in the area. As well, grizzly bear, wolverine and bighorn sheep are all blue-listed in British Columbia as a species of Special Concern (formerly Vulnerable) (BC Species and Ecosystems Explorer 2003). Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. In the absence of appropriate mitigation, these blue-listed species could be negatively affected by the project as a result of direct mortality from collisions with vehicles as well as the indirect impact of habitat fragmentation if the highway acts as a barrier to animal movement.

Breeding bird surveys conducted in June and July 2004 did not detect any Red- or Blue-listed species in the area impacted by the project footprint (Silvatech 2004).

Potential routes within the transportation corridor

The 3 options evaluated below are only preliminary routing designs that have been developed as part of work done to date (see Appendices 1 - 4). The actual route chosen may or may not correspond to any of these three possible alignments.

Option E-6 alignment

The Option E-6 alignment has a maximum grade of 5.5%. It appears to have the least potential impact on wildlife resources because it is the most permeable to allow large animals to move across the highway right-of-way (Figures 3 & 4). In addition to the bridge-tunnel complex over the Kicking Horse River, there is also the potential for a 320 m bridge at 13+080. The total length of retaining walls that would prevent animal movement is 220 m. The E-6 alignment option is the closest to the existing highway east of Park Bridge so the impact to ungulate winter ranges is less than the other two options.

Potential wildlife crossing structures on E-6
400 m bridge over Kicking Horse River at 11+340
540 m tunnel at 11+760
320 m bridge at 13+080

Barriers to large animal movement on E-6
80 m retaining wall of 10 m average height
140 m retaining wall of 20 m average height

Option 11 alignment

The Option 11 alignment has a maximum grade of 5.8%. It appears to have more potential impacts on wildlife resources than Option E-6, but less than Option 12A. The crossing over the Kicking Horse River involves both a bridge and a tunnel that could facilitate movement of animals (Figure 3). The total length of retaining walls that would prevent animal movement is 560 m (Figure 4). The Option 11 alignment is closer to the existing highway east of Park Bridge than Option 12, but further than Option E-6, so the impact to ungulate winter ranges is between the other two options.

Potential wildlife crossing structures on Option 11
379 m bridge over Kicking Horse River at 11+400
480 m tunnel at 11+800

Barriers to large animal movement on Option 11
290 m retaining wall of 20 m average height
270 m retaining wall of 15 m average height

Option 12A alignment

The Option 12A alignment option appears to have the most potential impacts on wildlife resources compared to the other two options. It is potentially the least permeable to animal movements. At the Kicking Horse River, there is only a bridge, with the tunnel system of the other two options being replaced by a large cut. As well, the total length of retaining walls that would prevent animal movement is the longest of the three options at 780 m (Figure 4). The Option 12 alignment is the furthest away from to the existing highway east of Park Bridge, so the impact to ungulate winter ranges is higher than the other two options.

Potential wildlife crossing structures on Option 12A
379 m bridge over Kicking Horse River at 11+400

Barriers to large animal movement on Option 12A
280 m retaining wall of 6 m average height
340 m retaining wall of 10 m average height
160 m retaining wall of 10 m average height

Cumulative Effects

Cumulative effects are defined as “changes to the environment that are caused by an action in combination with other past, present and future human actions” (Hegmann *et al.* 1999). For the purposes of this initial appraisal of cumulative effects, the area under consideration is the Kicking Horse Canyon. The other factors in the canyon considered to be of sufficient magnitude to cause potentially meaningful effects on wildlife populations were timber harvesting, hunting and linear developments.

Timber harvesting as currently practiced should have no measurable impact on wildlife populations. Timber harvesting in the Kicking Horse Canyon is conducted in a sustainable manner consistent with government objectives managing and conserving environmental resource values through provisions in the Forest and Range Practices Act. This includes landscape and operational planning of forestry operations, designation of ungulate winter ranges, establishment of old growth forest retention targets, and provisions to protect the habitats of species at risk through the Identified Wildlife Management Strategy.

Hunting and trapping are also managed on a sustainable basis within the Kicking Horse Canyon and should have no measurable negative impact on the viability of wildlife populations. Ungulate hunting within the Kicking Horse Canyon (Management Units 4-35 and 4-36) are managed conservatively through the Limited Entry Hunting permit system (e.g. moose and mountain goat), shortened seasons (e.g. white-tailed deer bucks Sept 1-9), and age class restrictions (e.g. 4 point buck only for mule deer and 6 point bull for elk).

Linear developments in the Kicking Horse Canyon include the Canadian Pacific Railway (CPR), the Glenogle Forestry Service Road and the Trans-Canada Highway. Without appropriate mitigation, there are potential cumulative effects associated with other linear developments within the Kicking Horse River canyon, specifically the Canadian Pacific Railway and other phases of the upgrading program on the Trans-Canada Highway. Both of these other linear developments could have long-term synergistic effects with impacts associated with the potential for animal-vehicle collisions and habitat fragmentation that may result, if appropriate mitigation measures are not implemented.

The Canadian Pacific Railway is located close to the Trans-Canada Highway within the project area, although most (73%) of the project alignment is on the opposite side of the Kicking Horse River from the railway. The geographic distribution of train-killed wildlife is below average within the project area (CPR Mile 21-30) compared to other sections of the CPR between Revelstoke and Field (Wells 1997). Similar to the WARS (1999) data, Wells (1997) reported a much higher rate of train-killed wildlife further west in the Kicking Horse Canyon closer to Golden.

With appropriate mitigation, there should be no significant negative cumulative effects of timber harvesting, hunting, trapping, other linear developments and the Park Bridge to Brake Check highway project. In the absence of mitigation measures it is likely there will be measurable impacts resulting from an interaction between project impacts and the impacts of other linear developments (animal-vehicle collisions and habitat fragmentation).

Potential Mitigation Strategies

The best way to mitigate the adverse impacts of highways is to avoid areas with high concentrations of animals, and ecosystems that support rare plants or plant communities. To a large extent this been accomplished within the existing transportation corridor under consideration. It is very likely that all the potential wildlife impacts identified can be mitigated through careful planning, design, construction and monitoring. Appropriate mitigation strategies include provisions for avoiding animal-vehicle collisions through wildlife fencing systems, design features that allow animals to move across the highway right-of-way, and techniques that minimize habitat impacts and human disturbance.

Avoiding Animal-Vehicle Collisions

Conventional wildlife warning signs or lighted/animated warning signs have proved ineffective in reducing accident rates or vehicle speeds on highways in the United States (Romin and Bissonette 1996). Most detailed studies in the United States have shown that roadside reflector systems have no effect in reducing animal-vehicle collision rates (Romin and Bissonette 1996). In British Columbia, the installation of reflectors did not alter overall local accident trends at two case studies on Highway 3 (Sielecki 2004).

Animal exclusion fencing 2.4 m high is generally acknowledged as the most effective means of reducing animal-vehicle collisions, despite the high initial capital investment (Woods 1990, Keystone 1995, Clevenger 1998a). This type of fencing systems also requires one-way escape gates and “ungulate guards” or “Texas gates” at side road access points. The requirements for preventing wildlife access to transportation corridor rights-of-way should be addressed early in the detailed design phase. At the very least, right-of-ways and potential access for possible future ungulate exclusion fencing should be included in the highway design.

In revegetating the right-of-way, the use of nitrogen-fixing plants and other species preferred by wildlife as forage should be avoided in order to prevent attracting animals to the transportation corridor where they could be killed by collisions. Off the shelf mixtures used to revegetate most rights-of-way in the province often contain clover and alfalfa and will attract wildlife. The compendium of standard grass seed mixes for revegetation of British Columbia highway roadsides (Ministry of Transportation 2004) contains appropriate seed mixtures that avoid wildlife attractants.

Reducing Habitat Fragmentation

Whether fenced or unfenced, transportation corridors represent a barrier to movement for at least some wildlife species. These physical barriers, and their potential for fragmenting habitats, are considered by many to be the greatest risk to maintaining species diversity and ecological integrity in the vicinity of transportation corridors (Clevenger and Waltho 2000). When fencing is used to eliminate road-kill mortality, then provisions for allowing animals to move across the highway are needed in order to prevent disruption of migration routes and movement patterns. The more effective structures are located along natural movement corridors (Ruediger 1998), and are free of human disturbance (Clevenger and Waltho 2000), include adequate security cover at both ends (e.g. Figures 5 and 6), and are not perceived as “confining” to the animals involved. Different species have different tolerances to these factors. Wildlife overpasses and highway tunnels are among the best structures for allowing animals to move relatively unimpeded from one side of a fenced transportation corridor to another. Wildlife underpasses have been shown to be effective for a variety of animal species, including large ungulates, cougar and variety of smaller animals (Foster and Humphrey 1995, Beier 1995). Most large ungulates are reluctant to use confining structures (Reed *et al.* 1975), so the larger the structure, the more likely it will be used by the widest variety of species. High span bridges, with adequate clearance for animal movement through natural habitats along the banks of rivers or gorges, are likely the most effective crossing structure that moves animals under a highway.

Smaller tunnels and culverts have also been designed for use by amphibians in Britain (Knight 1998), leopard frogs and spring peepers in Virginia (Latane 1995), and spotted salamanders in Massachusetts, and toads in Texas (Kelso 1995). As well, high concrete median barriers may act as a barrier to small mammals, reptiles and amphibians, preventing them from crossing a highway or trapping them within the roadway. Cut-outs (15 x 50 cm) at the bottom of these concrete barriers can be used to allow small animal passage. Conversely, if the objective is to encourage small animals to use culverts and underpasses to pass under the roadway, then concrete barriers could be used to prevent access onto the traveled surface of the road.

Requirements for maintaining permeability of transportation corridors for wildlife should be addressed early in project design to minimize incremental costs associated with providing animal crossing-structures at a later date. The high span bridge over the Kicking Horse River and the tunnels immediately east of this bridge could both serve as high quality animal crossing structures provided wildlife passage requirements are included in their design and construction (e.g. Figure 5, 6 & 7).

Installation of smaller tunnels and culverts that have been designed for passage by amphibians, reptiles and small mammals should be considered if a need for them is determined during the detailed design stage. Non-perched culverts suitable for fish passage would generally be appropriate for amphibians. Drainage culverts fitted with small animal shelving have also proven useful to mitigate habitat fragmentation effects on 14 species of small mammal (Foresman 2004). Vegetative hiding cover would be required at the entrances of these structures in order for specially modified culverts to be effective.

Mitigating Habitat Impacts

The most substantive way of minimizing habitat impacts associated with highway construction is to include the relative habitat impacts of the various alignments in the choice of the final alignment that will go to the next stage of detailed design. Other appropriate mitigation strategies to minimize habitat impacts associated with the project footprint include; carefully considering future and existing activities to avoid disturbing or removing important habitat components (e.g. animal movement corridors), conserving and salvaging topsoil for later use in habitat restoration, salvaging significant botanical resources (e.g. plant species at risk) if they are encountered, and controlling erosion in watercourses using standard construction techniques. Similar considerations for site location, botanical salvage, and habitat enhancements should also apply to any waste rock sites developed for the project during detailed design In order to facilitate rehabilitation of wildlife habitats affected by any waste rock sites it will be necessary to conserve and salvage sufficient topsoil for later use in habitat restoration. The depth of soils to be conserved will depend on site-specific conditions and restoration objectives, but should include both the uppermost layer (e.g. A horizon) and some portion of the next layer (B horizon), since B layer is also contains substantial plant nutrients and will be needed to fill voids between the rocks. These two soil layers should be salvaged and reapplied separately, and the site should be rehabilitated using standard habitat restoration techniques such hydro-seeding and planting with appropriate high wildlife-value shrubs and trees.

Mitigating Human Disturbance

General mitigation strategies to avoid and mitigate wildlife impacts associated with human disturbance include; using temporary fencing to restrict human travel to construction zones and away from sensitive wildlife habitats, and determining the area of influence and shock wave impact area of construction blasting and avoid blasting during the critical period any sensitive species within that area (e.g. mountain goats at the Park Bridge mineral lick).

Summary and Conclusions

Importance of wildlife habitats affected by the project footprint

The total habitat impact associated with the footprint of the project is estimated at 36 to 38 ha, depending on the final alignment chosen. South-facing Douglas-fir habitats east of Park Bridge are considered moderately important ungulate winter ranges and summer bear foraging sites, and approximately half the project footprint (a total of 16 to 18 ha) impacts these habitat types. Wildlife habitat mapping rate most of these habitats as class 3 and 4 (moderate and low) for deer, elk and bear, and class 4 (low) for moose and bighorn sheep. The project footprint only impacts between 3 and 8% of any specific habitat type within the 1 km wide "area of interest" around the Trans-Canada Highway (Table 1). The total habitat impact associated with the footprint of a potential waste rock disposal site is estimated at 11 ha. That particular site is entirely contained within an existing clearcut, and wildlife habitat ratings are class 3 (moderate) for elk and bear, and class 4 (low) for deer and moose.

Likelihood of project impacts resulting in measurable population reductions

With appropriate mitigation measures in place, it is unlikely there will measurable negative impacts on wildlife populations associated with direct mortality from animal-vehicle collisions and habitat fragmentation from barriers to animal movement.

Although the faster design speed and straightening of curves in the project area means vehicle traffic speed will increase with completion of the project, wildlife exclusion fencing has a proven track record for mitigating these impacts. WARS data from 1982 to 1993 indicates that the number of road-killed wildlife is higher at the east end compared to the west end of the project, but is still relatively low compared to sections of the highway closer to Golden. Approximately 70% of these roadkills were deer, 25% were elk and 5% were moose. With appropriate mitigation measures in place, it is unlikely that the project will increase habitat fragmentation associated with barriers to animal movements.

The total habitat impact associated with the footprint of the project is estimated at 36 to 38 ha for the highway alignment and 11 ha for the associated waste rock disposal site. Approximately half of this is moderate value ungulate and bear foraging habitats on south-facing Douglas-fir habitats. Since critical ungulate winter ranges occur further west in the Kicking Horse Canyon, habitat impacts associated with the project are unlikely to result in measurable population impacts.

All the proposed alignments avoid sensitive mountain goat habitats north and south of the Kicking Horse River (Figure 8). The BC Conservation Data Centre did not locate any specific element occurrences (site locations) for species at risk (including COSEWIC listed species) within the project area.

Breeding bird surveys in habitats affected by the project footprint were able to detect 48 species, all of which are widely distributed throughout much of British Columbia. Breeding bird surveys conducted in June and July 2004 were able to detect 48 species, all of which are widely distributed throughout much of British Columbia. There were no Red- or Blue-listed bird species in the area impacted by the project footprint.

Likelihood of project impacts combined with other factors resulting in measurable population reductions

Timber harvesting and hunting are well regulated and monitored in the East Kootenays and no cumulative adverse effects are expected to result from potential additive wildlife impacts associated with highway construction and operation. With appropriate mitigation measures in place, it is unlikely there will cumulative impacts on wildlife populations associated with mortality from animal-vehicle collisions and habitat fragmentation related to long-term synergistic negative impacts the Canadian Pacific Railway and other phases of the upgrading program on the Trans-Canada Highway.

Relative importance of the other impacts on wildlife populations

Among the potential other impacts on wildlife populations, the most important are those associated with other linear developments in the Kicking Horse Canyon (e.g. the Canadian Pacific Railway). Impacts associated with hunting and timber harvesting are not considered significant in the project area.

Likelihood of project impacts jeopardizing long-term survival of local and regional wildlife populations

The project is not likely to jeopardize long-term survival of any local or regional wildlife populations. Most species are relatively common, and even if mitigation efforts were unsuccessful these populations are large enough to be able maintain viable populations. Only rare species have populations low enough to be negatively affected to the point of jeopardizing long-term survival of local populations. Among vertebrates, only the Blue-listed grizzly bear and wolverine could potentially be affected by unmitigated impacts resulting from animal-vehicle collisions and habitat fragmentation. With appropriate mitigation measures in place, no long-term significant adverse affects are anticipated to either grizzly bear or wolverine populations.

Rare plants species are unlikely to occur within the project area, and therefore populations could not be affected by the project. The only rare plants that occur in the general area of the Western Continental Ranges Ecoregion are four red-listed plants (*Carez crawei*, *Chenopodium atrovirens, Solidago gigantea* ssp. *serotina*, and *Lomantium triternatum* ssp. *platycarpum*) and two blue-listed (*Melica smithii* and *Astragalus bourgovii*). Although the likelihood of any of these species occurring within the project area is considered remote, efforts should be made during construction to look for their presence in appropriate habitat types in order to prevent any possible negative impacts.

Potential Mitigation Strategies

To a large extent the proposed alignments avoids areas with high concentrations of animals, and ecosystems that support rare plants or plant communities. All of the potential wildlife impacts identified can potentially be mitigated through careful planning, design, construction and monitoring. Appropriate mitigation strategies include provisions for avoiding animal-vehicle collisions through wildlife fencing systems, design features that allow animals to move across the highway right-of-way, and techniques for minimizing habitat impacts and human disturbance. Any waste rock disposal sites will require particular attention, so sufficient topsoil and cover material is available for effective on-site habitat restoration and rehabilitation.

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Figures

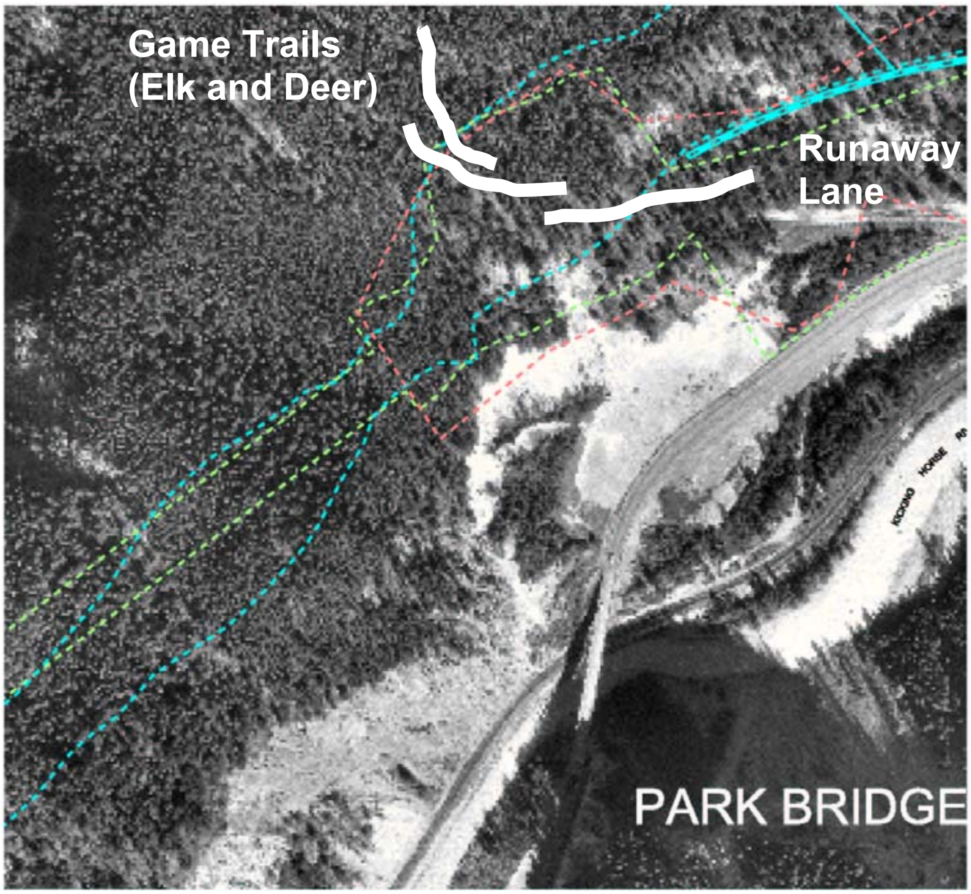

Figure 2. Elk and deer trails observed Oct 21, 2004 above Park Bridge slide (others exist north and east of the area surveyed).

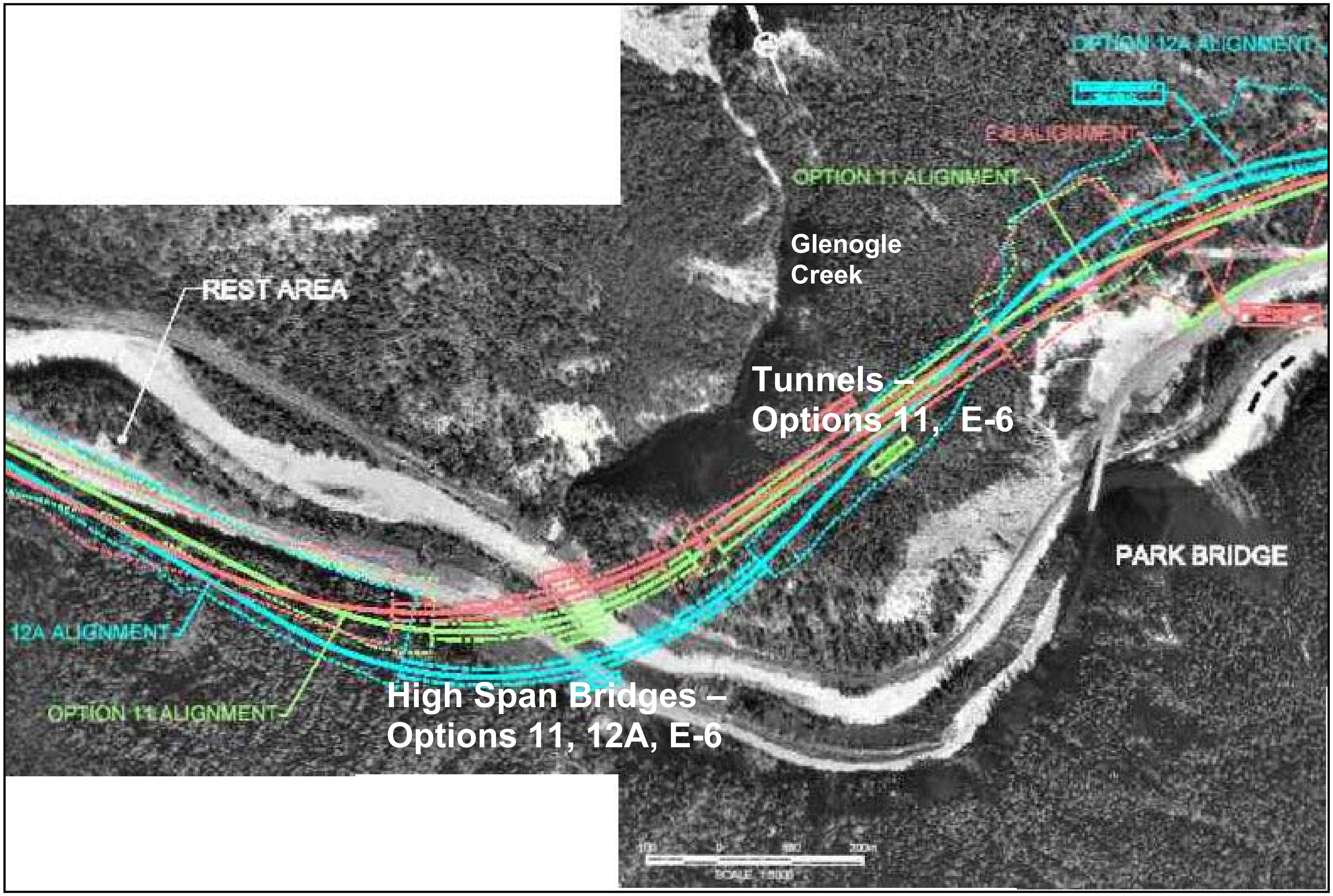

Figure 3. Possible bridge and tunnel system to replace Park Bridge crossing of Kicking Horse River.

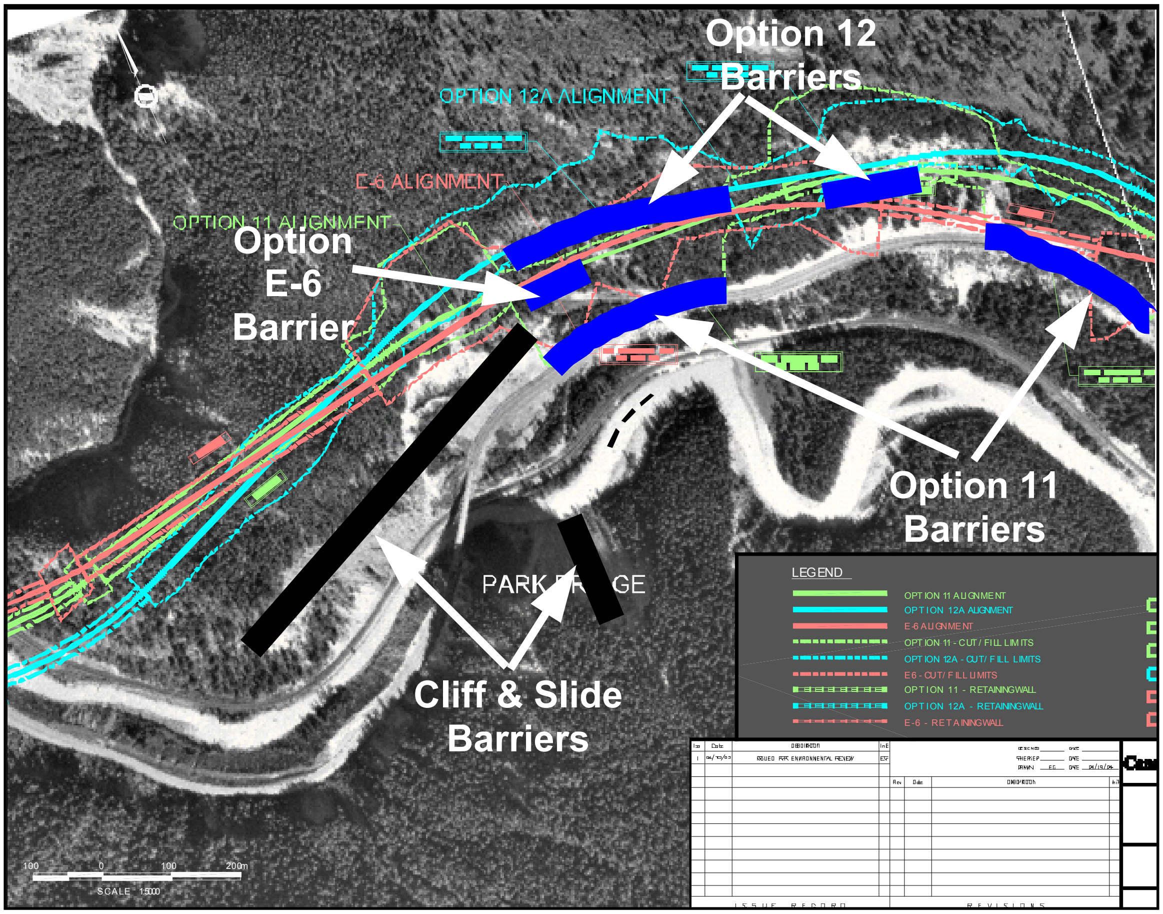

Figure 4. Natural and potential man-made barriers to animal movement above Park Bridge slide.

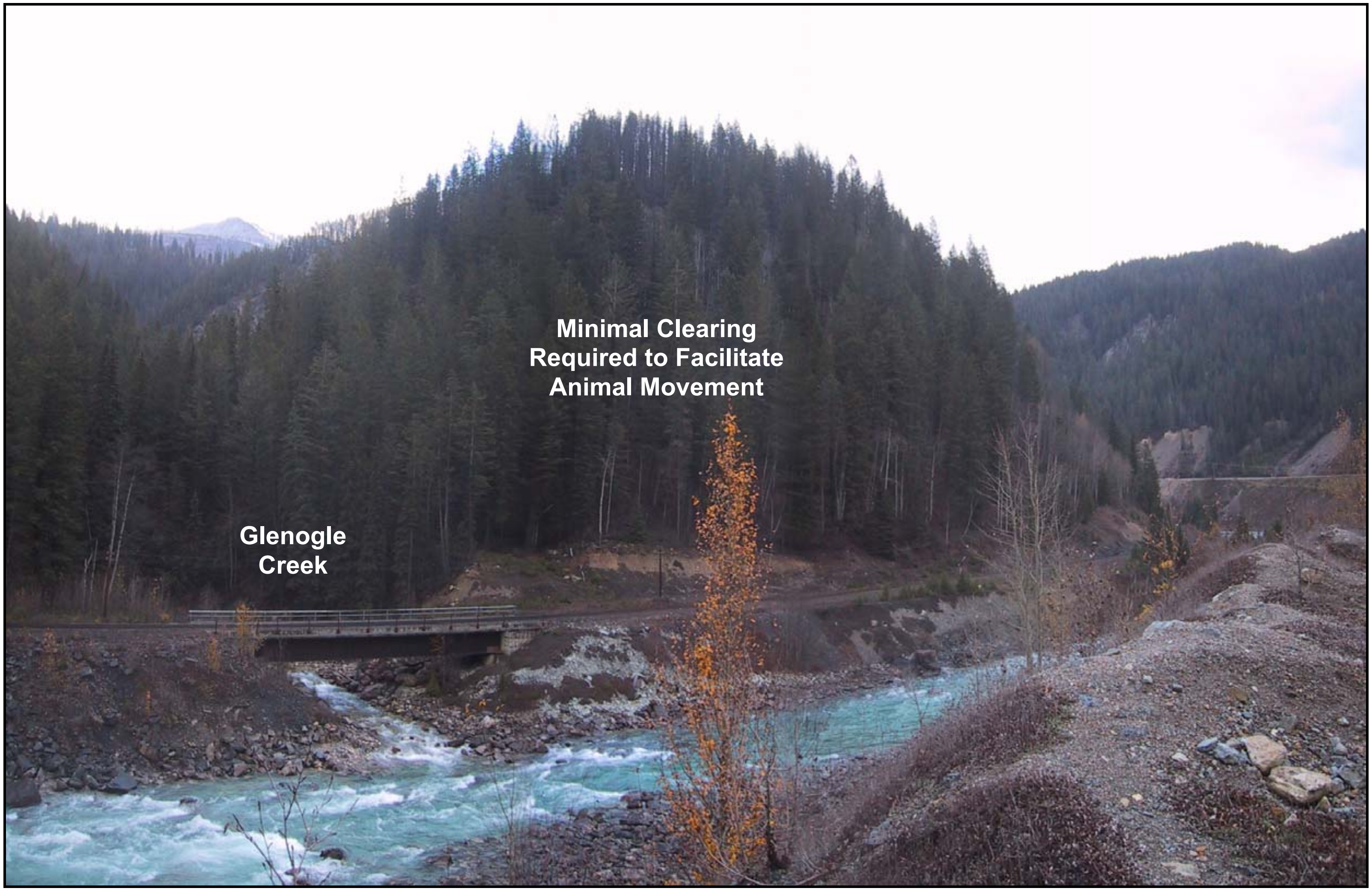

Figure 5. LKI 13.1 – New Crossing of Kicking Horse River near Glenogle Creek (Phase II).

Figure 6. LKI 13.4 – New Crossing of Kicking Horse River near Glenogle Creek (Phase II).

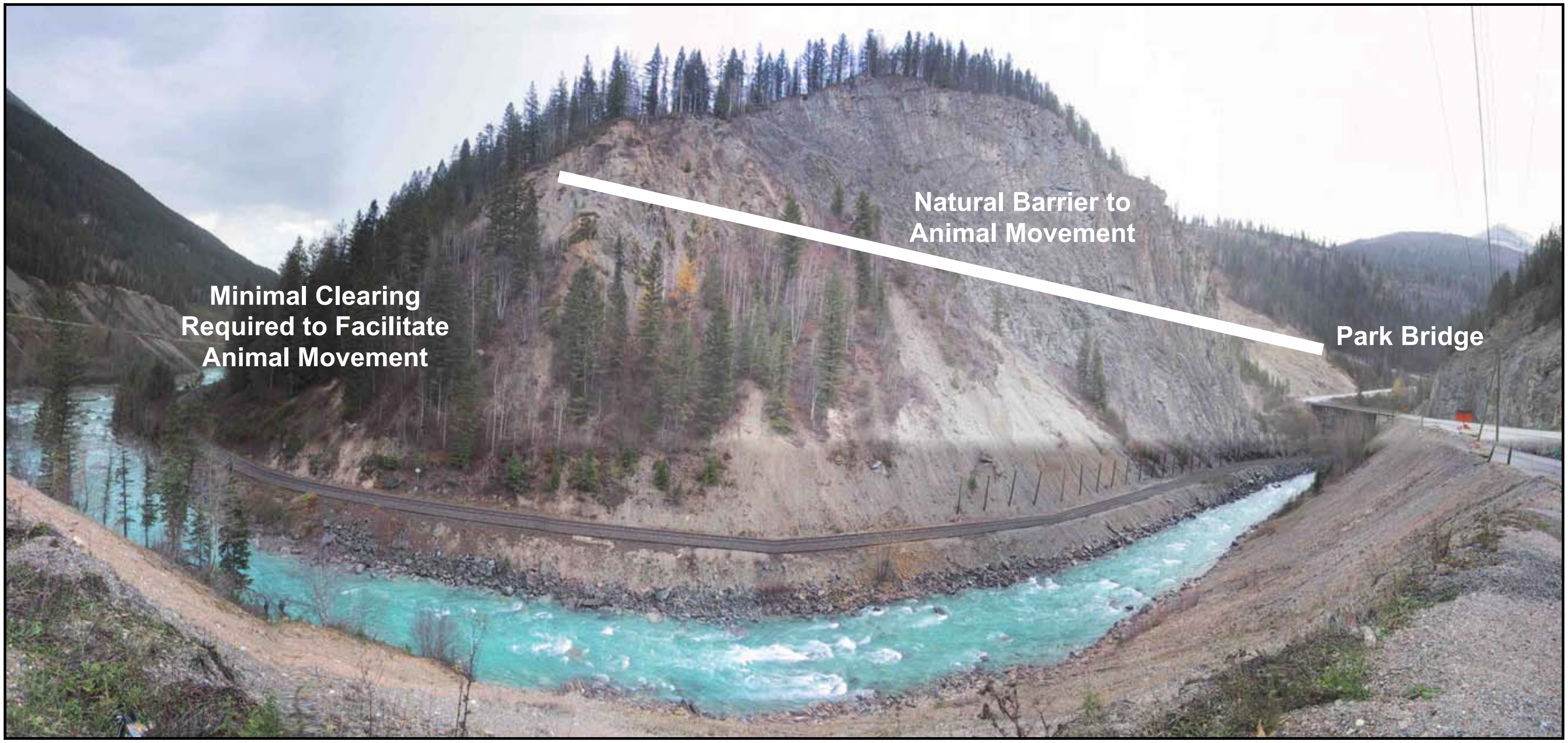

Figure 7. LKI 13.8 – New Crossing of Kicking Horse River near Park Bridge (Phase II).

Figure 8. LKI 14.5 – Park Bridge Slide and runaway lane (Phase II).

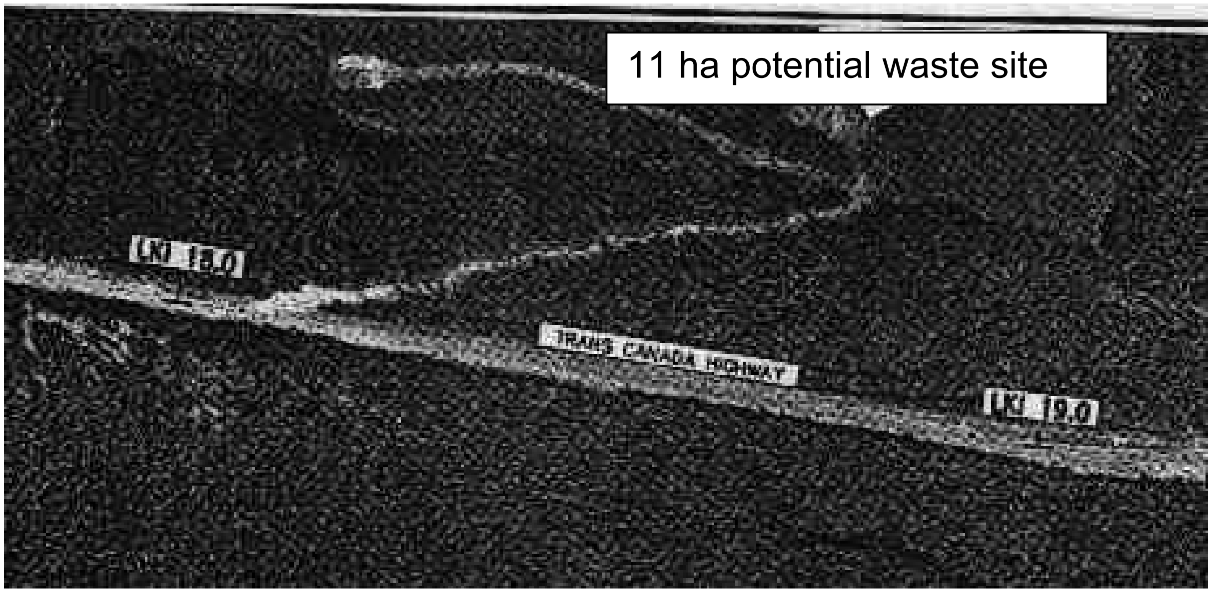

Figure 9. Location of possible waste rock disposal site on Mt. Hunter.

Figure 10. Photograph of Mt. Hunter proposed rock disposal site (one of several potential sites).

Appendices