# Trans Canada Highway
# Kicking Horse Canyon Project
# Phase 4 : West Portal to Yoho Bridge

## Business Case

NovaTrans Engineering Inc.

for

British Columbia Ministry of Transportation and Infrastructure

April 2016

BRITISH COLUMBIA

PREMIER'S AWARD
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# Table of Contents

***Executive Summary***

***1. Required Information*** **1**

***2. Background*** **5**

2.1 Importance of the Highway Corridor to Trade and Tourism 7
2.2 Advancement of Federal and Provincial Transportation Strategies and Plans 8
2.3 Traffic Volumes and Growth 9
2.4 Problem Definition 10
2.5 Status of Other Phases of the Kicking Horse Canyon Project 11
2.6 Other Relevant, Unique or Sensitive Aspects of the Project 12

***3. Project Description*** ***13***

3.1 Alternatives 13
3.2 Preferred Option 13
3.3 Project Delivery 14
3.4 Work Schedule and Phasing 15
3.5 Project Costs and Cash-Flows 15
3.6 Project Guidelines and Obligations 15

***4. Multiple Account Evaluation*** ***17***

4.1 Traffic Forecasting 19
4.2 Travel Time Costs 20
4.3 Highway Closure Costs (Reliability) 21
4.4 Collision Costs 22
4.5 Vehicle Operating Costs 23
4.6 Construction and Property Costs 23
4.7 Operations, Maintenance and Rehabilitation Costs 23
4.8 Economic Indicators for Road Users 23
4.9 Environment 24
4.10 Socio-Community 26
4.11 Economic Development - Provincial / National / Local 26
4.12 Overall Evaluation 27
4.13 Performance Measurement 28
4.14 Additional Public Benefits 29

BRITISH COLUMBIA

***5. Risks and Sensitivity Analysis 30***
5.1 Risks 30
5.2 Sensitivity Analysis 32

***6. Corridor Economics 33***
6.1 Background 33
6.2 Significance of the Kicking Horse Canyon Project on Trade 33

***7. Summary of Expected Outcome 37***

Appendix A Annex D - Environmental and Aboriginal Consultation Information Requirements

## *Executive Summary*

This Business Case proposal presents the justification for significant works to be carried out on approximately 4.8 kilometres of the Trans Canada Highway through the most challenging section of the Kicking Horse Canyon between the West Portal and Yoho Bridge (Figure 2.1 Project Key Plan). These works include the realignment and upgrading of 4 km. of 2-lane undivided highway to a 4-lane 100 kmh divided highway with an additional 0.8 km upgraded from existing 3 lanes undivided to 4 lanes divided. The existing highway is presently posted at 80 kmh but with actual speeds between 55 and 65 kmh. The proposal describes the needs based on the desire to improve the mobility, reliability and safety of this critically important stretch of highway. This report presents the business case for the project based on the optimal method of addressing these needs. The project is an eligible investment as it meets the requirements outlined under the Highways and Major Roads category of the Business Case Guide provided by Transport Canada for the New Building Canada Fund (NBCF) – National Infrastructure Component (NIC). The project provides significant additional capacity to a highway which is nationally significant, the Trans Canada Highway, a key interprovincial and international corridor connecting the major Port of Vancouver to the rest of the Province and country.

The Trans-Canada Highway (TCH) completed in 1962, is Canada's National Highway. It serves as a link to all Canadians and, is the primary east-west route for inter-provincial trade and travel from coast to coast, a distance of over 7,800 kilometres from St. John's to Victoria. This corridor has been identified by the province as the priority transportation corridor in recognition of the Highway's importance for the movement of people and goods, and its importance as a vital link for commercial transport, tourism, and inter-provincial and international trade. As this highway connects the rest of the nation with Canada's most important port on the Pacific Ocean, Vancouver, the economic competitiveness of the region, the province and the nation, particularly the western provinces is directly affected by the operational efficiency and effectiveness of this highway. As such, it is critical to British Columbia and Canada as a whole to have this corridor perform to standards of efficiency, reliability and safety appropriate to its intended national purpose and also to serve as the gateway to Asian markets.

As a result of the addition of the tourist traffic to the regular highway traffic, the Trans-Canada Highway is particularly well used during peak summer months. Present annual average daily travel (AADT) is over 5,000 veh/day with this average increasing to over 10,000 per day during the summer months (SADT). These levels are expected to increase to about 8,500 veh/day AADT and over 15,000 veh/day SADT over a 35-year planning horizon period. In addition, this highway is subject to an extraordinarily high commercial usage with a heavy vehicle proportion of approximately 25% of AADT or almost 1,300 heavy vehicles per day increasing to over 2,000 by 2049.

Upgrading of the Kicking Horse Canyon Phase 4 Project section of the Trans Canada Highway is clearly required on the basis of the following:

- Summer traffic exceeds 10,000 vehicles per day, including a high percentage of commercial vehicles (13% during summer, 30% in the off-season). The existing Phase 4 portion is a winding older sub-standard two-lane undivided highway.
- 4-laning of this segment will complete the 4-laning of the Kicking Horse Canyon Project over the entire 26 km. project length connecting the Phase 3 West project to the west and the 4-lane Phase 1 Yoho Bridge to the east (see Figure 3.1). This will serve to create

consistency within the corridor, which is strongly recommended under Transportation Association of Canada (TAC) Design Guidelines.

- There are 13 sub-standard curves, poor vertical geometry, a narrow highway cross-section and often non-existent shoulders which affect both traffic operations as well as traffic safety;
- Average operating speeds are in the 55 – 65 km/h range, with many areas in which passenger vehicles are heavily platooned behind slower moving recreational vehicles and commercial trucks.
- The collision rate is more than 3 times the provincial average for older 2-lane rural highway facilities and far greater than can be expected from a modern 4-lane facility.
- The narrow highway cross-section and often non-existent shoulder provide poor safety to cyclists who are common visitors to the corridor, including a number of organized tours that visit the 'golden triangle', which comprises Banff and Yoho National Parks and Radium Hot Springs.
- Natural hazards include 7 rock fall / landslide / debris torrent hazard sites (5 rated high hazard and 2 moderate to high hazard) as well as 13 avalanche paths which, along with the high collision rate, cause poor reliability and frequent closures;
- Longer closures require a significant diversion via Highway 93/95, a two lane route with few passing lanes and is 104 km. longer requiring an additional 1-1/2 hours of travel time;
- The wildlife sensitivity within this area was rated as "moderate" with the number of animals killed on this segment averaging 1to 2 collisions per km per year, based on data from the Province's Wildlife Accident Reporting System;
- The heavy traffic volumes and low travel speed underscore the fact that the existing highway while appropriate for the time of construction in the 1950s is totally out of date with respect to current design guidelines and, unless upgraded, will be strongly inconsistent with adjacent sections of modern 4-lane highway.
- There is a great risk of negative economic impacts to both Canada and the Province from trade being diverted to the faster and much safer and more reliable U.S. Interstate highway system, with shipments lost to U.S West Coast ports like Seattle, Portland, San Francisco and, Los Angeles.

The Kicking Horse Canyon Phase 4 Project will address the above needs as follows:

- Highway geometry will be brought up to current standards consistent with the rest of the corridor with significant reliability, safety and mobility benefits. In particular increases in median and shoulder width and the introduction of a concrete median barrier will provide for immediate benefits;
- Travel speeds for passenger vehicles will immediately be increased from approximately 60 kmh to over 90 kmh with vehicles not affected by grade being able to travel at the 100 kmh posted speed. Heavy vehicle speeds will also be increased from an average in the 50 kmh range to the 70 kmh range over the 35-year horizon;
- Travel reliability will immediately be increased with a reduction in collision closures from 3.4 to 0.8 closures per years and a reduction in avalanche closures from 8.3 to 0.03 occurrences per year;

- Travel safety will immediately be improved with a collision reduction of 66% calculated over the 35-year planning horizon. This reduction is largely caused by the 4-laning of the roadway to current standards including the concrete median barrier and includes an expected savings of 13 fatalities and 194 injuries ;
- Wildlife fencing provided as a part of the Phase 4 Canyon project, will have a significant and dramatic beneficial effect by reducing animal-vehicle collisions within this section and provide for safe wildlife passage.
- The project phase will complete the 26 kilometre 4-laning of the Kicking Horse Canyon corridor;
- The project will aid in the scheduling and performance of maintenance activities;
- The project will provide for a safer local roadway connection to the Dart Creek Forest Service Road as well as safer local access to CP Railway access points;
- The project does not appear to have any significant environmental impacts which cannot be mitigated.

A comparative analysis of the Project with the Do Nothing Base Case results in the conclusions:

- For the Kicking Horse Canyon Phase 4 Project there are quite significant life-cycle incremental benefits with a PV of $M 81.6 with about 40% from reliability savings, 35% from safety savings, 18% from delay savings and 7% from vehicle operating cost savings. However, these significant benefits are tempered by extremely high construction costs ( > $M 90 /km.) through the difficult terrain of the Rocky Mountains. Incremental present value costs amount to $M 252.7 yielding a NPV of -$M 171.1 and a BCR of 0.32.
- However, the more important benefits revolve around the benefits accruing to continuity within the corridor and wider provincial and national economic development benefits and trade. Completion of the Kicking Horse Canyon Project would mark a significant milestone towards meeting the important Federal objective of providing Canadians with a 4-lane 100 km/h highway facility linking the nation’s far-flung regions.
- This 4-lane 100 km/h highway facility objective is critical to the nation's competitiveness. It will aid in providing the connectivity necessary for the effective movement of national and international commercial goods directed to and via the Gateway / Port of Vancouver via the Trans-Canada Highway. This will aid Canada and BC in effectively competing with the many US west coast ports fed by American 4-lane highway facilities. While the original 2-lane standard was adequate in the 1950s when the highway was originally constructed, the 4-lane 100 kmh standard is consistent with standards throughout the OECD countries.

The resulting recommendations are as follows:

- The Kicking Horse Canyon Phase 4 Project be approved on the basis of improved mobility, reliability, safety, highway corridor design consistency and consistency with federal objectives.
- The Trans-Canada Highway within the Kicking Horse Canyon Phase 4 Project area be upgraded to a 4-lane 100 kmh highway with concrete median barrier
- Total Funding of $M 450.0 for this project be approved with a Federal contribution to this funding of $M 215.2 over 7 years.

| Category | Past | 2016/17 | 2017 / 18 | 2018 / 19 | 2019 / 20 | 2020 / 21 | 2021 / 22 | 2022/23 | 2023 / 24 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Total | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ 450.0 |
| Federal | $ - | $ - | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ 215.2 |
| Provincial | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ [redacted] | $ 234.8 |

# *1. Required Information*

The project and its benefits are described more fully in the body of this report as well as in the report Executive Summary. This portion of the report is provided to exactly match the Business Case Guidelines in order to simplify the requirement confirmation process. References as to where more detailed information resides within the report are provided.

## *Project Description and Minimum Federal Requirements*

The project is the Kicking Horse Canyon Phase 4 Project and is located between a location 4.2 km. east of Golden Highway 95 intersection to the Yoho Bridge (Figure 2.1 Project Key Plan). It consists of the realignment and upgrading of 4 km. of 2-lane undivided highway to a 4-lane divided highway with an additional 0.8 km upgraded from existing 3 lanes undivided to 4 lanes divided. (Section 3.2 and Figure 3.1).

It is requested that this project be considered for funding under the New Building Canada Fund – National Infrastructure Component (NIC). This project falls under the Highways and Major Roads category, with significant new construction including bridges and other structural improvements that will provide added capacity and safety improvements. It is a part of the national Highway System with Annual Average Daily Traffic volumes of between 5,000 and about 8,500 veh/day over the 35-year horizon period 2015 - 2049 and most importantly between 1,300 and over 2,000 trucks per day over the same period. Summer Average Daily Traffic volumes increase to between 10,000 and over 15,000 veh/day. The Trans Canada Highway through the Rocky Mountains provides access to the Port of Vancouver for all of the rest of Canada and is therefore a critical piece of the nation's transportation infrastructure.

The project provides significant economic advantages and broad public benefits as follows:

- Highway geometry will be brought up to current standards with significant reliability, safety and mobility benefits, in particular increases in median and shoulder width and the introduction of a concrete median barrier will provide for immediate benefits;
- Travel speeds for passenger vehicles will immediately be increased from approximately 60 kmh to over 90 kmh with vehicles not affected by grade being able to travel at the 100 kmh posted speed. Heavy vehicle speeds will also be increased from an average in the 50 kmh range to the 70 kmh range over the 35-year horizon;
- Travel reliability will immediately be increased with a reduction in collision closures from 3.4 to 0.8 closures per year and a reduction in avalanche closures from 8.3 to 0.03 occurrences per year;
- Travel safety will immediately be improved with a collision reduction of 66% calculated over the 35-year planning horizon;
- The project phase will complete the 26 kilometre 4-laning of the Kicking Horse Canyon corridor;
- The project will aid in the scheduling and performance of maintenance activities;
- The project will provide for a safer local roadway connection to the Dart Creek Forest Service Road as well as safer local access to CP Railway access points;

- The project does not appear to have any significant environmental impacts which cannot be mitigated. In fact, wildlife fencing provided as a part of the Phase 4 Canyon project, will have a significant and dramatic beneficial effect by reducing animal-vehicle collisions within this section.
- The major impetus and justification for the project is the desire for continued and enhanced economic development for the local, provincial and national economies. The Trans-Canada Highway links BC, including the Port of Vancouver, to the rest of the country and reasonable operating conditions in terms of both travel time, reliability and safety are critical in the competitiveness of this route in comparison to the various US routes;
- The Project is also located within an important tourist-oriented area and as such the continued enhancement of the corridor is critical to the local and BC economies.

Some small parcels of crown land will be required for the project and have been budgeted for. Project timelines are presented below.

| **Segment** | **2016/17** | **2017/18** | **2018/19** | **2019/20** | **2020/21** | **2021/22** | **2022/23** | **2023/24** |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Federal Funding | | | | | | | | |
| Des/Eng/Procurement | | | | | | | | |
| Construction | | | | | | | | |

## *Project Outcomes and Benefits*

The project meets the category-specific outcomes and benefits as presented earlier above. Additional details are presented as a part of the rigorous Multiple Account Evaluation carried out as a part of the Business Case Report and presented in Section 4.

## *Project Governance*

Governance and oversight for the project will be carried out by the Province of British Columbia's Ministry of Transportation and Infrastructure for all phases of the project.

## *Financial Requirements*

Project estimates were originally prepared and further refined by the Kicking Horse Project Team. An appropriate level of contingency and escalation has been allowed for as is standard in all of the BC Ministry of Transportation and Infrastructure project cost estimates. Provincial funding for the project has been assured with financial details presented in Section 3.5 and summarized for the project below.

| Cost Type | Past | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **A: Non-Eligible Costs** | | | | | | | | | | |
| Project Management | $ | | | | | | | | | |
| Planning | $ | | | | | | | | | |
| Environmental | $ | | | | | | | | | |
| Stakeholder Relations | $ | | | | | | | | | |
| Corporate Services | | | | | | | | | | |
| Engineering | $ | | | | | | | | | |
| Propety Acquisition | $ | | | | | | | | | |
| Other | | | | | | | | | | |
| Contingency | | | | | | | | | | |
| **Sub-Total** | $ | | | | | | | | | |
| **B: Eligible Costs** | | | | | | | | | | |
| Engineering External | | | | | | | | | | $ |
| Environmental External | | | | | | | | | | $ |
| Construction Supervision | | | | | | | | | | $ |
| Construction (Road and Bridge) | | | | | | | | | | $ |
| Contingency | | | | | | | | | | $ |
| **Sub-Total** | $ | | | | | | | | | |
| **TOTAL** | $ | | | | | | | | | $ 450,000 |
| **Federal Contribution** | $ | | | | | | | | | $ 215,198 |

## Legal Requirements

The Province of British Columbia confirms that the project will adhere to all applicable legislation and that all necessary permits and authorizations required for the project will be obtained.

The KHCP has undertaken environmental studies as well as reviewed previous studies conducted for the project. A draft environmental synopsis report for the Phase 4 Canyon section that identifies all environmental constraints and requirements for the project is complete. There are no unacceptable environmental impacts anticipated from the project, provided that planned mitigation is implemented. This report provides information required to complete an environmental assessment. The report will be updated upon approved funding for the project to ensure the project appropriately mitigates any environmental impacts.

Registered archaeological sites have been identified within the Phase 4 Canyon project area, including a stone tool manufacturing site. A summary report of archaeological assessments listed the site locations.[1] The summary report determined that the sites identified and mapped can be avoided and, if not, that site alteration permits can be obtained, mitigating effects of disturbance.

The project is in the asserted traditional territories of the Ktunaxa Nation, the Shuswap Nation, the Neskonlith Indian Band and the Adams Lake Indian Band. The project has consulted with these groups (Appendix A) and will provide further consultation and opportunities for engagement with the project.

The contract award process for eligible expenditures to be funded under the project is in accordance with the Province's policies and procedures and will be transparent, competitive, fair, consistent with value for money principles, or in a manner otherwise acceptable to Canada, and if applicable, in accordance and consistent with the Agreement on Internal Trade and other international trade agreements.

## Project Risks and Mitigation Measures

Technical, Financial and Implementation risks have been identified and assessed (Section 5.1) with appropriate mitigation measures identified.

## P3 requirements

In accordance with PPP Canada's guideline for the New Building Canada Fund: P3 Screen Suitability Assessment Guide, a draft Suitability Assessment has been completed and indicates that the project presents a mix of favourable and unfavourable indicators for P3 delivery. The Phase 4 portion of the Kicking Horse Canyon Project is currently within the existing Phase 2 P3 concession, and thus a broader new P3 concession agreement to include the new Phase 4 works would entail opening up the existing agreement with its subsequent legal, negotiation and timeline implications. Consequently, the Project is recommending a Design-Build or Design-Build-Finance delivery.

[1] **Summary Report-Archaeological Assessments Kicking Horse Canyon Project, Phases 3 and 4,** Golder, July 2014

## *2. Background*

The Trans-Canada Highway is the major vehicular transportation link between the Province of British Columbia and the rest of Canada. As such, it is recognized to be integral to the economic well being of not only the province, but indeed the entire country, and in particular the remaining western provinces of Alberta, Saskatchewan and Manitoba. Due to the north/south orientation of the numerous mountain ranges traversing the province between the coast and the Alberta border, the provision and maintenance of the efficient and reliable transportation service to and from British Columbia's economic centres has not kept pace with the economic growth and resulting travel demands through the Rocky Mountains. Since the initial construction of the highway in the 1950's, traffic volumes have continued to increase, in parallel with the expanding economic development of the country, to the point where the Trans Canada Highway, through the Rocky Mountains, will not meet the country's transportation needs. Economic development and growth played an important part in the rationale for the initial construction of the Trans Canada Highway more than fifty years ago. A major up-grading of this aging and out-dated facility is now a 'must' in order to ensure that national and provincial objectives in regards to the safety, operation and reliability of the Trans-Canada Highway are respected and that national and provincial economic growth is not hindered due to the inadequacy of the Phase 4 Kicking Horse Canyon segment of this national highway through the Rocky Mountains.

This corridor is heavily used for commercial goods movement. It is the major corridor between British Columbia and the rest of Canada, with alternative routes involving significant additional travel times. The value of goods shipped over this section of the Trans Canada Highway every year is a major influence on the economic value and resulting benefits. The Kicking Horse Canyon Project is presently a top provincial transportation priority. The highway is paralleled by the Canadian Pacific (CP) Rail-line, however, this is seen as a complementary service not a replacement service. The types of goods carried by the highway mode often differ from those carried by the railways in terms of time sensitivity and flexibility of origin and destination. Although the overall travel time and the safety of the highway are of concern to freight haulers, a key issue of concern is reliability. Unscheduled delays caused by highway closures are far more costly to freight haulers than just the cost of the driver/truck travel time as unloading, transfer and usage schedules are disrupted.

This section of highway is also particularly important from the perspective of tourist travel, particularly in the summer period. Not only is this section a part of the general link between the interior and coast of BC and the rest of Canada, but it also carries its own intrinsic value as a tourist attraction with its rugged topography. This is evidenced by its heavy use by longer distance tour buses. In addition, the importance of the corridor from a business and social perspective cannot be understated. Canada's experience has largely been one of linked regions and regional economies. The Rocky Mountains must be recognized as a formidable barrier to this necessary and very important interaction. Historically, first the national railway, and then the original Trans-Canada Highway can be seen as the necessary elements addressing this need. The required set of improvements to the Trans-Canada Highway corridor is simply the natural evolution of the elements serving the need for the province to be connected to the rest of the country.

As a result of the addition of the tourist traffic to the regular highway traffic, the Trans-Canada Highway is particularly well used during peak summer months. Present annual average daily travel (AADT) is over 5,000 veh/day with this average increasing to over 10,000 per day during the summer months (SADT). These levels are expected to increase to about 8,500 veh/day AADT and over 15,000 veh/day SADT over a 35-year planning horizon period. In addition, this highway is

subject to an extraordinarily high commercial usage with a heavy vehicle proportion of approximately 25% of AADT or almost 1,300 heavy vehicles per day increasing to over 2,000 by 2049.

In recognition of the importance to the nation, this corridor is designated a part of the continuous Trans Canada Highway, the nation's primary east-west route. Because of the importance of this corridor to the Province, the highway is a primary corridor in the Provincial Highway Network and plays a large part in the Province's yearly Capital Improvement Program. Aside from the Kicking Horse Canyon Project other corridor improvements currently underway or recently completed include Monte Creek to Pritchard, Pritchard to Hoffman's Bluff, Donald Bridge and Overhead and the Clanwilliam Overhead Replacement.

The Province employs numerous initiatives to ensure efficiency in long distance transportation throughout the provincial network. Primary amongst these is the efficient use of existing corridors. Roadway upgrades that increase capacity while simultaneously providing fuel efficiency and operating cost savings are increasingly sought out. The province puts a strong emphasis on full Multiple Account Evaluations of all major capital projects ensuring that "softer" criteria such as economic development, fuel consumption, vehicle operating costs, greenhouse gas emissions and socio-community factors are adequately considered for options within a project as well as in the program selection between projects.

The importance of this project and its priority are very clearly stated in the Province's "2016/17 - 2018/19 Service Plan" with the following:

- "This portion of the Trans-Canada Highway serves as a gateway between British Columbia and the rest of North America, connecting resource extraction sites with processing, manufacturing, and distribution centres, and is a key part of the province's resource economies, particularly forestry and mining, tourism and inter-provincial trade."
- The Kicking Horse Canyon Project is one of the Major Capital Projects identified for continued funding through this period.
- In partnership with the federal government, the province has previously invested $327 million and plans to invest a further $450 million for a total of $777 million to up-grade the 26 km section between Golden and Yoho National Park into a four-lane highway.

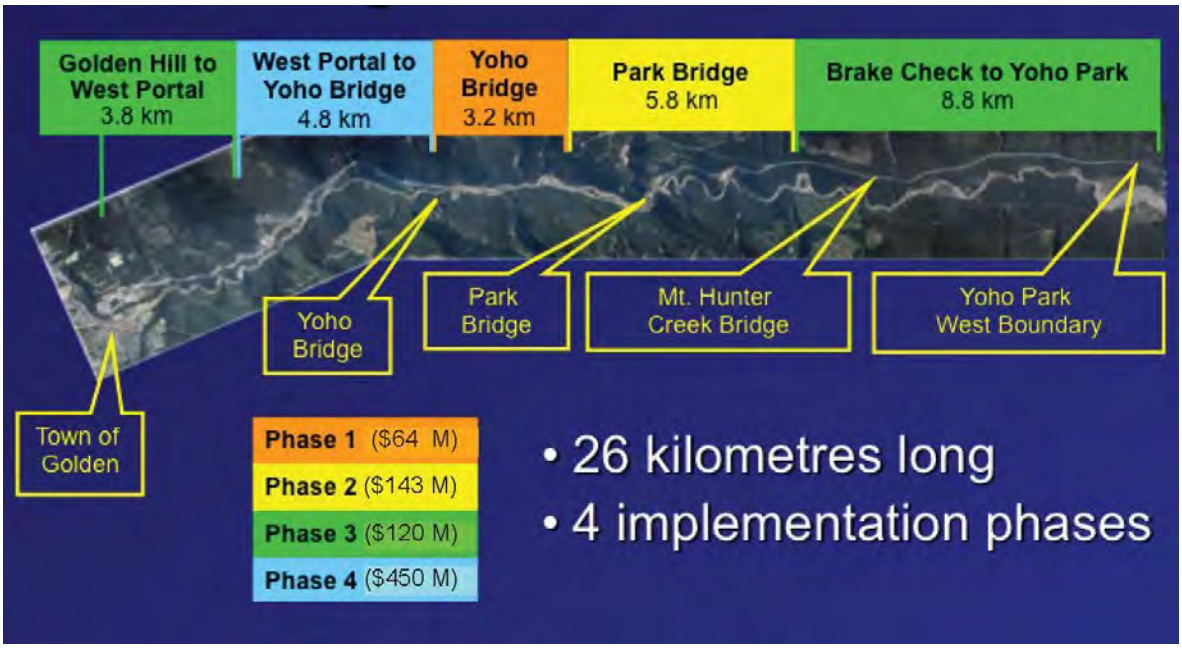
The importance of this corridor and its priority are also identified in the Province's "Pacific Gateway Transportation Strategy 2012 - 2020" with the following:

- Increase major road capacity – completing $4.9-billion investment on provincial road and bridges including the Port Mann Bridge, the new South Fraser Perimeter Road, Highway 1 upgrades from Kamloops to Golden and the Kicking Horse Canyon.

Due to the area setting, the 26 kilometres of the project were broken down into four phases (Figure 2.1 Project Key Plan). Phase 1 consists of the Yoho Bridge replacement and approaches, Phase 2 consists of the Park Bridge replacement and approaches, Phase 3 consists of approximately 4 km for the section between Highway 95 and Phase 4 (Phase 3 West), and approximately 9 km for the section between the Brake Check and Yoho National Park (Phase 3 East). Phase 4, the final phase, consists of 4.8 kilometres of the Trans Canada Highway through the most challenging section of the Kicking Horse Canyon. These works include the realignment and upgrading of 4 km. of 2-lane 80 kmh undivided highway, operating far below the posted speed, to a 4-lane 100 kmh divided highway with an additional 0.8 km upgraded

from existing 3 lanes undivided to 4 lanes divided. This last Phase, Phase 4, is the subject of this report.

***Figure 2.1, Project Key Plan***




## *2.1 Importance of the Highway Corridor to Trade and Tourism*

The proposed works under Phase 4 of the Kicking Horse Canyon Project are highly important to B.C and Canada from an economic perspective. The Trans Canada Highway through the Kicking Horse Canyon provides primary access from the rest of Canada to the port of Vancouver. The quality of service provided by this route is key to British Columbia and Canada as a whole for internal, inter-provincial and national trade, and also as the gateway to Asian markets. The significance of this **Pacific Gateway** can be best highlighted by Canada's support of the continued commitment to this initiative. Canada is well positioned to prosper in the emerging global economy through the Pacific Gateway Initiative which is obviously critical to realizing our potential as a country.

### *Canada's Pacific Advantage*

The rapid rise of the Asia Pacific Region as a trading power directs particular attention to both the challenges and opportunities associated with Canada's Pacific orientation. Canada is uniquely positioned to take advantage of emerging opportunities in China and other Asia-Pacific countries including India and Korea. The **Pacific Gateway** also benefits considerably from a population that enjoys strong cultural connections with the Asia-Pacific through heritage, family ties, businesses and investments.

The proximity of Canada's West Coast ports to Asian markets offers a sailing time advantage of roughly two days over all others in the Western Hemisphere. Canadian railways offer among the

most affordable freight rates in North America and the country's trucking sector is also highly competitive and efficient, both in Canada and in the trans-border markets. As a result, a significant portion of the goods handled in Canada's West Coast ports are coming from, or destined for, the United States. In 2013, West Coast Ports handled close to 3.3 Million containers with 2.8 Million of these through Port Metro Vancouver. It is forecast that West Coast port throughput for an additional 4 Million containers will be required by 2030. Clearly, a strong foundation exists on which to further develop Canada's Pacific Gateway as the crossroads between North America and Asia.

### *The Challenges Facing Canada's Pacific Gateway*

Despite the vast potential, Canada's advantages are being jeopardized by freight congestion in British Columbia's Lower Mainland and points further east, and concerns exist about the capacity necessary to handle projected trade growth. Recent trade flow increases have strained existing transportation infrastructure capacity on the West Coast. Specifically, the Port of Vancouver has experienced periods of significant backlogs partly as a result of bottlenecks on the road network, causing slowdowns in British Columbia's Lower Mainland, and points further east. The rail network is also being challenged to meet rising demands. The port backlogs have resulted in freight diversion to other ports and are causing some shippers concerns about the future reliability of West Coast ports, road and rail services and infrastructure.

In their pursuit of the vision of British Columbia serving as a key North American gateway to Asian markets and to achieve the provincial and federal goal of efficiency and effectiveness in transportation, the Federal Government and British Columbia must commit to investments that will include the following:

- Transportation infrastructure investments made in concert with the growth planned for British Columbia to serve as a key North American gateway for Asian markets.
- Increased capacity and up-grading as appropriate of those transportation routes to major trade centres in the Vancouver region.
- Improvements to aging transportation routes that require major investments to meet the demands for a healthy economy and the basics of everyday life.

## *2.2 Advancement of Federal and Provincial Transportation Strategies and Plans*

Such investments are consistent with current federal-provincial transportation strategies which have been successful in the implementation of other projects on the Trans-Canada Highway including Phases 1, 2 and 3 of the Kicking Horse Canyon Project. The Province's transportation strategy, as described earlier and articulated in the Province's "2016/17 - 2018/19 Service Plan notes that a key component of the Province's transportation strategy is to partner with the federal government to provide needed infrastructure.

This approach is also consistent with Federal Government priorities. The 2013-14 Report on Plans and Priorities clearly lays out the inspiration behind the Gateways and Corridors portion of the Transport Canada Programs as follows:

*"Canada is a trading nation, and the efficiency and reliability of the transportation system to support this trade impacts directly on the nation's prosperity and well-being. For this reason, it is imperative that the federal government play a role in the development of an integrated transportation network linking importers and exporters to markets and suppliers in the increasingly complex global supply chains. Guided by the National Policy Framework for Strategic Gateways*

*and Corridors, the Gateways and Corridors Program supports Canada's international commerce by creating a more efficient, reliable and seamless trade-related transport system in Canada. The Program: develops initiatives to improve and integrate transportation networks in key regions; fosters partnerships between all levels of government and the private sector; supports and oversees projects that contribute to the increased capacity and efficiency of gateway and corridor infrastructure; develops and puts in place measures that remove impediments to the effective development of gateways and corridors; and markets the use of gateways and corridors within Canada and internationally."*

The Federal Government has also committed $4-Billion over a 10-year period for the National Infrastructure Component of the Building Canada Fund that will support projects of national significance. Projects, such as the Kicking Horse Canyon Project, must support the following objectives:

- Generate positive economic activity;
- Reduce potential economic disruptions or foregone economic activity;
- Generate productivity gains for the Canadian economy;
- Provide benefits that extend beyond the provinces or territories where the project would be located.

The Kicking Horse Canyon Phases 1, 2 and 3 were recipients of similar past cost-sharing programs. Continuation of cost-sharing arrangements between the governments of Canada and British Columbia to improve highways in the province is critical to timely investments to national and regional infrastructure projects that secure opportunities towards continued sustainable economic growth and the quality of life for Canadians.

In this context, the completion of the Kicking Horse Project with the final Phase 4 Project will aid in achieving the desired travel efficiency, reliability and safety through the Rockies. This project remains a Provincial priority candidate for federal cost-sharing, given its strong role in the efficient movement of goods and people across Canada and to and from the economic and trading centres in the Vancouver Region.

This Business Case Report is for the purpose of providing the rationale and to explain, where required, the need for the improvements, the economic and social benefits resulting from the improvements and other factors that provide justification for the proposed works as a measure to secure Federal/Provincial cost-sharing arrangements as may be appropriate.

## *2.3 Traffic Volumes and Growth*

As a result of the addition of the tourist traffic to the regular highway traffic during the summer months, the Trans-Canada Highway is particularly well used during these peak summer months. Present annual average daily travel (AADT) is well over 5,000 veh/day with this average increasing to over 10,000 per day during the summer months (SADT). These levels are expected to increase to about 8,500 veh/day AADT and over 15,000 SADT over a 35-year planning horizon period. On a daily basis, travel patterns are fairly typical of the rural/recreational pattern with a general mid-day peak between 12:00 and 4:00 PM. In addition, this highway is subject to an extraordinarily high commercial usage with a heavy vehicle proportion of approximately 25% of AADT or almost 1,300 heavy vehicles per day increasing to over 2,000 by 2049.

## *2.4 Problem Definition*

The existing highway through the Kicking Horse Canyon was constructed when the Yoho and Park bridges were completed in 1956. The highway runs through very difficult terrain and is of sub-standard design, with a low operating speed and a very poor level of safety. Specific sub-standard design elements such as deficient horizontal curve radii, super-elevation, inadequate shoulder widths and clear zones, and steep gradients lead directly to low operating speeds in the 55–65 km/h range and a poorer than average safety record. The reliability of the highway is compromised because of the difficult terrain, which is the primary cause of a variety of natural hazards such as avalanches and debris torrents, with little mitigation at present. The difficult terrain and challenging geotechnical conditions require exceptionally high capital expenditures to implement the desired improvements. These high costs have been the primary reason in the past for not embarking on an aggressive up-grading strategy to address the much needed operational and safety deficiencies.

Deficiencies for this section include the following:

- Summer traffic in the range of 10,000 vehicles per day, including a high percentage of commercial vehicles (15% during summer, 30% in the off-season), is currently accommodated on a winding older standard two-lane undivided highway.

- This 2-lane segment is inconsistent in design with the 4-lane Kicking Horse Canyon Project Phase 3 West to the west and the 4-lane Yoho Bridge segment to the east (see Figure 3.1).Corridor consistency is strongly recommended under Transportation Association of Canada (TAC) Design Guidelines.

- There are 13 sub-standard curves, poor vertical geometry, a narrow highway cross-section and often non-existent shoulders which affect both traffic operations as well as traffic safety;

- Average operating speeds are in the 55 – 65 km/h range, with many areas in which passenger vehicles are heavily platooned behind slower moving recreational vehicles and commercial trucks.

- The collision rate is more than 3 times the provincial average for older 2-lane rural highway facilities and far greater than can be expected from a modern 4-lane facility.
- The narrow highway cross-section and often non-existent shoulder provide poor safety to cyclists who are common visitors to the corridor, including a number of organized tours that visit the ‘golden triangle’, which comprises Banff and Yoho National Parks and Radium Hot Springs.

- Natural hazards include 7 rock fall / landslide / debris torrent hazard sites (5 rated high hazard and 2 moderate to high hazard) as well as 13 avalanche paths which, along with the high collision rate, cause poor reliability with frequent closures;

- Longer closures require a significant diversion via Highway 93/95, a two lane route with few passing lanes and is 104 km. longer requiring an additional 1-1/2 hours of travel time;

- The wildlife sensitivity within this area was rated as "moderate" with the number of animals killed on this segment averaging 1to 2 collisions per km per year, based on data from the Province’s Wildlife Accident Reporting System;

- The heavy traffic volumes and low travel speed underscore the fact that the existing highway while appropriate for the time of construction in the 1950s is totally out of date with respect to current design guidelines and, unless upgraded, will be strongly inconsistent with adjacent sections of modern 4-lane highway.
- There is great risk of negative economic impacts to both Canada and the Province from trade being diverted to the faster and much safer U.S. Interstate highway system, with shipments lost to U.S West Coast ports like Seattle, Portland, San Francisco and, Los Angeles.

## *2.5 Status of Other Phases of the Kicking Horse Canyon Project*

A diagram illustrating the relationship between the various phases is provided in Figure 2.1.

### *Phase 1*

Construction of Phase 1 (Yoho Bridge and approaches) was announced by the Provincial and Federal Government in July 2002. The cost of Phase 1 was $64 million, including a Federal Government contribution of $21 million provided through the Strategic Highway Infrastructure Program. Phase 1 was completed in the fall of 2006.

### *Phase 2*

Phase 2, a 5.8 kilometre segment, located immediately east of Phase 1, consists of the Park Bridge replacement and the upgrading of the Highway from the Rafter's Pull Out and east to the Brake Check. The up-grading was to a 4-lane with concrete median barrier standard. Phase 2 was constructed under a 'Design, Build, Finance and Operate' (DBFO) Agreement with construction completed in 2008. The project costs were $143 million, which included a Federal Government contribution of $62.5 million provided through the Canada Strategic Highway Infrastructure Fund Agreement.

### *Phase 3*

The projects that comprised the sections of Phase 3 have been completed and include:

- Brake Check to Yoho (Phase 3 East); Upgrade to 4 lanes with concrete median barrier of 8.8 km. of original 2-lane highway. Completed in 2011, cost $M 63.6;
- Golden Hill to West Portal: 3.8 kilometre section of Trans-Canada Highway between the Highway 95 intersection and the western limits of Phase 4. Completed in 2012, $M 56.2;
- The Total Phase 3 Cost was $M 120 with the Federal Government contributing $M 51.5.

## *2.6 Other Relevant, Unique or Sensitive Aspects of the Project*

One of the most interesting and unique aspects of this project is that, unlike many transportation corridors, it not only provides for its primary objective of safe and efficient access from Canada's interior to BC's gateways to the Asia Pacific Region, but also itself has an extraordinary intrinsic beauty making the route itself a major tourist attraction.

The area's unique beauty of rugged mountainous topography, complemented with gullies, fast flowing rivers at the valley bottoms and white snow caps at the mountain tops, make this section of the Trans-Canada Highway through the Rocky Mountains extremely attractive. Another unique feature of the project area is its proximity to such attractions as Banff and Lake Louise and the world class Kicking Horse Mountain Ski Resort in Golden, BC, which enhances its potential towards attracting overflow business or as a complementary attraction.

The attractiveness of the region and its potential towards tourism and recreational activities are well reflected in the make-up of the businesses in the area. The potential for growth in both tourism and recreation is considered significant. Some of the types of businesses already reaping the benefits the area's natural beauty has to offer include:

- Snowmobiling tour and rental companies that provide opportunities for sledders of all abilities to take advantage of the mountain terrain and views,

- Businesses that offer introductory and scenic Tandem Para-glider flights over the Canadian Rockies and the Columbia Valley,

- Numerous Heli-Skiing and Heli-Hiking businesses and backcountry lodges that provide these activities in unspoiled alpine environments,

- The Golden golf course, recognized as one of the top courses in BC..

The heli-ski operations, world famous white water rafting and kayaking, world class mountain bike trails and one of the top hang gliding and para-gliding launch sites in North America can only be described as an indication of what Golden and surrounding area have to offer.

Kicking Horse Country has seen a large increase in businesses start ups since the inception of the project. The continued up-grading of Highway 1 will provide a boost towards the continuation of business growth in the region.

# *3. Project Description*

The Phase 4 Canyon Project extends 4.8 km. from the east limits of the Phase 3 West Project at a location 4.2 km. east of the Golden Highway 95 intersection to the Yoho Bridge (Figure 2.1 Project Key Plan). These works include the realignment and upgrading of 4 km. of 2-lane 80 kmh undivided highway, operating well below its posted speed, to a 4-lane 100 kmh divided highway with an additional 0.8 km upgraded from existing 3 lanes undivided to 4 lanes divided. This would include the four lane widening, addition of median barrier, vertical and horizontal alignment improvements, shoulder widening, wildlife exclusion fencing and mitigation of rock fall and avalanche hazards. The mitigation of rock falls and avalanches would be achieved using a combination of bridges, wide ditches, catchment benches, retaining walls, high energy rock fall attenuation mesh and other measures.

## *3.1 Alternatives*

Numerous design and construction alternatives were developed using a wide range of horizontal and vertical geometry, variations of tunnels and bridges as well as splitting the project into a number of work packages. Alternatives included variations in number of lanes, sightline standards, use of tunnels and hazard protection sheds and wildlife mitigation. The selected alternative satisfies 4-lane median barrier separated 100 km/h Provincial standards while minimizing impacts on property and the environment.

Existing accesses for private and public use will be maintained, up-graded or modified to suit the up-grading of the highway.

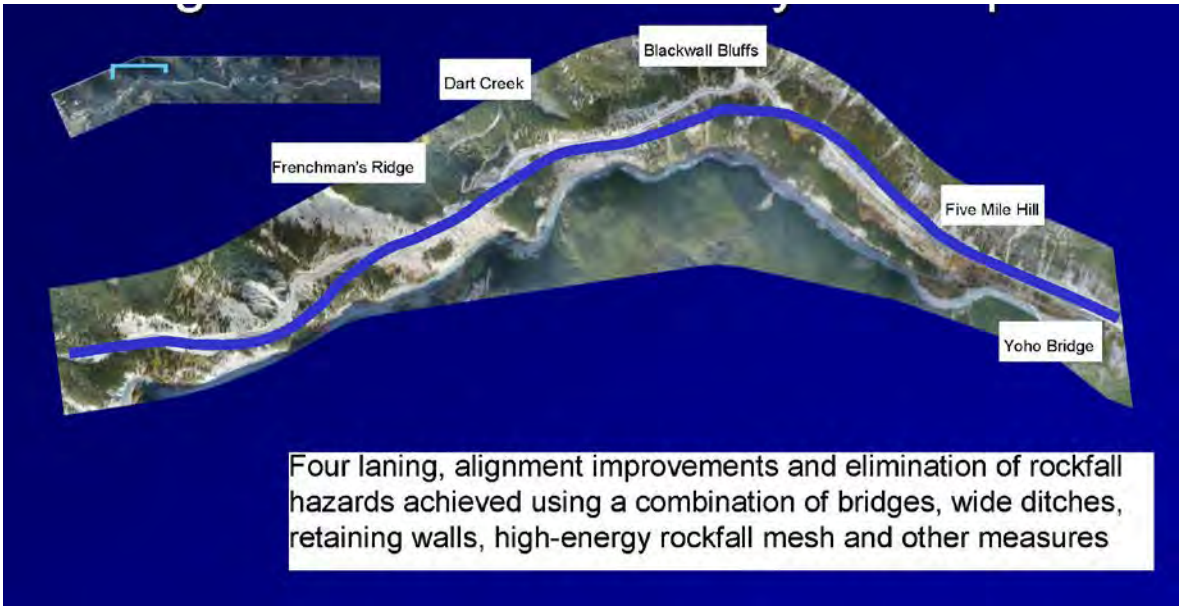
## *3.2 Preferred Option*

The preferred alternative, referred to as ‘Option Z9A-D’ achieves the up-grading of the highway to four-lanes to standards that satisfy Provincial 100 km/h design requirements, and in a manner that minimizes the impacts on the adjacent lands and is the least costly alternative meeting this criteria. The alignment is presented in Figure 3.1, Project Scope.

Significant cost savings were realized by creating curvilinear alignments more suited to the topography. Geotechnical hazards on all alignments have been mitigated through the use of a combination of high energy rock fall attenuation mesh, wide ditches, retaining walls and other measures.

The project will also provide safer access for local roadway connections to the Dart Creek Forest Service Road and two CP Railway access points;

***Figure 3.1, Project Scope***




The design criteria applied in the development of this option is as follows:

- 4.8 km of 4-lane roadway, to satisfy arterial standards,
- 100 km/h design speed throughout the section,
- Four (4) 3.7 m lanes,
- 2.5 m outside/right shoulders, and 1.0 m inside/left shoulder,
- 2.6 m median with concrete median barrier,
- Right In / Right Out only at Dart Creek Rd. and at 2 CP Rail access points
- Wildlife fencing is included

## *3.3 Project Delivery*

Phase 4 could be delivered by various procurement options, including design-bid-build; design-build; design-build-finance; and design-build-finance-operate (DBFO). Each procurement option would have its own schedule, costs and risk implications. For the purposes of this business case the project is assumed to be delivered through a design-build model as one package.

In accordance with PPP Canada's guideline for the New Building Canada Fund: P3 Screen Suitability Assessment Guide, a draft Suitability Assessment has been completed and indicates that the project presents a mix of favourable and unfavourable indicators for P3 delivery. The Phase 4 portion of the Kicking Horse Canyon Project is currently within the existing Phase 2 P3 concession, and thus a new broader P3 concession agreement to include the Phase 4 work would entail opening up this existing agreement with its subsequent legal, negotiation and timeline implications. Consequently, the Project is recommending a Design-Build or Design-Build-Finance delivery.

## *3.4 Work Schedule and Phasing*

Based on delivery as a single project, procurement work on the project would commence in 2016/17 and the project would be complete in 2023/24.

The preliminary engineering stage for the Phase 4 work has been completed. The schedule and cash-flows that follow are based on a one work package design- build arrangement. The current plan is that construction would be completed over a period of five years, with a start date of 2019. This is of course dependant on early approval and funding of the project.

The following is an illustrative schedule of the design/engineering/procurement and construction.

### *Table 3.2 Schedule*

| Segment | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Federal Funding | | | | | | | | |
| Des/Eng/Procurement | | | | | | | | |
| Construction | | | | | | | | |

## *3.5 Project Costs and Cash-Flows*

The estimated costs and yearly cash-flows for the project are presented in Table 3.3 below. These are total project costs which include property, design, engineering, procurement and construction and are estimated to be $M 450.0. The projected cash-flows are based on completing the works over an 8 year period.

## *3.6 Project Guidelines and Obligations*

### *Engineering*

The BC Ministry of Transportation and Infrastructure delivers its projects to the Ministry's own design and construction standards, to the guidelines provided by the Transportation Association of Canada and to industry practices. The Kicking Horse Canyon Project will be delivered with the same commitment towards these standards as has been the practice for other projects.

### *Jurisdictional*

The Kicking Horse Canyon Project is to be delivered by the BC Ministry of Transportation and Infrastructure, working in cooperation with local jurisdictions, regulatory and other agencies. This is the approach the Ministry uses as part of its delivery process, the same approach that will be used in the delivery of the Kicking Horse Canyon Project. All guidelines, procedures, and regulations applicable to this project will be applied throughout the implementation of the proposed up-grading of the Kicking Horse Canyon Project.

## *Table 3.3, Total Project Cash-Flows ( $M)*

| Cost Type | Past | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **A: Non-Eligible Costs** | | | | | | | | | | |
| Project Management | $ | | | | | | | | | |
| Planning | $ | | | | | | | | | |
| Environmental | $ | | | | | | | | | |
| Stakeholder Relations | $ | | | | | | | | | |
| Corporate Services | | | | | | | | | | |
| Engineering | $ | | | | | | | | | |
| Propety Acquisition | $ | | | | | | | | | |
| Other | | | | | | | | | | |
| Contingency | | | | | | | | | | |
| **Sub-Total** | **$** | | | | | | | | | |
| **B: Eligible Costs** | | | | | | | | | | |
| Engineering External | | | | | | | | | | $ |
| Environmental External | | | | | | | | | | $ |
| Construction Supervision | | | | | | | | | | $ |
| Construction (Road and Bridge) | | | | | | | | | | $ |
| Contingency | | | | | | | | | | $ |
| **Sub-Total** | **$** | | | | | | | | | **$** |
| **TOTAL** | $ | | | | | | | | | $ 450,000 |
| **Federal Contribution** | $ | | | | | | | | | $ 215,198 |

# *4. Multiple Account Evaluation*

The above described option has been evaluated on a number of performance criteria typical for roadway projects. An analysis period of 35-years has been chosen. This is a bit longer than the more typical 25-year life-cycle cost analysis, however, this is because of the longer than usual, 8-year project period required for this complex project and the necessity to consider a reasonable period after construction for the comparison of benefits. The option is compared to a "Base Case" which can be described as a "Do Minimum" scenario which involves leaving the facility largely "As Is" but includes maintenance and rehabilitation estimates for the existing facility over the analysis period.

The basis for the evaluation for each of the criteria is described in each of the following sections. The criteria can generally be separated into three types; financially quantifiable benefits and costs leading to the economic indicators, other non-financial but still quantifiable benefits and impacts, and, subjectively evaluated benefits and impacts. The financially quantifiable criteria are evaluated and discounted to the year 2015. Economic indicators aiding in the determination of the economic justification for a project can be calculated from these. However, many of the criteria cannot be reasonably converted to dollars and cents. Consequently, these are either presented quantitatively based on any quantitative indicators available, or evaluated subjectively based on the experience of the particular sector experts. Table 4.1, the Multiple Account Evaluation Summary, summarizes the results of the category evaluations and provides a convenient reference during the individual criteria discussions. The cost elements were described earlier within Section 3, the Project Description section of the report. It should be pointed out that the costs within Table 4.1 are the present values of the construction costs presented in the earlier Option Description.

***Table 4.1, Multiple Account Evaluation Summary (x $M): 6% Discount Rate***

| Criteria | Present Value @ 6 % | |
|---|---|---|
| | Base Case | Phase 4 |
| **Benefits** | | |
| Travel Time Costs | $83.3 | $68.8 |
| Delay Savings | | $14.6 |
| Highway Closure Costs | $53.1 | $20.3 |
| Reliability Savings (closures) | | $32.9 |
| Collision Costs | $63.6 | $35.3 |
| Safety Savings | | $28.2 |
| Vehicle Operating Costs | $95.5 | $89.5 |
| Vehicle Operating Cost Savings | | $5.9 |
| **Incremental Benefits** | | $81.6 |
| **Costs** | | |
| Construction Cost | $0.0 | |
| Incremental Cost | $0.0 | |
| Property Cost | $0.0 | |
| Incremental Cost | | |
| Delay During Construction | $0.0 | |
| Incremental Cost | | |
| Maint & Rehabilitation | | |
| Incremental Cost | $0.0 | |
| Salvage Value | $0.0 | |
| Salvage Value Savings | $0.0 | |
| **Total Discounted Costs** | | $262.0 |
| **Incremental Costs** | | $252.7 |
| **Economic Indicators** | | |
| Net Present Value (NPV) | | -$171.1 |
| Benefit/Cost Ratio (BCR) | | 0.32 |
| **Environmental Indicators** | | |
| Fuel Consumption (Million Litres) | 75.3 | 77.4 |
| Fuel Savings (Million Litres) | | -2.1 |
| CO Emissions (Tonnes) | 214803 | 215854 |
| Emissions Savings (Tonnes) | | -1052 |
| **Environmental** | | |
| Fisheries | | |
| Wildlife | | |
| Archaeological | | |
| **Socio-Community** | | |
| First Nations | | |
| Accessibility | | |
| Alternate Modes | | |
| **Economic Development** | | |

**Legend**

| | | | |
|---|---|---|---|
| ○ | Excellent | ◔ | Good |
| | No Effect | | Little Effect |
| ◑ | Average | ◕ | Poor |
| | Moderate Effect | | Strong Effect |
| ● | Very Poor | | |
| | Severe Effect | | |

## *4.1 Traffic Forecasting*

Many of the criteria evaluated are dependent upon the forecast of traffic over the 35-year study horizon from 2015 – 2049. A significant amount of effort was applied towards this as a part of the Corridor Management Plan carried out by Urban Systems in 1999 in the report titled "Trans Canada Highway Corridor Management Plan (Kamloops to the Alberta Border) Community Impact and Development Study". The horizon year utilized in the Urban Systems study was the year 2021 with a linear growth rate of 1.74% per year calculated for the AADT and 1.63% for the SADT. However as this study was carried out years ago using older data the forecasts have been upgraded using more recent data. Figure 4.2 presents the data used to establish the long term trend-line from 1991 to 2014 as well as showing the trend-lines for both AADT and SADT. The traffic data was extracted from the Ministry of Transportation and Infrastructure permanent count station P-37-1 at a location 2.5 km east of Route 95, Golden. Linear growth was established to be 1.4% per year for AADT and 1.2% per year for SADT. While the complete set of data for the year 2015 is not yet available, the months that are available confirm that the above expected rates continue to be reasonable.

***Figure 4.2: Traffic Forecasts - Historic Trend***

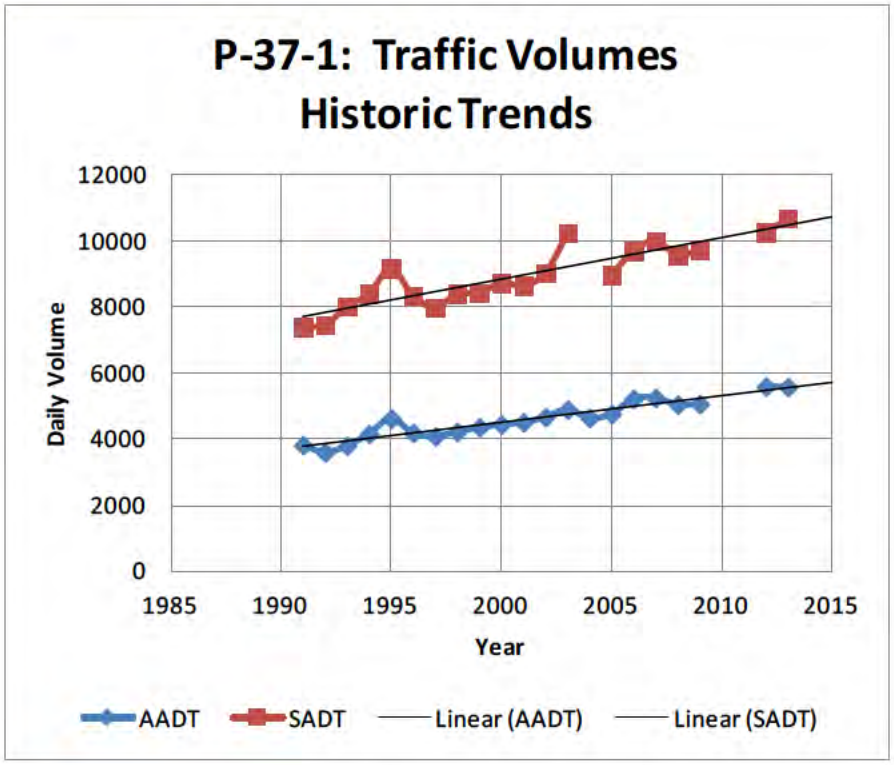
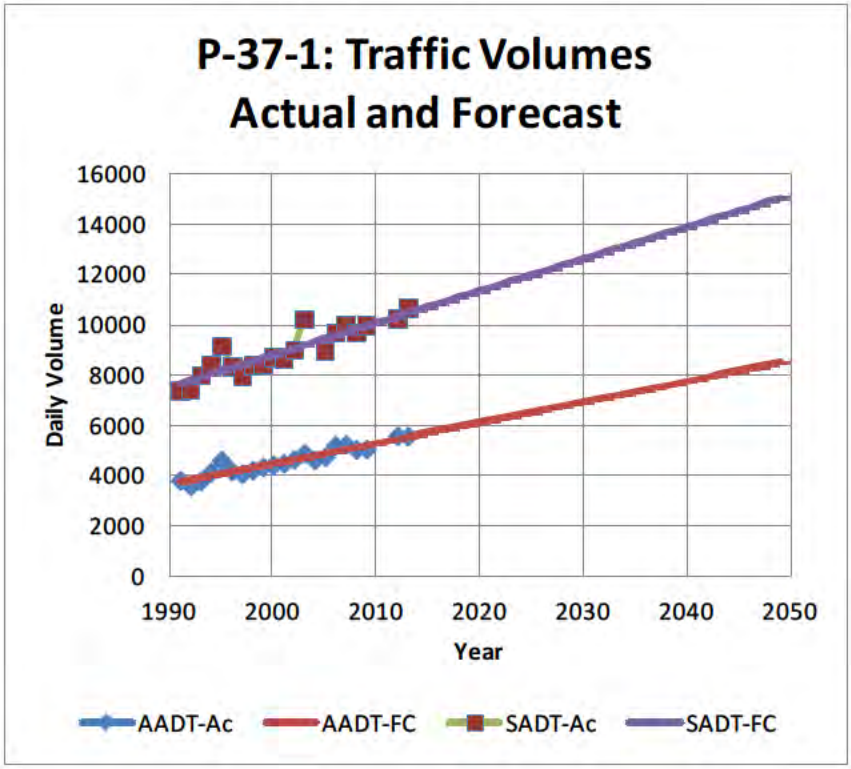



Figure 4.3 presents the extension of the historical trend data into the future to provide the traffic volume forecasts through the 35-year planning period to 2049. As a result of the addition of the tourist to the regular highway traffic during the summer months, the Trans-Canada Highway is particularly well used during the peak summer months. Present annual average daily travel (AADT) is well over 5,000 veh/day with this average increasing to over 10,000 per day during the summer months (SADT). These levels are expected to increase to about 8,500 veh/day AADT and over

15,000 SADT by 2049. On a daily basis, travel patterns are fairly typical of the rural/recreational pattern with a general mid-day peak between 12:00 and 4:00 PM.

***Figure 4.3: Traffic Forecasts***




In addition, vehicle classification was extracted from the permanent counter information with extraordinarily high heavy vehicle splits of 25%, 13% and 30% noted for the AADT, SADT and OSADT (Off-Season average daily travel) respectively.

## *4.2 Travel Time Costs*

The travel time savings generated by upgrading the roadway were calculated in detail. The analysis methodology was based on the estimation of the total travel time over the 35-year planning period for both the Base Case as well as for the Preferred Option. The difference in travel time caused by the upgrade was then defined as the delay savings. As the Phase 4 project is a 2-lane rural highway upgrade project, the travel speed was determined by roadway geometry and the travel time was generated using the TwoPAS two-lane rural highway model within the FHWA's Interactive Highway Safety Design Model (IHSDM). This model estimates typical travel speeds for passenger, RVs and heavy vehicles based on the grades and curvature and traffic characteristics of the highway geometric options.

As the characteristics for off-season travel and high-season travel were considerably different, the above analysis was carried out separately for both periods to generate the overall yearly travel time. Standard travel time cost rates were then applied to the yearly travel times to produce yearly travel time costs. The yearly travel time costs were then discounted to provide the present value. A summary of the average speeds calculated using the IHSDM model over the 4.8 km. project length

for the peak hour over a number of different periods and used for the travel time savings calculations are provided in Table 4.4 below. It is evident that Option Z9A-D will provide significant speed savings under both low volume 2015 Off-Season conditions as well as busier 2039 summer conditions. The overall life-cycle travel time costs over the entire 35-year period and consequent delay savings are shown in Table 4.1. The delay savings generated by the higher speeds made possible by the Phase 4 upgrade were calculated to be approximately $M 14.6.

***Table 4.4 Option Speed Calculations Summary***

| Option | Speed (kmh) | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | | | | 2039 | |
| | Off-Season | | Summer | | Summer | |
| | PV* | Trucks | PV* | Trucks | PV* | Trucks |
| Base Case | 64.0 | 56.0 | 58.4 | 51.1 | 55.8 | 48.8 |
| Option Z9A-D | 91.4 | 72.1 | 89.7 | 70.7 | 88.9 | 70.1 |

* Passenger Vehicles

## *4.3 Highway Closure Costs (Reliability)*

The reliability of the highway in terms of the ability to be clear of incidents and hazards, such as avalanches, etc. has been identified as an issue of prime importance to the commercial trucking and business community. Predictability in arrival times is critical for businesses in their optimal planning and scheduling of activities. Hazard and safety upgrades that reduce the potential for road closures serve to increase the reliability of the highway system. Both collision and avalanche hazards are significantly high within this section, and when they do occur there is little mitigation available. The highway is narrow and as a result there is often little opportunity for emergency service personnel to create either a bypass or single lane alternating traffic scenario. Redirection via Highways 93 and 95 is an option, but is estimated to add about 90 minutes of travel time.

Highway closure data for the years between 2006 and 2014 was analyzed with the average number of closure occurrences and the average closure delay over that period shown in Table 4.5 below. The reduction in collision closures was calculated using the collision forecast models described in Section 4.4 below with a collision reduction of 66% calculated. Avalanche closure reductions were based on the design criteria for avalanche events of a maximum of 1 event every 30 years. The mitigation of rock fall hazards and avalanches can be achieved using a combination of bridges, wide ditches, catchment benches, retaining walls, high energy rock fall attenuation mesh and other measures. This resulted in a reduction in collision closures from 3.38 to 0.78 closures per years and a reduction in avalanche closures from 8.3 to 0.03 occurrences per year. The costs of these highway closures were calculated in detail with the results presented in Table 4.1 above. The Base Case has been calculated as having total highway closure costs of $M 53.1 and the Phase 4 Upgrade $M 20.3. Consequently, the reliability savings generated by the Phase 4 upgrade were estimated to be approximately $M 32.9.

***Table 4.5 Highway Closure Data Summary***

| Option | Closure Type | Traffic Volume ( % ADT ) | Period | Typical Delay ( Hrs ) | Occurences per Year ( # ) |
|---|---|---|---|---|---|
| **Existing (Full 2-lane Closures)** | | | | | |
| | Collision | 20% | SADT | 3.4 | 3.38 |
| | Avalanche | 30% | OSADT* | 6.7 | 8.3 |
| **Option Z9A - D (Full 4-lane Closures)** | | | | | |
| | Collision | 20% | SADT | 3.4 | 0.78 |
| | Avalanche | 15% | OSADT | 3.4 | 0.03 |

* OSADT: Off-Season Average Daily Traffic

## *4.4 Collision Costs*

The Phase 4 section of the highway is characterized by a very poor safety record. This can be attributed to a number of factors including the older geometry of the highway, sub-standard curves, poor vertical geometry, a narrow highway cross-section, often non-existent shoulders as well as the severe weather conditions, unexpected wild animals, poor roadway surface conditions and driver frustration caused by queuing behind slow moving heavy vehicles. The upgrade provided by the recommended project option addresses these issues.

Projections of the number and type of collisions, their costs and the savings associated with the upgrade have been made. A series of collision prediction models were set up and calibrated to accurately estimate the collisions to be expected over the 35-year life-cycle planning period. The models estimates collisions based on a wide variety of factors including grades, roadway cross-sections, curvature and traffic flow on the various highway options. The model was calibrated to specific Kicking Horse Canyon conditions on the basis of the Ministry of Transportation and Infrastructure's HAS collision database. A summary of the project collision forecasts is presented in Table 4.6.

The forecast for the study section show the collision numbers and rates for the entire section with significant collision savings expected. A total of 844 collisions would be expected under the existing Base Case including 19 fatalities and 290 injuries. The 4-laning of the roadway to current standards including the concrete median barrier would be expected to reduce these collisions to 288 over the 35-year period including 6 fatalities and 96 injuries. Consequently, collision savings of 556 total collisions, a 66% reduction, including 13 fatalities and 194 injuries would be generated by the project. As a result, the collision cost savings generated by the Phase 4 upgrade, shown in Table 4.1 were estimated to be approximately $M 28.2.

***Table 4.6 Collision Forecasts***

| Criteria | Units | 35-Year Collision Forecast | | |
|---|---|---|---|---|
| | | Base Case | Option Z9A-D | Reduction |
| Fatal | (#) | 19 | 6 | 13 |
| Injury | (#) | 290 | 96 | 194 |
| PDO | (#) | 535 | 186 | 349 |
| Total | (#) | 844 | 288 | 556 |
| Rate | (coll/MVKm) | 1.68 | 0.57 | -66% |
| Severity | Index | 6.3 | 6.0 | -5% |

## *4.5 Vehicle Operating Costs*

Vehicle operating costs (VOC) calculations were based on fuel consumption calculations as well as a variety of other user-related VOC costs largely based on distance and travel speeds. The Project has a shorter distance than the Base Case and results in higher travel speeds. While the higher travel speeds cause fuel consumption to increase the shorter distance reduces many other types of VOC. The overall result is a beneficial decrease in VOC costs (Savings). Referring to Table 4.1, the calculated total VOC Savings for the Phase 4 project were $M 5.9.

## *4.6 Construction and Property Costs*

Facility capital cost estimates have been presented previously in section 3.5 of this report. The total as spent cost for construction and property is estimated to be $M 450.0. With a Phase 4 project length of only almost 4.8 km. this is clearly the most challenging of the three phases of the Kicking Horse Canyon Project to construct with a per km construction cost of over $M 90 per km. The present value for combined construction and property costs in Table 4.1 amount to $M 281.5.

## *4.7 Operations, Maintenance and Rehabilitation Costs*

Yearly operations, maintenance and rehabilitation (OM&R) costs were also calculated, based on the detailed review of rehabilitation and maintenance costs under the existing Concession Agreement in place whereby the Concessionaire operates, maintains and rehabilitates the entire 26 km Kicking Horse Canyon corridor, including the existing Phase 4 Canyon limits, until the year 2030. The overall discounted maintenance and rehabilitation costs are expected to amount to $M[redacted] for the Base Case and $M[redacted] for the Phase 4 upgrade. As a result of rounding, this leads to an increase in OM&R costs of $M[redacted] (Table 4.1).

## *4.8 Economic Indicators for Road Users*

Utilizing the above results, and referring to Table 4.1, the Option Evaluation Summary, two key economic indicators can be calculated; the Net Present Value (NPV) and the Benefit/Cost Ratio (BCR). The net present value has been calculated on the basis of a discount rate of 6%. The calculations of these indicators yield an NPV of -$M 171.1 and a BCR of 0.32. This is based on incremental present value benefits of $M 81.6, 40% from reliability savings, 35% from safety savings, 18% from delay savings and 7% from vehicle operating cost savings. However, these significant benefits are unfortunately tempered by extremely high construction costs through the difficult terrain of the Rocky Mountains. Incremental present value costs, based on present value construction and property costs, calculated using the 6% discount rate, amount to $M 281.5.

## *4.9 Environment*

The KHCP has completed numerous environmental studies including those described below. An environmental synopsis report that identifies all environmental constraints and requirements for the project is complete. There are no unacceptable environmental impacts anticipated from this project, provided that planned mitigation, outlined below, is implemented. The environmental synopsis report provides information required to complete an environmental assessment. The report will be updated upon approved funding for the project to ensure the project appropriately mitigates any environmental impacts. The Province will ensure that all provincial and federal environmental statutory requirements are met. In addition to the foregoing information, the Province has also completed and appended (Appendix A) to this report, "**Annex D - Environmental and Aboriginal Consultation Information Requirements"**

### *Air Quality*

Greenhouse Gas (GHG) emission savings in terms of Millions of Kilograms produced were calculated in order to provide an indication of the relative affect of the project on air quality. The results are also presented in Table 4.1. The calculations for the GHG production were based on emissions factors drawn from an Environment Canada report[2] applied to the fuel consumption calculated as described earlier. The emission factors are presented in Table 4.8. Fuel consumption calculations were based on unit rates and travel speed. As the expected travel speed increases in step with the increase in design and posted speeds, fuel consumption, and consequently GHG emissions, can be expected to rise. The resulting unit emissions were applied to the total Million vehicle kilometres traveled (MvkmT) for each of the 35-years within the planning period to produce the total emissions for each of the 35-years. These results were then summed with a result of 2.1 M Litres of additional fuel consumed and 1,052 Tonnes of additional GHG emissions produced for the Phase 4 upgrade. As the Trans Canada Highway is upgraded to provide better mobility and consequent economic benefits for all, the travel speed will increase leading to increased fuel consumption. Consequently, GHG emissions may be expected to rise.

***Table 4.8: Emission Factors***

| Emission Type | Gas Kg/l | Diesel Kg/l |
|---|---|---|
| CO | 2.36 | 2.73 |
| NO | 0.26 | 0.08 |
| HC | 0.12 | 0.12 |
| Total | 2.74 | 2.93 |

However, the above has been calculated on the basis of constant fuel consumption rates. It is anticipated that the federal government plans to reduce Canada's greenhouse gas emissions, which will have an effect in reducing the vehicular fuel consumption rates over the longer planning horizon period. While this would be true for both scenarios equivalently, and consequently the preferred option would still have higher GHG emissions than the existing case, it does mean that in an absolute sense there is likely to be a decrease in GHG emissions over this period. If the

[2] **Canada's Greenhouse Gas Inventory 1990 – 2002 Annex 7: Emission Factors**

government's plan is effective, greenhouse gas emissions from vehicles using this section of highway will be lower than they are today.

Construction works will comply with all federal, provincial and local emissions regulations. Vegetation debris will not be burned.

### *Fisheries*

Within the Phase 4 Canyon section of the project the highway alignment crosses a number of small, ephemeral non-fish-bearing drainages, including the Dart Creek drainage, which has year-round flow. MoT standard specifications (SS165), including environmental and sediment and drainage management plans, will be implemented during construction and operation to ensure that water quality is protected in Dart Creek and the Kicking Horse River. As a result of the project design and the above-noted mitigation, the Phase 4 Canyon project is not expected to adversely affect fisheries or aquatic resources and is therefore rated as Little Effect.

### *Wildlife*

Wildlife surveys and habitat assessments that included the KHCP area were conducted between 1996 and 2000 as part of the Cache Creek to Rockies highway improvement program. Detailed wildlife and habitat assessment studies were also undertaken during and prior to Phases 1, 2, 3 and 4 of the KHCP project. These included a detailed terrestrial vegetation inventory and wildlife habitat mapping[3], ungulate snow-tracking and winter aerial surveys carried out between 2005 and 2010.

Animal-vehicle collision rates are among the highest on the entire TCH between Kamloops and the Alberta border, ranging from an estimated 1.5 to 3.9 collisions per km per year within the Phase 4 Canyon segment, based on data from the Province's Wildlife Accident Reporting System. Unmitigated, the wider highway and increased traffic speed are expected to result in increased animal-vehicle collisions. Wildlife fencing within the Phase 4 Canyon project, covered in a separate report[4], will have a significant and dramatic beneficial effect by reducing animal-vehicle collisions within this section.

The B.C. 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. Bird surveys conducted in 2005 did not detect any Red- or Blue-listed bird species.

The base case for wildlife is rated as Severe Effect. However, with the proposed wildlife fencing mitigation system for the Phase 4 Canyon project, this is reduced to No Effect.

### *Archaeological*

Nine registered archaeological sites have been identified within the Phase 4 Canyon project area, including a stone tool manufacturing site. A summary report of archaeological assessments listed

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[3] Vegetation and Wildlife Habitat Mapping, Kicking Horse Canyon Project, Phase Three East and West, Trans Canada Highway, Golden to Yoho Bridge and Brake Check to Yoho National Park, Timberline Forest Inventory Consultants, July 2006

[4] **Comparison of Alignment Options with Respect to Wildlife Exclusion Fencing -** West Portal to Yoho Bridge Project, W. Harper, June 2007

the site locations.[5] The summary report determined that the sites identified and mapped can be avoided and, if not, that site alteration permits can be obtained, mitigating effects of disturbance. With the proposed mitigation, archaeological effect within the Phase 4 Canyon project area is rated as Little Effect.

### *4.10 Socio-Community*

#### *First Nations*

The Province will ensure that all provincial and federal environmental statutory requirements are met. In addition to the foregoing information, the Province has also completed and appended (Appendix A) to this report, "**Annex D - Environmental and Aboriginal Consultation Information Requirements"**

The project is in the asserted traditional territories of the Ktunaxa Nation, the Shuswap Nation, the Neskonlith Indian Band and the Adams Lake Indian Band. The project has consulted with these groups (Appendix A) and will provide further consultation and opportunities for engagement with the project. Involvement in the project construction phase as well as possible archaeological investigations can provide opportunities for the First Nations groups. Effects on First Nations are rated as Little Effect.

#### *Accessibility*

The highway upgrade does include highway widening through the connection at Dart Creek Forest Service Rd. This full movement unsignalized provides access to a logging area and, although at very low volumes, the slow moving heavy vehicles are presently at particular risk turning onto and off of the highway at this location. Consequently this intersection will be designed to ensure that there will be no dangerous left turn movements to be carried out at this location and the access will be considerably safer than today. However, this may entail some redirection of traffic causing longer travel times to be experienced. The designs also include safer local access to the CP Railway access points with the median barrier through the access points preventing the left turns into and out of the access points . As a result of the present combination of full access but with higher safety risk the existing base case has been rated as Poor. As a result of the benefits of the trade-off of greater safety with longer travel times the upgrade has been rated as Average.

#### *Alternate Modes*

The highway upgrade also provides an opportunity to support alternate modes of transportation. These can include longer distance cycling activities on the TCH corridor, as well as local cycling activities. Cycle touring along this route is increasing in popularity. Wider paved shoulders on the highway will be far safer than the existing shoulders. As a result, the existing base case has been rated as Very Poor with the Phase 4 upgrade rated as Excellent.

### *4.11 Economic Development – Provincial / National / Local*

In a primary corridor such as the Trans-Canada Highway economic development benefits accrue most significantly to society as a whole, to the citizens of the entire province and country and often

[5] **Summary Report-Archaeological Assessments Kicking Horse Canyon Project, Phases 3 and 4,** Golder, July 2014

to the surrounding local economy. The effects of the Phase 4 project upgrades on provincial and national economic development are described subjectively. Poor travel, safety and reliability characteristics presently experienced through the Phase 4 Project area add to the general disincentive for national and international commercial activity directed to and via the Gateway / Port of Vancouver via the Trans-Canada Highway. The Phase 4 Project effectively deals with these poor conditions. The geometric improvements, 4-laning with concrete median barrier to Provincial standards, that are a part of the Phase 4 Project effectively address the traffic operations and safety issues, as well as the reliability requirements. In addition, the Phase 4 Project will provide the Golden area local economy with greater opportunity for tourism growth as well as a significant boost to the local economy by providing additional employment during the construction period. Consequently the existing highway has been rated as Very Poor and the Phase 4 Project Excellent for Provincial / National economic development.

### *4.12 Overall Evaluation*

Utilizing the above results, and referring to Table 4.1, the Option Evaluation Summary, two key economic indicators can be calculated; the Net Present Value (NPV) and the Benefit/Cost Ratio (BCR). The net present value has been calculated on the basis of a discount rate of 6%. The calculations of these indicators yield an NPV of -$M 171.1 and a BCR of 0.32. This is based on incremental present value benefits of $M 81.6, 40% from reliability savings, 35% from safety savings, 18% from delay savings and 7% from vehicle operating cost savings.

However, the above significant benefits are unfortunately tempered by extremely high construction costs through the difficult terrain of the Rocky Mountains. Incremental present value costs, based on present value construction and property costs, calculated using the 6% discount rate, amount to $M 281.5. The high cost of construction in the rugged topography of the Rocky Mountains makes it difficult to achieve a positive NPV or benefit cost ratio greater than one. However, it needs to be noted that these indicators are based on localized benefits only, and ignore both the many unquantifiable benefits, as well as wider area benefits accruing to continuity within the corridor and wider provincial and national economic benefits.

The project provides significant economic advantages and broad public benefits as follows:

- Highway geometry will be brought up to current standards with significant reliability, safety and mobility benefits, in particular additional median and shoulder width and the introduction of a concrete median barrier will provide for immediate benefits;
- Travel speeds for passenger vehicles will immediately be increased from approximately 60 kmh to over 90 kmh with vehicles not affected by grade being able to travel at the 100 kmh posted speed. Heavy vehicle speeds will also be increased from the 50 kmh range to the 70 kmh range over the 35-year horizon;
- Travel reliability will immediately be increased with a reduction in collision closures from 3.4 to 0.8 closures per years and a reduction in avalanche closures from 8.3 to 0.03 occurrences per year;
- Travel safety will immediately be improved with a collision reduction of 66% calculated over the 35-year planning horizon;
- The project phase will complete the 26 kilometre 4-laning of the Kicking Horse Canyon corridor;
- The project will aid in the scheduling and performance of maintenance activities;

- The project will provide for a safer local roadway connection to the Dart Creek Forest Service Road as well as safer local access to CP Railway access points;
- The project does not appear to have any significant environmental impacts which cannot be mitigated. In fact, wildlife fencing provided as a part of the Phase 4 Canyon project, will have a significant and dramatic beneficial effect by reducing animal-vehicle collisions within this section.

Unquantifiable benefits include:

- Increased competitiveness for national and international commercial activity directed to and via the Gateway / Port of Vancouver via the Trans-Canada Highway;
- An additional step towards meeting the important Federal objective of providing Canadians with a 4-lane 100 km/h highway facility linking the nation's far-flung regions;
- Improved access to a significant active logging area as well as tourism and recreation opportunities;
- Accommodation of alternate modes including important tourist cycling tours.

The wider area benefits accruing to continuity within the corridor and wider provincial and national economic benefits generally revolve around provincial and federal economic development benefits and trade. While these are discussed in greater detail in Section 6 of this report, it can be noted that the value of goods moved by road through the Kicking Horse Pass increased by 64% over ten years from almost $20 billion in 2005 to over $32 billion in 2015[6]. [redacted]

[6] Value of Commercial Goods on the Highway 1 Corridor between Golden and the Alberta Border, MMK Consulting, March 2016.

### *4.13 Performance Measurement*

[redacted] These points have been converted to actual performance measures and listed with their expected targets in Table 4.9 below. Significant increases in Summer Peak Hour travel speeds can be seen as well as significant decreases in the number of highway closures and the number and severity of collisions.

*Table 4.9 Performance Measure Targets*

| Performance Measure | Existing | 2049 Target |
|---|---|---|
| Average Summer Peak Hour Speed (km/Hr) | 57 | 86 |
| Highway Closures (# of Closures / Year) | 11.7 | 0.8 |
| Collisionj Rate (col/MV-Km) | 1.68 | 0.57 |
| Severity Index | 6.3 | 6 |

### *4.14 Additional Public Benefits*

a) This project has a major impact on access to major transportation facilities. The Kicking Horse Canyon is an integral part of the Trans Canada Highway corridor, which is the main corridor linking British Columbia and its ports to the rest of Canada. Given the difficult topography, adverse weather conditions, large number of heavy vehicles using the corridor and poor operating conditions, an upgrade of this portion of the highway will significantly affect the efficiency of heavy vehicle and goods movement.

b) Upgrading of the Kicking Horse Canyon will encourage system efficiency by providing more reliability within the corridor by significantly reducing the avalanche and collision risk and by providing greater flexibility of choice of mode for the transportation of goods to and through British Columbia's ports.

c) Improved access for Forestry and CP Rail use will strongly support the local economy.

d) Accommodation of alternate modes including important tourist cycling tours will also strongly support the local economy.

e) Project implementation will address the significant public expectation and acceptance of the project.

f) Up-grading the Trans-Canada Highway through the Kicking Horse Canyon goes a long way to meeting the transportation needs of all Canadians. The importance of this highway's role as the primary route for the movement of people and goods, and in meeting the province's vision of this highway serving as BC's gateway to Canada and the Asian markets, will be greatly enhanced.

g) The four-laning of the Kicking Horse Canyon section of the Trans-Canada Highway should be viewed as a step towards achieving a national and provincial goal of having one national four-lane facility to serve Canada from coast to coast, thus enhancing Canada's ability and opportunity to accommodate the Asian markets. Without the safety, reliability and efficiency of

such a facility, Canada's competitive position is severely compromised when compared against east-west Interstate routes I-90, I-80 and I-10. Interstate I-90 was constructed when traffic volumes were in the same range as current volumes on the Kicking Horse Canyon section of Highway 1.

h) Investing in transportation infrastructure that helps move people and goods more efficiently and with greater safety is a top priority for British Columbia and no doubt the rest of Canada. Efficiency and safety in travel are great economic drivers for the benefit of all.

i) The Kicking Horse Canyon Project will be viewed as one of Canada's success stories due to the area's unique and treacherous topography, and natural beauty. When completed, the new four-lane facility will promote the initiation and continued generation of economic solutions locally, thereby building regional capacity and fostering the integration of economic, social and environmental objectives. Such a movement is already taking place under the recent "re-branding" of the Golden area which has resulted in a flurry of activity from community enhancement projects, marketing, information dissemination, and establishing a new image.

j) Completing the four-lane highway through the Rockies is a key priority for the government of BC in that it will improve the province's ability to compete and will strengthen the province's commitment in serving as Canada's gateway to the world. This project will serve as an important engine for economic growth for all of British Columbia as well as for the rest of Canada

k) The up-grading of the Phase 4 segment will maximize the incremental benefits that will be realized from completing the entire 26-kilometre section. If the existing deficiencies within the Phase 4 segment are not addressed, the benefits that are being sought through improved safety, reliability and efficiency will be severely compromised.

l) British Columbia is rich in natural and man-made attractions. The attractiveness of the province will be greatly improved through the improved safety, reliability and efficiency of travel on the main vehicular entry point from the rest of the nation.

m) The Town of Golden has experienced significant recreational and real-estate growth, with major investments such as the $100 million "Kicking Horse Mountain Resort" which provided a considerable boost to the local economy and population growth. Additional growth will likely continue from tourism as the area is expanding its summer and winter attractions/facilities. An up-graded TCH through the Rockies will make travel to/from Alberta (which has been key to growth in the Columbia-Shuswap Regional District) much more attractive, thus enhancing the opportunity for continued economic growth.

n) In addition, the Phase 4 Project will provide the Golden area local economy with a significant boost to the local economy by providing additional employment during the construction period.

# *5. Risks and Sensitivity Analysis*

## *5.1 Risks*

The design and implementation of a highway project always carries various elements of risk. The risks associated with this project may be categorized into 3 major areas, Technical, Financial and Implementation, with a number of specific risks identified within each area. A listing of specific risk examples within each category is provided below:

Technical Risk Examples:

- Geotechnical uncertainties
- Traffic Management during construction
- Environmental issues
- Confined working area

Financial Risk Examples:

- Cost over-runs associated with design or construction difficulties
- Cost over-runs associated with construction delays
- Cost over-runs associated with material costs and delivery schedules
- Inflation

Implementation Risk Examples:

- Stakeholder issues
- Availability of experienced contractors and resources
- Availability of materials and equipment
- Excessive impact on the surrounding community
- Employee/contractor safety conditions

Technical risk is best managed by ensuring that experts of the highest caliber are utilized, and that their services are funded appropriately. Technical expertise used by the Provincial Ministry in such disciplines as design, geotechnical, traffic management and construction will provide the appropriate controls to manage the issues and implement any necessary measures to eliminate or effectively manage the risk. Technical risk is also continually reduced over the project program as more information becomes available.

Financial risk is managed most effectively by ensuring that the most precise cost estimating procedures possible are in place, followed by rapid feed-back mechanisms in order to identify cost pressures before or as they are occurring. This will lead to an immediate and effective response to difficulties as they occur. The KHCP Project team has a wealth of experience in developing procurement documents and procedures that will minimize contractor cost and over runs. The KHCP Project team has also factored in inflation and escalation in their cost estimates.

Many of the financial risks are intimately connected to the above-mentioned technical risks; consequently expert management of the technical risks will largely address the key financial risks. Proper financial procedures will be followed to ensure financial accountability. In order to ensure the most efficient use of the budgets allowed, contracts will be let based on a competitive bidding process.

Implementation risks are most effectively addressed through sound investigation of the effects and careful consideration of the trade-offs followed by good communications with industry, the public and stakeholders. Key to the success of the project is to have the appropriate expert personnel in

place with a rapid flow-through of the information necessary to ensure accurate prediction of any possible difficulties, and rapid response to unforeseen difficulties as they occur. An effective Communication Plan for will address any communications issue and reduce or eliminate this risk.

Sufficient contingency in the project cost estimate is also in place to cover the eventual unforeseen risks should they occur.

## *5.2 Sensitivity Analysis*

The sensitivity of the analysis results to a number of assumed inputs within each of the criteria was carried out. The assumed inputs were varied within what was felt to be a reasonable range, and the resulting economic indicators logged. The results are tabulated within Table 5.1 : Sensitivity Analysis. In general, the results show that as can be expected the NPVs and the BCRs remain less than those generally desired for transportation projects through the full range of the sensitivities tested. As previously discussed, this is not as a result of few benefits, but rather the result of high construction costs through the difficult terrain of the Rocky Mountains. To the upside, the results are most sensitive to variations in the capital cost and the discount rate yielding maximum NPVs in the -$M 140 range and a maximum B/C Ratio of 0.45. On the downside, the results are most sensitive to cost over-runs and discount rate yielding a minimum NPV in the -$M 240 range and a minimum B/C Ratio of 0.20.

***Table 5.1 Sensitivity Analysis***

| Criteria | Assumed Input | | Sensitivity Range | | Option | |
|---|---|---|---|---|---|---|
| | Type | Value | Min | Max | Option Z9A-D | |
| | | | | | NPV | BCR |
| Delay Savings | Yearly Traffic Growth | 1.4% | | | -$ 171.1 | 0.32 |
| | | | 1.0% | | -$ 175.4 | 0.31 |
| | | | | 2.0% | -$ 165.4 | 0.35 |
| Safety Savings | Collision Rates (col/mvkm) | 0.57 | | | -$ 171.1 | 0.32 |
| | | | -25% | | -$ 178.2 | 0.29 |
| | | | | +25% | -$ 164.0 | 0.35 |
| Capital Cost | Capital Cost | $ 281.2 | | | -$ 171.1 | 0.32 |
| | | | -10% | | -$ 143.0 | 0.36 |
| | | | | +25% | -$ 241.4 | 0.25 |
| Discount Rate | | 6% | | | -$ 171.1 | 0.32 |
| | | | 4% | | -$ 142.1 | 0.45 |
| | | | | 10% | -$ 173.6 | 0.20 |

# *6. Corridor Economics*

## *6.1 Background*

As described in earlier sections of this business case, the efficiency, reliability and safety of the Trans-Canada Highway (TCH) through the Rocky Mountains are critical to the economic competitiveness of both British Columbia and Canada. This corridor is extremely important to Canada's trade, the everyday movement of people and goods, and in meeting the province's vision of this highway serving as BC's gateway to Canada and the Asian markets.

Canada is an open economy dependent on inter-provincial and international trade. Our economy depends on combining our people, resources and technology to produce goods and services that can be marketed competitively around the world. Transportation systems are trade corridors, which enable continued growth and prosperity. When trade corridors function effectively, they allow Canadian firms and industries to produce goods and services that can be marketed competitively in domestic and international markets. Remaining competitive is a necessary condition for Canada's continued prosperity and growth. Trade corridors, which function efficiently, provide Canadian consumers access to competitively priced, quality goods, which maximize their purchasing power and increase quality of life.

Constraints that impede trade corridor efficiency have repercussions throughout the economy. Increasing delay in a world of just-in-time delivery means firms must hold additional inventory in supply chains which increases production costs and alters relative prices. A change in relative price impacts the competitive position of Canadian firms in both domestic and international markets with very real and tangible impacts on employment, investment and GDP. Increasing price decreases the purchasing power of Canadians, impacting quality of life.

Strengthening Canada's position as a trading nation by investing in trade corridor improvements is key to securing Canada's and British Columbia's long term economic prosperity.

This business case presents an investment strategy designed to mitigate constraints impacting Canada's domestic and international trade moving through British Columbia using the Trans-Canada Highway through the Rockies. This small section of highway acts as the primary gateway for exports from across Canada destined for markets in BC and around the world and for imports from BC and the rest of the world used by Canadian industry to remain competitive in global markets and by consumers to maximize welfare.

The following describe the significance of the Trans-Canada Highway through the Rockies as Canada's gateway to trade.

## *6.2 Significance of the Kicking Horse Canyon Project to Trade*

The Kicking Horse Canyon is a critical component of Canada's primary east-west trade corridor linking producers to markets and resources and consumers to goods and services from across Canada and around the world. On an annual basis, billions of dollars worth of exports and imports flow over this section of highway, supporting income and employment in communities across Canada, adding value to local, regional and national economies and providing the potential for future growth.

*As a trading nation, price matters.*

Capital investment flows to regions with a competitive advantage in land, labour, resources and access to markets, which impact the cost of production. Firms make strategic decisions based on demand for their output, the price of its factor inputs, production costs and the cost of moving goods to market. Consumers purchase goods and services based on their disposable income, the available supply, product quality, and product price.

For firms and industries producing primary goods (natural resources like coal, energy, grains), buyers and sellers enter into long term contracts involving significant quantities for a fixed price over extended periods of time. These goods are often of low value (in terms of revenue per ton-mile) and shipments are not time sensitive. For buyers and sellers in these markets, the opportunity cost of shipment ownership[7] and inventory costs[8] are low. Examples of primary goods imported to BC for re-export through the Pacific Gateway to markets around the world are coal, grains and potash. Primary goods are often not time sensitive, are of low value and are generally moved by rail.

However, the value of secondary goods moving through the Kicking Horse Canyon is high. Secondary goods include imports moved through the Pacific Gateway for export to the rest of Canada. Goods such as these are required by firms and industry across Canada to produce products or services that increase value added, providing employment and income to individuals and communities across Canada. Imports also include finished products destined for purchase by Canadian consumers who demand high quality, lower cost products in an effort to maximize purchasing power and improve quality of life.

As a trading nation, Canada's competitive advantage lies in our ability to continue to provide competitively priced goods and services to markets within Canada and around the world. How our transportation corridors perform can impact costs.

In the case of secondary goods, opportunity costs of shipment ownership and inventory costs associated with delay are high. Examples of secondary goods imported into BC then re-exported to firms and industry across Canada, include such things as computer chips, electronic and automobile parts. For firms using these types of inputs, maintaining a competitive advantage requires their production processes be tied to just-in-time delivery. Late deliveries brought about by transportation delays impact production cycles, increase the amount of inventory that must be held in the supply chain, increasing costs and impacting price. A change in price impacts market share, the financial viability of the firm, employment and income, and GDP.

Value added goods and services produced or manufactured in Canada then exported to markets in BC and around the world have similar characteristics. Examples of secondary goods and services exported from Canada include goods such as finished lumber, electronics and aircraft parts, and services like tourism, one of the fastest growing sectors in the Canadian economy. Products and services in these categories are time sensitive and there are significant costs associated with delay. For producers, the cost of transportation delay impacts price and market share. For consumers, the cost of transportation delays impacts price, reducing disposable income and employment opportunities. While some of these products and services use rail, the majority are moved by road.

[7] Shipment ownership costs represent the daily cost associated with delays to a shipment. It represents the time value of money tied up in owning a shipment for additional time, in transit, between the source and the destination.

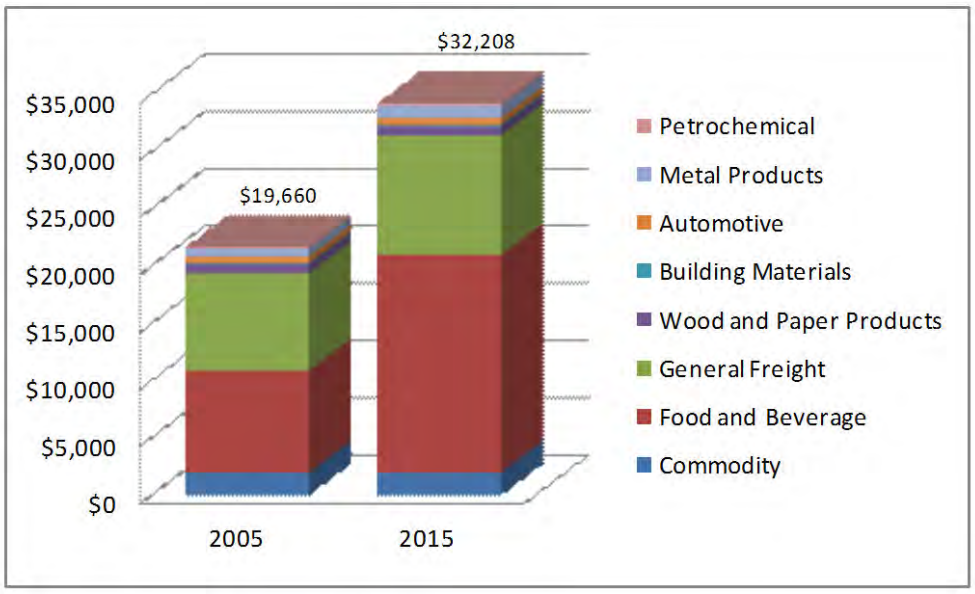
[8] Inventory costs is the dollar cost for additional inventory that must be maintained at the destination to "cover" delays in receiving "re-stock inventory" if a slower mode is used to replenish stocks.

An economic analysis study[9] to identify the value of goods shipped annually over the Kicking Horse Corridor has been recently completed. It serves to demonstrate the significance of the Kicking Horse Canyon as a primary gateway to Canada's east-west trade and as an indicator of future economic growth and prosperity. Table 6.1 and Figure 6.2 below show the dollar value of Canadian Exports moved through the Kicking Horse corridor. The value presently total $B 32 a 64% increase over the almost $B 20 estimated in 2005. It is evident in Figure 6.2 that a significant proportion of the growth seen can be attributed to growth in the secondary Food and Beverage commodity sector. This growth occurs from both significant growth in volume from just over 2B tonnes to just over 3B tonnes as well as price appreciation from $1.93/lb to $2.81/lb.

***Table 6.1 Value of Goods on the Trans-Canada Highway: Golden to Alberta Border***

| Commodity | 2005 Estimate | | | 2015 Estimate | | |
|---|---|---|---|---|---|---|
| | Tonnes (`000) | Value/lb | Value ($M) | Tonnes (`000) | Value/lb | Value ($M) |
| **Food and Beverage** | 2,089 | $1.93 | $8,887 | 3,067 | $2.81 | $18,995 |
| **General Freight** | 2,002 | $1.93 | $8,517 | 2,259 | $2.09 | $10,421 |
| **Wood and Paper Products** | 827 | $0.43 | $784 | 775 | $0.46 | $794 |
| **Building Materials** | 84 | $0.48 | $89 | 96 | $0.59 | $125 |
| **Automotive** | 134 | $1.93 | $570 | 142 | $1.93 | $605 |
| **Metal Products** | 668 | $0.48 | $706 | 781 | $0.62 | $1,063 |
| **Petrochemical** | 348 | $0.14 | $107 | 414 | $0.22 | $205 |
| **Total** | 6152 | $1.45 | $19,663 | 7533 (+22%) | $1.94 (+34%) | $32,207 (+64%) |

***Figure 6.2 Value of Goods on the Trans-Canada Highway: Golden to Alberta Border***




[9] Value of Commercial Goods on the Highway 1 Corridor between Golden and the Alberta Border, MMK Consulting, March 2016

For high-value exports, the cost of moving product from the factories across Canada to the Pacific Gateway favours trucks. Substitution to rail is unlikely in the short to medium term given transit times and shipment costs. Shipments by truck offer savings ranging from 57 to 81 hours for goods moving Toronto to Vancouver when compared to rail (trailer on a flat car). The combination of transit time and shipment value cost savings offer shippers a logistics savings of about 28% (see Table 6.2). Projections by Transport Canada are that road freight movements generated by import and export activity will continue to grow at a robust rate of 2 to 2.5 per cent per year in each of the coming 15 years[10].

**Table 6.2**
**Comparison of Logistics Costs for TOFC and Direct Trucking**

| | **Trailer on Flat Car (Rail)** | Direct Trucking |
|---|---|---|
| **Toronto - Vancouver** | | |
| **Rail Transit Costs** | $6,697 | $5,529 |
| **Time Value of Shipment*** | $1,409 | $785 |
| **Total Logistics Cost** | $8,106 | $6,315 |

Source: Operating Costs of Trucks in Canada 2003, Bulk Plus Logistics, Transport Canada, 2005; *assumes average trailer cargo worth $75,000 C$.

*The Kicking Horse Canyon is now at capacity. Increasing volumes of commercial and recreational vehicles are increasing congestion, slowing the movement of goods and services with potential to impact the strategic location of industries, the purchasing power of consumers and Canada's terms of trade. The opportunity costs of no action are significant. Firms and industries engaged in value added production could lose market share with impacts on employment and income. Our standard of living could be impacted. Over the longer run, Canada's economic growth and continued prosperity could suffer. Strengthening Canada's position as a trading nation by investing in infrastructure improvements in the Kicking Horse Canyon is 'key' to securing British Columbia's and Canada's collective economic prosperity now and in the future.*

[10] Garry Tulipan, Director, Transportation Statistics and Forecast, Transport Canada, September, 2005

# *7. Summary of the Expected Outcome*

This highway corridor is the primary Pacific Gateway to British Columbia and Canada; is essential to the quality of life of Canadians and the commerce of both the province and the nation. The BC Government has identified the upgrading of the Trans-Canada Highway through the Kicking Horse Canyon as a top transportation priority.

This project will achieve the following:

- The additional laning in conjunction with the reduction in grade and curvature and consistency with the rest of the corridor will serve to significantly improve safety, operations, capacity, and reliability to the benefit of commuters, tourists, businesses, and inter-provincial commercial travel;

- As a result of the additional capacity, travel time savings, safety and reliability this will aid in revitalizing BC and Canada's economy through a more efficient, cost-effective and competitive transportation system;

- Greater availability and reliability, particularly for inter-provincial commercial transport supports BC's vision to expand BC as Canada's trade gateway to the world through improved highway systems, border crossings, ports and airports;

- Greater availability and reliability will serve the all-important need for the province to be connected to the rest of the country linking the far-flung regions and regional economies of our country;

- The infusion of Federal Funds towards the upgrading of the Trans Canada Highway greatly leverages opportunities in the delivery of transportation infrastructure thus enhancing the achievement of economic growth while respecting the objective of integrated and environmentally sustainable transportation.

# Appendix A

# INFC - Annex D - Environmental and Aboriginal Consultation Information Requirements