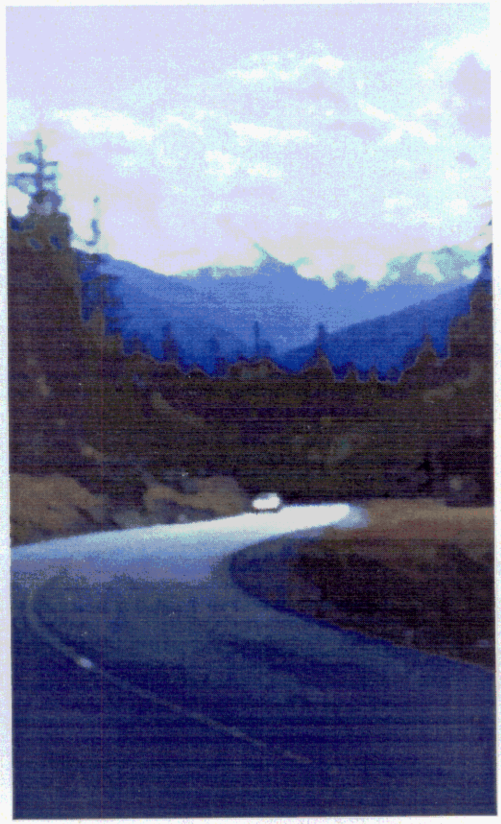
Trans-Canada Highway

Comprehensive Highway Corridor Management Plan

Kamloops to the Alberta Border



Summary

Previous Planning Studies

BRITISH COLUMBIA

Ministry of Transportation and Highways

Trans-Canada Highway
Comprehensive Highway Corridor Management Plan
Kamloops to the Alberta Border

BRITISH COLUMBIA

Ministry of Transportation
and Highways

Summary
Previous Planning Studies

October 1996

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Introduction

Sections of the Trans-Canada Highway have been studied before, by various agencies and consultants, at various levels of interest and detail.

This *Summary* document is intended to be a source for quick review of transportation related studies previously done by others which are pertinent to the section of highway between Kamloops and the Alberta border. If further information is required the reader can refer directly to the individual studies of interest, available at the indicated planning office locations of the British Columbia Ministry of Transportation and Highways.

This *Summary* is divided into three sections

- Studies with specific application to the corridor [Kamloops to the Alberta border]
  Studies are ordered from west to east along the highway corridor
- Studies with provincial scope and general application to the corridor
- Land use plans

Previous studies included some interesting observations and recommendations.

- "It would be desirable to meet...a *Highway Capacity Manual* level of service 'C' or better with travel speeds of at least 90 km/hr, achieved through an extensive capital improvement program with the aim of moving towards four lane standards."
  Highway 1 Corridor Study, Afton Interchange to Perry River, 1994

- "The existing highway, ignoring the affects of intersections, is operating at an acceptable level of service 'B' or better, in nearly all sections where the cross section is four lanes or more...The only four lane section not operating at an acceptable level under 1990 traffic volumes...is the...freeway section between Columbia Street and Highway 5 North in Kamloops. Because of the grade on this section, it is necessary to increase it to six lanes in order to provide an adequate level of service. All other sections of Highway 1 between Kamloops and Revelstoke are presently operating at an unacceptable level of service 'D' or 'E'." "An evaluation of...thirteen alternatives concluded that the future Highway 1 should remain approximately within its existing corridor." *Highway 1 Planning Study, Phase 1 - Capacity Analysis, Kamloops to Revelstoke; Phase 2 - Corridor Evaluation, Kamloops to Canoe, 1991*

- "...level of service 'C'...criteria led to the conclusion that four-laning of the entire section of Highway 1 from Monte Creek to Revelstoke would be required within the 25 year planning period, with most of it required within ten years. Attempting to satisfy this criteria by constructing new passing lanes would mean that alternate passing lanes would be required along virtually the entire length of the highway, in effect, turning Highway 1 into a three-lane highway." "It is recommended that a staged implementation program spread over a short period be followed. The benefits achieved by constructing new passing lanes will essentially disappear on most sections

of Highway 1 by 2007, and therefore an implementation period of five years or less would maximize the benefits achieved." "Constructing passing lanes at regular intervals and in locations where existing passing opportunities are minimal helps break up platoons of vehicles."
Highway 1 Passing Lane Study, Monte Creek to Revelstoke, 1993

- "Over the past 20 years, traffic has increased approximately 70%, with the result that during the peak summer months significant congestion and reduced operating speeds are common along much of the highway." "...the entire length of the Trans-Canada Highway between Revelstoke and the Alberta border must be upgraded to four lanes by 2011, in order to maintain a level of service 'C'. A number of sections require four-laning sooner and some require four lanes immediately. On other sections it is possible to add passing lanes at specific locations to achieve a level of service 'C'. As traffic increases, the number and length of passing lanes required along each section of the highway will increase, until it is not possible to add any more passing lanes without expensive construction. At this point a four-lane section is required." *Capacity Analysis Study, Trans-Canada Highway, Revelstoke to the Alberta Border, 1991*

- "In terms of traffic composition, it is estimated that truck traffic will grow at a faster rate that auto traffic over the next 20 years." "...twelve passing lanes (including climbing lanes) in Glacier Park (five westbound and seven eastbound), and three in Mount Revelstoke Park (one westbound and two eastbound) are required to accommodate traffic volumes at an acceptable level of service up to year 2005." "In order to maximize the operational benefits expected from the proposed passing lanes, planning and design should be integrated with the long term plans for the Trans-Canada Highway in British Columbia."
Passing Lane Study and Traffic Analysis of the Ponding Areas for Avalanche Control, Mount Revelstoke and Glacier National Parks, 1988

- "By the year 2005 the Trans-Canada Highway in both Glacier and Mount Revelstoke National Parks must be upgraded to four lanes in order to maintain an acceptable level of service. If the passing lane program is not implemented in the near future its value as an interim measure to extend the life of the Trans-Canada Highway as a two-lane facility will be seriously eroded." *Ponding Area Analysis and Traffic Management Plan, Mount Revelstoke and Glacier National Parks, 1991*

- "In order to ensure that the life of the highway as a two-lane facility is extended as long as possible, passing lanes are proposed at four westbound and six eastbound locations.:" *Passing Lane Study, Yoho National Park, 1987*

- "The long term objective is to widen the highway to four lanes between Kamloops and the Alberta border." *Provincial Transportation Plan, Going Places, Transportation for British Columbians, 1995*

- "Highways of greatest concern include the Trans-Canada Highway between Kamloops and the Alberta boundary..." "The goals (for the TCH) are to keep the standard of service consistent with the route's function as a key inter-provincial link,...and to ensure that the route's principle function is not compromised by local congestion caused by commuter travel." "The general strategy for this corridor is to add capacity between Kamloops and the B.C. / Alberta border."
A British Columbia Highway Strategy, 1994

- "...large sums of money must be spent in the next 15 years to ensure that British Columbia's expanding economy and population continue to enjoy the benefits of well maintained transportation systems." "There are a number of corridors in the Province which are either already suffering congestion or will do so before the year 2000...These corridors include...Highway #1, Kamloops to the Alberta Border"
A Transportation Planning Overview of The Province of British Columbia, 1988

- "Priorities...include critical stretches on the Trans-Canada Highway between Kamloops and Salmon Arm, and Donald / Golden to Yoho..." "In the strategic network plan for the year 2000, four-laning of the Trans-Canada Highway from Kamloops to the Alberta border would be warranted." *Recommendations of the Regional Transportation Task Force for the Thompson-Okanagan, 1988*

- "It is estimated that 20 sections of highway in the Mountain Parks Zone either are, or will become deficient in terms of highway capacity during the period 1985 to 2000." "The development of new routes through the Rocky Mountains (...Howse Pass) would have little effect on reducing traffic volumes on existing routes." "The traffic volumes on all but one of the 20 projects are now, or will be before the year 2000, above the practical limit below which passing lanes are effective."
Western Trans Mountain Parks Highway Study, 1985

- "... the 1985 *Highway Capacity Manual* level of service methodology does not provide a sufficiently accurate representation of traffic operational characteristics in Canada. Predicted platoon delay values are generally much higher than observed, while speed prediction errors were more random in nature." *Two-Lane Highway Capacity and Level of Service Research Project, Phase III - Final Report, 1991*

The *Trans-Canada Highway Comprehensive Highway Corridor Management Plan, Kamloops to the Alberta border*, has the directive to review previous work and prepare a sound corridor plan which defines existing highway deficiencies, projects future needs, explores alternatives and impacts, and recommends a management strategy which realistically addresses highway investment, operation, improvement and policy options.

List of Contents

LAND USE PLANS

NOTES

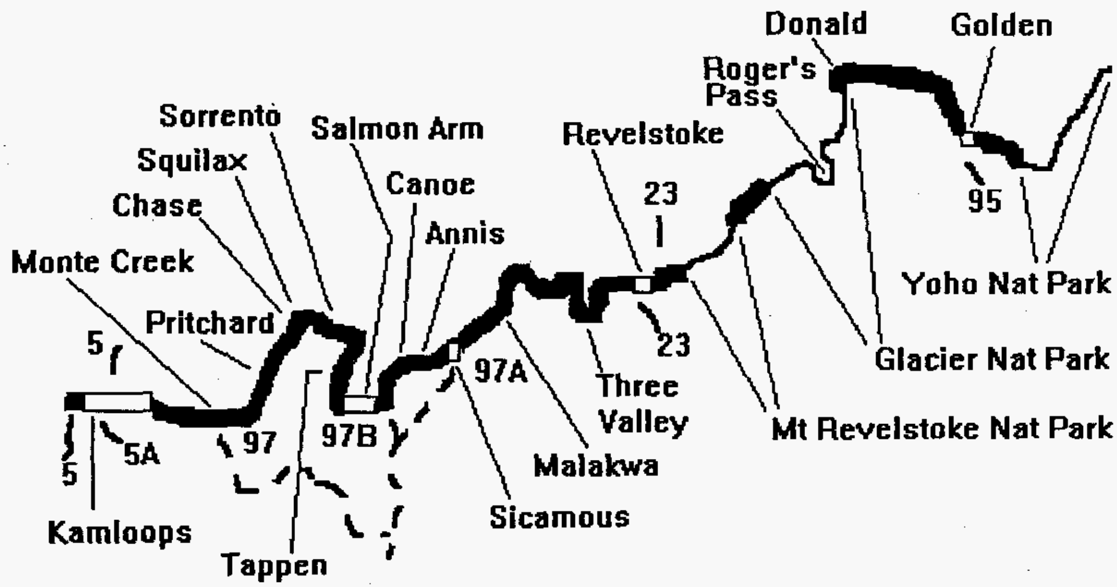
- Date: IP Denotes Study "in progress". No official copy is available.

- Location: To obtain a copy of a report of interest, contact Ministry of Transportation and Highways planning personnel at:

V	Highway Planning & Policy Branch, Victoria	604-387-7540
K	Thompson-Okanagan Regional Office, Kamloops	250-828-4840
N	Kootenays Regional Office, Nelson	250-354-6319

Trans-Canada Highway
Kamloops to the Alberta border

KEY PLAN



Approximate Total Corridor Length 450 km

Parks Canada Jurisdiction 100 km ———

B.C. MoTH Jurisdiction 350 km ▬▬

TRANS CANADA HIGHWAY - SYSTEMS STUDY
Highway Planning Branch, April 1992

The Trans Canada Highway is an important link to the national, regional and local highway networks in the province of British Columbia. Traffic volumes have increased steadily over the past 30 years; consequently, concerns have been raised related to the operating conditions of this highway.

The National Highway Policy Steering Committee completed a study which identified the importance of the Trans Canada Highway as part of the national highway network. The 1990 British Columbia Transportation Plan identified a number of deficiencies on the existing Trans Canada Highway between Kamloops and the Alberta border. These include:

- congestion, bottlenecks and summer traffic choke points
- operating conditions
- expected growth in truck traffic
- access versus mobility conflicts
- safety hazards

The Highway Functional Classification Report recognizes that sections of the Trans Canada Highway require upgrading and may need to be relocated in a number of areas to meet standards.

A Systems study was conducted to identify and confirm the preferred Trans Canada Highway corridor between the community of Hope and the Alberta border through the Thompson/Okanagan/Columbia area. The study was completed in 1992.

Two possible corridors were identified for the Trans Canada Highway: the Thompson Corridor and the Okanagan Corridor. The existing Highway 5 and 1 alignment passes through the Thompson Corridor. The Okanagan Corridor option would follow the Okanagan Valley and connect to Highway 5 via the Okanagan Connector (Highway 97C). Both corridors were studied with possible re-alignments and bypasses to determine the optimum highway network through each study area.

The findings concluded that the Thompson Corridor was the optimum Trans Canada Highway corridor. The Thompson Corridor is approximately 10 km shorter and has gentler grades than the Okanagan Corridor. The Thompson Corridor requires less construction and less capital to upgrade to the desired standard. There are fewer environmental concerns associated with construction through the Thompson Corridor. The recommendation of this report was to continue upgrading the Trans Canada Highway, through the Thompson Corridor from Kamloops to the Alberta border to freeway standards.

With the steep grade on Highway 97C, a Trans Canada Highway through the Okanagan Corridor is a less attractive option to long distance commercial and large recreational vehicle traffic. There are a number of environmental concerns associated with a route on the westside of Okanagan Lake, and concerns with construction through the prime agricultural land in the Deep Creek Valley. Right-of-way acquisition through Indian Reserves is also an issue. However, the economic analysis indicate that the Okanagan Corridor does have a number of user benefits. The construction of a high speed facility through the Deep Creek Valley and along the west side of Okanagan Lake would be an alternative east/west route through the province of British Columbia and through the Okanagan Valley. This proposal would reduce the travel time for a large portion of the local and regional travelers through the Okanagan Valley. Therefore, a second recommendation of this report was to further study alternative routes through the Okanagan Valley to determine viability as long range options.

HIGHWAY 1 CORRIDOR STRATEGY
AFTON INTERCHANGE TO PERRY RIVER
Thompson-Okanagan Regional Planning, October 1994

The Corridor Strategy provided:

- a framework for planning priorities.
- a basis for corridor preservation and protection.
- background and inventory information.

The corridor strategy defined an improvement strategy based on the information available at the time.

The Trans-Canada Highway is a significant transportation link between British Columbia and the rest of Canada. To meet long term transportation needs for this highway, the Ministry of Transportation and Highways has a stated a goal to four-lane the section from Kamloops to the Alberta Border.

Overall corridor goals for the Trans Canada Highway corridor:

- maintain, support and enhance a transportation network which serves the economic and social needs of people who live or travel within the Thompson-Okanagan Region.
- be compatible with provincial strategic objectives.
- reflect the functional classification of the corridor which is a primary arterial highway servicing both short and long distance travelers and goods.

The "British Columbia Highway Strategy 1994" document defines the function, goals, short and long term strategy for this section of highway.

It would be desirable to meet a Highway Capacity Manual Level of Service "C", with travel speeds at least 90 km/h, achieved through an extensive capital improvement program with the aim of moving towards four lane standards. Alternative alignments should be considered if it is not practical to achieve four-lane standards on the existing alignment.

Over the short term the corridor will be improved by four-laning through urban areas, resurfacing, adding passing lanes, upgrading intersections in rural areas upgrading intersections, minor alignment improvements, and applying access management techniques.

General Corridor Problems

Physical constraints, from west to east, include:
- Upgrading of the Valleyview section in Kamloops will be difficult given the constraints of the Canadian Pacific mainline railway and existing development in the area.

- Any Kamloops/Valleyview bypass option must consider the geotechnical problem of the silt bluffs on the south side of Highway 1.
- The terrain between Chase and Salmon Arm is rugged with very few options for low-cost improvements to the existing highway corridor. On the south side of the highway there are severe rock faces. Shuswap Lake abuts the north side, with salmon spawning and rearing areas adjacent to the Highway. Environmental and social impacts must be addressed.
- Upgrading through Sorrento will be difficult because of development constraints. Long term standards cannot be met without a bypass of the community.
- Providing alternative routing through the Turtle Valley between Pritchard and Tappen has its own set of issues. Environmental and social impacts need to be addressed and mitigated.
- Any proposed bypass south of Salmon Arm would be costly and several Indian Reserves must be considered with respect to alignment options. Alternatively, a suggested lake crossing from Engineers Point to Tappen would require a major structure, and environmental and social factors need to be addressed. Shuswap Lake is a navigable waterway and any proposed structure must allow for this factor.
- The terrain between Canoe and Sicamous is very rugged. The existing highway has limited passing opportunities and is physically restrained on the north side by the existing railway.
- Proposed improvements through Sicamous need to address social and environmental impacts.
- Between Sicamous and the regional boundary the existing highway is adjacent to the Eagle River. Any highway improvements need to mitigate effects on the river system.
- The existing highway has several geotechnical problems with slide areas and unstable ground around Balmoral, Tappen, on the westerly edge of Salmon Arm near Canoe, and along the Eagle River.

Until further planning can be completed, the corridor strategy defines the framework for a protection strategy and access management plan for Highway 1. This framework defines a general priority for highway improvements.

In the development of the corridor strategy, 13 planning studies and designs were analyzed and updated relative to highway needs, based on information available to date.

The following corridor strategy was recommended for Highway 1. Where possible:

- Protect the current corridor to a freeway standard in rural areas.
- Control access to current locations.
- Protect the Turtle Valley Route as an alternative corridor through corridor protection mechanisms.
- Refine system needs based on traffic assignments. This would require development of a transportation model within the next few years.
- Define planning study scope of work and needs at specified locations.

KAMLOOPS FREEWAY STUDY,
COPPERHEAD INTERCHANGE TO THE YELLOWHEAD INTERCHANGE
McElhanney Engineering Services Ltd., February 1991

A study of the Trans Canada Highway from the Copperhead interchange to the Yellowhead interchange in the City of Kamloops was undertaken following a serious truck accident.

The main focus of the study was to:

- Evaluate the freeway corridor and the arterial road network in terms of optimizing interchange spacing, providing adequate capacity and enhancing safety for both through and local traffic for the next 20 year period.

- Undertake conceptual planning and prepare functional designs of any identified improvements required between the Pacific Way interchange and the Summit Drive interchange.

Included in the scope of work was a review of brake check requirements, a review of posted speed limits, and an analysis of the freeway signing and lighting.
The following recommendations were made:

Long Term Improvements

Copperhead Drive to Columbia Street

A 20 year plan for upgrading the freeway identified the construction of collector-distributor roads (C-D roads) starting west of Pacific Way and ending at Columbia Street, to resolve the problems associated with close interchange spacing, to separate local traffic from through traffic, and to maintain a Level of Service "C" on the freeway. The corridor should be protected for this plan. Two C-D road concepts were included in the report for reference. As there are many possible C-D road alternatives, functional planning is required to identify the best alternative for use in protecting property and for use as a planning tool in assessing/approving future roadside development.

Major Municipal Streets

- Hillside Way to Battle Street

  It was recommended that right-of-way be protected for the extension of Hillside Drive to Summit Drive and to Battle Street. This was considered to be the only viable corridor that will reduce existing and future traffic congestion on Columbia Street and Summit Drive, by providing an additional route to carry north/south commuter traffic across the freeway.

- Sixth Avenue Extension

  The concept of extending Sixth Avenue to Summit Drive and Notre Dame Drive should be re-evaluated. The extension of Sixth Avenue could create further, unacceptable traffic congestion at Summit Drive and Notre Dame Drive, and would afford little benefit in terms of providing additional capacity for the north/south commuter traffic across the freeway.

Short Term Improvements

Highway 5A to Columbia Street

A collector-distributor road from Highway 5A to Columbia Street should be constructed as soon as possible to separate the high volume of local commuter traffic from the freeway traffic, and to provide additional sight distance for the exit to Columbia Street from the freeway. The approximate cost of this upgrading was estimated at $2.5 million.
The upgrading of the section of freeway between Highway 5A and Columbia Street will require modifications to the existing freeway signing in both directions between the Afton interchange and the Yellowhead interchange. The approximate costs for modifying the signing was estimated at $440,000.

Westbound Exit to Hillside Way

The paint markings on the freeway for the westbound exit to Hillside Way should be modified to make the exit taper more apparent.

Summit Drive Interchange

The separation between the ramps on Summit Drive at the Summit Drive interchange should be increased for capacity reasons (increase left-turn storage) by relocating the south ramp further south. [The City of Kamloops has now completed this initiative.]

HIGHWAY 1 PLANNING STUDY
PHASE 1, CAPACITY ANALYSIS, KAMLOOPS TO REVELSTOKE
PHASE 2, CORRIDOR EVALUATION, KAMLOOPS TO CANOE
Ward Consulting Group, March 1991

Background

The Trans Canada Highway serves as an integral component of British Columbia's Provincial Highway Trunk System. It is one of only three highways that cross the province in an east-west direction. The Trans Canada Highway is a part of the National Highway System as defined by the National Highway Policy for Canada.

The Trans Canada Highway is a basic two lane road along most of its length between Kamloops and the Alberta border. This section has been identified as a corridor which requires infrastructure improvements. This section carries significant volumes of both truck traffic and tourist oriented traffic, especially in the summer months. There is often congestion, especially adjacent to tourist attractions and recreational resorts, and it is apparent that this section of Highway 1 is not providing an acceptable level of service to the traveling public.

Concerns expressed include:

- tight curves around rock bluffs, and steep grades
- operating and maintenance costs
- capacity both on the highway and at intersections
- access to adjacent properties, especially campgrounds, gas stations, and stores
- interrupted traffic flows caused by traffic signals
- traffic circulation between adjacent activity points having to use the highway because of a lack of local roads
- congestion through the eastern suburbs of Kamloops and Salmon Arm
- unchannelized intersections with no provision for left turn movements
- pedestrian movements across the highway at campgrounds and other recreational attractions
- the lack of passing opportunities
- environmental, aesthetic, economic, social impact
- road network integration

This planning study addressed the length of highway between Kamloops and Revelstoke.

Scope of Study

The study was conducted in two phases. Phase 1 provided a capacity analysis of the existing route between the Afton Interchange west of Kamloops and the junction of Highway 23 at Revelstoke, a distance of 221.5 km. Phase 2 included the development and evaluation of alternative corridors between the Afton Interchange and Canoe, east of

Salmon Arm. Phase 1 addressed the issue of whether an upgraded facility should be built to various standards. Phase 2 addressed the issue of whether or not the upgraded highway should follow the existing right-of-way or be located along new alignments.

The goal of Phase 1 was:

> To conduct a detailed highway capacity analysis of specific sections of the Trans Canada Highway between Kamloops and Revelstoke which will identify operational levels of service based on the existing infrastructure and on proposed improvements to the infrastructure, for both existing and future traffic volumes.

The objectives of Phase 1 were:

- Document geometric data related to the existing infrastructure
- Review and summarize the current design program
- Obtain and review traffic information
- Document and define existing problems and concerns
- Project future traffic volumes to represent future operational conditions
- Collect and review all accident data
- Calculate the capacities and levels of service of all unique highway elements for both current and future conditions
- Show a comparison between traffic volumes and capacity over time, given the proposed improvements.

<u>Phase 1: Conclusions and Recommendations</u>

- The existing highway, ignoring the affects of intersections, operates at an acceptable Level of Service B or better, in nearly all sections where the cross section is four lanes or more.

- The only four lane section not operating at an acceptable level under 1990 traffic volumes, is the freeway section between Columbia Street and Highway 5 North in Kamloops. Because of the grade on this section, it is necessary to increase it to six lanes in order to provide an adequate level of service.

- All other sections between Kamloops and Revelstoke are presently operating at an unacceptable Level of Service D or E.

- Those sections of Highway 1 presently in the design and/or construction phases, (upgrade to a four lane standard), will operate at Level of Service A when completed.

- The existing signalized intersections in Kamloops are presently operating at an unacceptable Level of Service E and F. Those in Salmon Arm are operating at Level of Service D. Those in Revelstoke operate at Level of Service A and B, which is acceptable.

- The section between Highway 5 North and Dallas Drive in Kamloops will have to be upgraded to a four lane freeway standard. The elimination of all signalized intersections is necessary in order to overcome increasing congestion at these intersections.

- Highway 1 through Salmon Arm needs to be upgraded in order to provide an adequate level of service for highway traffic. A new expressway standard bypass around the perimeter of Salmon Arm should be considered as a long term solution.

- The existing six lane freeway section between Afton and Columbia Street Interchanges in Kamloops will be adequate through to the year 2010. The section between Columbia Street and Highway 5 North will also be adequate through to 2010 if it is widened to a six lane standard.

- The remaining sections should all be upgraded to a four lane expressway standard as soon as possible in order to provide an acceptable level of service.

- In upgrading the existing highway, every effort should be made to:

  - eliminate all direct access points to private and public property along the highway
  - restrict intersection spacing to a minimum distance apart of 1.8 km
  - locate all possible future interchanges a minimum of 4.0 km apart
  - provide left turn lanes at all intersections
  - provide acceleration and deceleration lanes at all rural intersections
  - allow for a possible future expressway standard.

- The recommended order of priority for undertaking improvements, based on the existing and projected traffic volumes and level of service, is as follows:

(i)	Dallas Drive Kamloops to Highway 97	4 lane expressway
(ii)	Highway 97B to Sicamous	4 lane expressway
(iii)	Highway 5N to Dallas Drive	4 lane freeway
(iv)	Salmon Arm	4 lane
(v)	Chase O/H to Salmon Arm	4 lane expressway
(vi)	Columbia Street to Highway 5N	6 lane freeway
(vii)	Highway 97 to Chase	4 lane expressway
(viii)	Sicamous to Malakwa	4 lane expressway
(ix)	Chase to Chase O/H Bridge	4 lane expressway

The above recommended improvements were made without the knowledge of the results of Phase 2.

The stated goal of Phase 2 was twofold:

- To determine current infrastructure constraints for all highway traffic in the Trans Canada Highway corridor between Kamloops and Canoe.
- To undertake a corridor study which would address the transportation requirements for the movement of people and goods in a safe, efficient and economical manner for the next 20 years for this section of highway.

The objectives of Phase 2 were to:

- Identify and define the transportation problems encountered in this corridor.
- Develop alternative end goals for this corridor and corresponding improvement strategies.
- Develop and employ an evaluation process to determine the optimum goal and strategies.
- Recommend an implementation schedule.
- Develop a transportation model for this corridor.

Phase 2: Conclusions and Recommendations

- Thirteen different alternative concepts were established for the corridor between Kamloops to Canoe

- If the future corridor selected is different from the existing corridor, it will be necessary to retain and maintain the existing highway to ensure continued accessibility to the extensive tourist areas. This will result in higher maintenance and rehabilitation costs.

- Whenever a new corridor is selected, it should not be necessary to widen the existing highway beyond its present two lane standard in the parallel equivalent.

- A new corridor following the Turtle Valley will result in a travel distance reduction of approximately 13 kms. This corridor will offer the lowest overall vehicle operating costs and the lowest right-of-way cost.

- Upgrading the existing highway to a four lane controlled access standard will result in the second lowest right-of-way cost estimated at $11 million. This is significantly less than some of the other alternatives.

- Upgrading the existing highway will result in the lowest construction cost, estimated at $126 million. This is significantly less than the next lowest alternative.

- Upgrading the existing highway is the preferred alternative from a geotechnical perspective.

- An evaluation of all thirteen alternatives concluded that the future highway should remain approximately within its existing corridor.

HIGHWAY 1 PASSING LANE STUDY, MONTE CREEK TO REVELSTOKE
Urban Systems Ltd. March, 1993

Traffic volumes on Highway 1 have grown at an average of 3% per year for the past two decades, and are now approaching the practical capacity of a two-lane rural highway. Vehicles traveling on Highway 1 are impeded by slower-moving vehicles, and experience delays during peak times. Passing is difficult due to the high volume of on-coming traffic.

The cost of four-laning Highway 1 dictates that any comprehensive upgrading of the highway would take many years to implement. The availability of significant funding is uncertain. Consequently, it is desirable to examine the potential of interim measures to improve conditions on Highway 1 until major upgrading can eventually be done.

These interim measures consist primarily of passing lanes. On two-lane highways, regularly spaced passing lanes can reduce delay by breaking up platoons of vehicles. The primary objective of this study was to identify the effectiveness of new passing lanes in improving traffic conditions on the 183 km section of Highway 1 between Monte Creek (east of Kamloops) and Revelstoke. Options to improve traffic conditions on the section of highway between Revelstoke and the Alberta border were previously studied.

Other interim measures, including intersection improvements, geometric design modifications, improved lighting and better signage, can also help to reduce delays and improve safety. However, the opportunities for intersection improvements are limited without major reconstruction, as most important intersections are already channelized and traffic signals are not generally warranted outside the urban areas.

Study Objectives

The purpose of the study was to identify locations for passing lanes, climbing lanes and other measures to reduce delay and improve safety on Highway 1. The following objectives guided the development of the improvement program:

- Improve level of service
- Minimize overall costs
- Maintain and rationalize access
- Improve safety
- Estimate when four-laning will be required

Initial Findings

Initially, the traffic analysis was based on an established definition of "acceptable" traffic conditions, defined as achieving a level of service 'C' or better for 30th highest hour traffic volumes. It quickly became apparent that this criteria led to the conclusion that four-laning of the entire section of Highway 1 from Monte Creek to Revelstoke would be required within the 25-year planning period, with most of it required within ten years.

Attempting to satisfy this criteria by constructing new passing lanes would mean that alternating passing lanes would be required along virtually the entire length of the highway, in effect, turning Highway 1 into a three-lane highway.

Constructing three-lane highway sections has practical limitations. Virtually none of the three-lane construction could be readily adapted to a future four-lane program, and therefore much of the construction cost (which would be substantial) would not be recovered. As well, the majority of passing lanes required to achieve a level of service 'C' for the 30th highest hour traffic volumes have locational constraints and excessive associated cost. These considerations mean that it would not be possible to improve traffic conditions on Highway 1 to "acceptable" levels only by constructing new passing lanes. This does not mean, however, that constructing passing lanes would not serve a useful purpose. Passing lanes can improve traffic conditions noticeably.

The appropriateness of the original criteria was received, and alternative criteria were identified. It was concluded that the analysis should be completed using design hour volumes based on 85% of the 30th highest hourly volume, although the basic objective of endeavoring to meet level of service 'C' at the design hour volume should remain. At 85% of the 30th highest hourly volume, 90% to 95% of the total annual traffic would experience better conditions than the design hour volume. The requirement to achieve level of service 'C' was maintained in order to avoid understating conditions on this section of Highway 1 if comparisons are made to studies of other highways where established criteria have been used.

Even with the design hour volume reduced to 85% of the 30th highest hour, the traffic analysis indicated that in order to achieve level of service 'C' with 1992 traffic volumes, Highway 1 would have to be upgraded to either a continuous three-lane cross-section with alternating passing lanes, or a divided four-lane cross-section.

Analysis Methodology

If passing lanes cannot achieve desirable levels of service, but immediate four-laning is impossible, the issue is then to determine what can be achieved at affordable cost, and what effect will it have.

The section of highway between Monte Creek and Revelstoke was divided into seven sub-sections. Each section was examined in detail to determine where feasible opportunities to build passing lanes exist. Feasibility was determined primarily based on the degree of construction difficulty (which equates to cost), constraints imposed by adjacent development, locations of intersections and accesses, existing roadway geometry and environmental impacts. The effect of constructing passing lanes in these feasible locations was analyzed using the TRARR simulation model.

The Recommended Passing Lane Program

The locations, lengths, estimated costs and priorities for construction of the recommended new passing lanes were summarized.

It was recommended that a staged implementation program spread over a short period be followed. The benefits achieved by constructing new passing lanes will essentially disappear on most sections of Highway 1 by 2007, and therefore an implementation period of five years or less would maximize the benefits achieved.

Priorities for passing lane construction were established based primarily on benefits to road users, with cost and compatibility with the pavement rehabilitation schedule as secondary considerations. Priorities were not based on measured improvements in level of service. The improvement due to any single passing lane would be marginal, and consequently any difference in improvement due to order of priority of installation would be imperceptible to road users.

The frequency and number of assured passing opportunities is perceived by drivers to be a measure of quality of driving experience, however, and consequently one of the major considerations in determining priorities for constructing new passing lanes was passing lane location. Constructing passing lanes at regular intervals and in locations where existing passing opportunities are minimal helps break up platoons of vehicles. This in turn reduces driver frustration and improves drivers perceptions of traffic conditions. Passing lane priorities were therefore determined based on driver relief, by reducing the maximum distance between assured passing opportunities. Proposed passing locations were examined in conjunction with passing opportunities provided by existing passing lanes, four-lane sections and in urban locations. The highest priorities were assigned to proposed passing lanes located in areas with the greatest distances between existing passing opportunities.

Conclusions

Installing passing lanes would reduce the overall percent time following between Monte Creek and Revelstoke by approximately 8%. This provides a corresponding increase in average speed of 4 km/h.

An analysis of future traffic volumes was carried out in five-year increments to determine the "period of relief" achieved by implementing the passing lanes, i.e. the time required for traffic conditions to decline to present day levels if the new passing lanes were constructed. The "period of relief" varies for each highway section, extending as far as 2022 for one section and as little as 1997 for another, but for the majority of sections the "period of relief" extends to 2007. This means that if passing lanes were constructed today, traffic conditions would remain at current levels or better on most sections for at least 10 years.

These conclusions indicate that although four-laning is required to meet established level of service criteria, constructing a limited number of passing lanes in feasible locations can significantly improve traffic conditions until the highway is eventually four-laned.

The total cost of the passing lane program was estimated at $16 million.

ARCHAEOLOGICAL OVERVIEW, HIGHWAY 1 CORRIDOR STUDY KAMLOOPS TO CANOE
I. R. Wilson Consultants Ltd, March 1991

This report was prepared at the request of the Archaeology Branch, and includes comments regarding general and specific constraints related to seven different corridors, including a ranking of the corridors. Only a conceptual level investigation of the relative archaeological potential of the various corridor options was undertaken.

Recommendations

This overview study attempted to evaluate the relative heritage sensitivity of seven different possible highway routes between Kamloops and Canoe. Assuming that a corridor is chosen, what is the next step? There are two answers to this question depending on the corridor chosen.

If Highway 1 is twinned, additional overview studies would not seem to be necessary. Many areas of this route exhibit heritage potential, both proven and assumed. Survey has not adequately addressed lands removed from the rivers and large lakes of the area. Recent surveys have demonstrated the presence of archaeological sites along the highway well-removed from the South Thompson. Therefore, if twinning of Highway 1 is the option chosen, detailed field inventory is merited with the exception of areas identified in this report as having no potential for site recovery.

If one of the other corridor options is chosen, field investigations would be necessary. More detailed route selection prefield studies would assist in determining the intensity and nature of field investigations. Additional ethnographic field research should be undertaken concerning place names and site utilization throughout the refined study zone. More ethnographic research is necessary in the southernmost corridor where no place names have as yet been recorded. This route is also archaeologically unknown. The issue of a previous under-representation of historic sites in the region has been addressed. Past historic use can be better assessed by historic research of specific route options. This is also recommended if a route selection study is undertaken. By undertaking further prefield studies on a more closely defined route as opposed to a wide corridor, it is assumed that field requirements could be fairly accurately determined.

In terms of reducing possible heritage site conflicts, it was recommended that the corridor identified as least sensitive to archaeological sites be chosen. This is the Kamloops bypass - Kamloops to Salmon Arm and the Salmon Arm bypass alternative.

HIGHWAY 1, PRITCHARD TO TAPPEN, CORRIDOR STUDY, ENGINEERING
Urban Systems Ltd., April 1993

This study was commissioned to evaluate corridor options for upgrading the Trans Canada Highway between Pritchard and Tappen. It primarily addressed the engineering components of the evaluation. Overviews identifying environmental impacts, geotechnical considerations, and potential cost-benefit are contained in companion reports. The study objectives were as follows:

- Identify possible routes within two corridors (existing Trans Canada Highway and Turtle Valley)
- Rate and compare alternatives in terms of performance and identify broad impacts
- Determine preferred corridor based primarily on engineering and operational factors
- Recommend appropriate future planning and implementation procedures.

An arterial standard 4 lane undivided facility on the existing Trans Canada Highway alignment was compared with a freeway in the Turtle Valley. The 4 lane arterial was selected to represent base line costs and minimum impact. This comparison was chosen following initial user benefit-cost analysis which confirmed the presupposition that the cost of building a freeway in the existing Trans Canada Highway corridor would be prohibitive and would provide less benefits due to longer travel distance.

Alternative Routes

Turtle Valley Option:
Several options were examined for a new route from the South Thompson River Valley to the Chase Creek Valley. The recommended alignment leaves the Trans Canada Highway 2 km east of Pritchard, cuts through the southeast corner of Neskainlith I.R.#1 and skirts Mount Scatchard before crossing the Chase Creek Valley. From there the route runs through the Turtle and Skimikin Valleys past Chum, Phillips and Skimikin Lakes to Tappen.

Four interchanges were identified at the following locations:

- Pritchard (with Trans Canada Highway)
- Chase Creek (with Chase - Falkland Road)
- Chum Lake (with Squilax connector)
- Tappen (with Trans Canada Highway)

The principal constraints include:

- Steep topography at the west end of the proposed route
- Numerous social and environmental impacts through the Turtle and Skimikin Creek Valleys including; agricultural land, farming and grazing operations, wetlands, wildlife habitat, fisheries, and forestry (principally the Skimikin Seed Orchard).

Existing - Trans Canada Highway - Option:
This route would essentially follow the existing highway. Horizontal and vertical curves totalling 28% of the section length would require realignment to meet current 90 km/h design speed standards. Major realignments would be required at Hoffman's Bluff, Chase Hill, Cruickshank Point, Sorrento, and several intersections east of Sorrento.

The principal constraints include:

- Steep sidehill topography, between Chase and Sorrento
- Proximity of adjacent development, including the CPR line in the western portion
- Major fisheries concerns in Little River and Shuswap Lake
- Agricultural land impacts between Pritchard and Chase, and east of Sorrento

Construction Cost Estimates

- Turtle Valley $235 million
- Trans Canada Highway $308 million

Estimates included road construction, right-of-way acquisition, engineering design and supervision, but did not include any allowance for environmental or social impact compensation or mitigation.

Route Analysis
The impacts of highway construction in each of the two corridors were documented and compared according to; traffic operation, design standards, construction, cost, operation and maintenance, socio-economic impact, environmental impact, cost benefit analysis.

Socio-economic and environmental impacts were identified in an overview fashion and initial agency response sought. Most agency responses indicated a preference for upgrading along the existing corridor. The Department of Fisheries and Oceans (concerned about the Shuswap Lake salmon fishery) and the Agricultural Land Commission (citing higher value agricultural lands in the Trans Canada corridor) were notable exceptions, favouring the Turtle Valley route.

Conclusions and Recommendations
The Turtle Valley corridor appears to be the best option for a high standard highway facility. However, environmental impact and mitigation studies will be required before this conclusion can be confirmed.

Major improvements are not economically warranted until traffic volumes have grown by about 40%, which is expected to occur in about ten years.

An improvement strategy should include:

- Proceeding with low cost improvements in the short term.
- Proceeding with further study and planning of the Turtle Valley corridor, as ten years lead time will be required to carry out the process necessary before a project of this magnitude could proceed to completion.

TRANS CANADA HIGHWAY 1, PRITCHARD TO TAPPEN
PRELIMINARY GEOTECHNICAL INVESTIGATION
MoTH Geotechnical & Materials Engineering Branch, April 1993

This report contains the results of a preliminary investigation into the soils and bedrock conditions which exist within the alternative corridors.

<u>Terms of Reference</u>

A geotechnical investigation of a preliminary nature which would supply:

- sufficient soils and bedrock data to evaluate the engineering feasibility of options
- sufficient data to be able to establish a preliminary cost for options
- information on problem sites and engineering implications

<u>Geotechnical Investigation Methodology</u>

No subsurface investigation was carried out. The investigation consisted of a helicopter reconnaissance, airphoto interpretation, reference review, file search and limited field investigation.

<u>Previous Work</u>

Previous geotechnical assessments have been undertaken along the Trans Canada Highway, including investigations for bridges, landslides and aggregate resource pits. Sites previously investigated include:

- Pritchard Bridge
- Chase Bridge
- Squilax Bridge
- Chase Overhead Slide
- Balmoral Slide
- South Thompson River Valley - Report "Landforms and Observed Hazard Mapping, South Thompson Valley, British Columbia"
- South Thompson River Valley - Report "Some Aspects of Natural Slope Stability in Silt Deposits Near Kamloops, British Columbia," taken from the Proceedings, 29th Canadian Geotechnical Conference, 1976.

<u>Summary and Conclusions</u>

The proposed Turtle Valley alignment should not be affected by any severe geotechnical problems, however, further investigation of stream crossing sites, high fill areas and rock cut areas is required before this can be confirmed.

Construction of the Turtle Valley alignment will be enhanced by having an adequate supply of construction materials at points well-distributed along the alignment. Several existing supply sites were noted during the helicopter reconnaissance trip and this may be augmented by further exploration, particularly in the areas of glaciofluvial outwash.

The existing Trans Canada Highway alignment has several known problem areas and further construction along the present alignment may lead to reactivation of these sites. In addition, poor soils are known to exist in several locations and this will require careful design and construction methods to alleviate any impacts.

Construction along the existing Trans Canada Highway alignment will be hampered by having to maintain traffic flows and constructing the roadway structure in sequences. This practice in the past has led to problems in the transition zones and in timing where surcharging or pre-loading is necessary for extended periods of time.

Both routes are feasible to construct from a geotechnical viewpoint, however, the proposed Turtle Valley alignment does appear somewhat better in terms of soils and foundation problems.

The proposed Chum Creek connector to Squilax will be difficult to construct. Channel re-alignment or double structures on a moderately steep gradient will require extensive investigation and design with subsequent higher construction costs. Stability in the areas of the proposed Chum Creek crossings is also questionable and further investigation is required to determine the feasibility of constructing at these sites.

HIGHWAY 1 PRITCHARD TO TAPPEN,
ENVIRONMENTAL SCOPING STUDY
Westland Resource Group, March 1993

The objective was to identify the environmental constraints and opportunities along the proposed corridors. This was accomplished by soliciting information from various Government agency staff, interested individuals, and non-profit organizations regarding the comparison of expected environmental impacts between the proposed Turtle Valley route and upgrading the existing Trans Canada Highway between Pritchard and Tappen. An overview field examination of the two highway options was also conducted.

This document could be the basis for a plan that would provide the information necessary for further, more detailed environmental studies. The report contained overview information on the following ecological components:

- Terrestrial plants and wildlife (including ungulates, waterfowl, raptorial birds, fur bearers); endangered species; painted turtle habitat in the Turtle Valley
- Aquatic resources (fish, amphibians, reptiles, and aquatic plant communities) in both lakes and streams/rivers
- Agriculture Land Reserve lands and grazing

The following land use information was collected for the study area:

- Ministry of Environment, Lands and Parks, Parks Division recreation reserves and proposed assessment areas (areas being considered for Provincial Park status by the Protected Areas Strategy)
- Ministry of Forests recreation sites and trails, and reserve lands
- Ministry of Environment, Lands and Parks, Wildlife Branch guiding and trapline territories

Methodology

A total of 42 people in federal and provincial government agencies and private conservation organizations were contacted. 33 responded to the request for information on the study area. Meetings were held with several of the contacts. The information received during the study was mapped on two 1:40,000 map sheets.

Summary/Conclusions

With the exception of the Department of Fisheries and Oceans and the Agricultural Land Commission, virtually all environmental, forestry and agricultural agency staff, representatives of environmental groups and organizations, and the majority of study area residents contacted supported the option which involved the upgrading and re-alignment of the existing Trans Canada Highway between Pritchard and Tappen.

The Department of Fisheries and Oceans expressed concern regarding the upgrading of the existing Trans Canada Highway in the vicinity of the Little River, Squilax Bridge to Cruickshank Point. DFO is also very concerned regarding any encroachment of a realigned highway into Shuswap Lake, and the possible resulting loss of fish habitat.

Riparian habitat loss in this section is also a concern to DFO and the Ministry of Environment.

The Agricultural Land Commission is very concerned about the potential impacts on agricultural land along the existing highway, and has expressed a preference for the Turtle Valley option. However, the Ministry of Agriculture, Fisheries, and Food staff who responded did not consider the agricultural impacts of the existing highway upgrading to be as significant as the "new" impacts expected along the Turtle/Skimikin Valley route.

<u>Recommendations</u>

- A detailed environmental impact assessment of the selected option is required.
- Environmental components of high priority along each of the options include:

  Existing Trans Canada Highway Option
  - Long term and detailed fish habitat and investigation along Little River
  - Agricultural land investigations
  - Riparian habitat investigation
  - Water quality/runoff assessment
  - Wildlife habitat disturbance investigation

  Turtle/Skimikin Valley Option
  - Wildlife habitat investigation
  - Wildlife movement studies
  - Vegetation impact assessments
  - Drainage and water quality investigations
  - Fish habitat impact assessments
  - Agricultural land assessment

- A detailed Environmental Protection Plan should be prepared that incorporates all impact avoidance and mitigation measures.
- An archaeological and heritage review of the selected route option should be conducted.
- A special investigation of the distribution, natural history and habitat requirements of North American Painted Turtles should be undertaken, for use in the assessment of impacts of highway development on this species.
- The environmental and construction phase detour and re-routing impacts should be assesed, if sections of the Trans Canada highway will be temporarily closed due to upgrading.
- A complete review of agricultural practices and land tenure should be undertaken, and mitigation plans prepared.
- A special investigation should be conducted on the impact of highway construction on wetland areas and shallow lakes in the Turtle/Skimikin Valley.
- The potential release of naturally occurring radioactive substances (uranium) into the air, surface water, and groundwater of the Turtle/Skimikin Valley, (Phillips Lake area) should be assessed.

HIGHWAY 1, PRITCHARD TO TAPPEN ROUTE STUDY
USER BENEFIT COST ANALYSIS
Thompson-Okanagan Regional Planning, July 1993

The objective was to define the user benefits and costs associated with the various improvements. The results were generated by the User Benefit Cost Spreadsheet (UBCS).

The Independent Segment Approach was used to evaluate the base case against the improvement options.

1989 Photolog and User-Defined Kilometer Inventory databases were used to define the characteristics associated with the existing alignment. Improvement options were divided into relatively homogeneous segments based upon annual average daily traffic, posted speed, laning, grade, and terrain.

Individual improvement options were evaluated as independent projects using net present value and benefit/cost ratio criteria. Mutually exclusive improvement options were then evaluated against one another using the incremental benefit cost ratio criterion.

The original terms of reference required route selection for each corridor to be carried out based upon the premise of an ultimate freeway facility. Initial analysis showed the Turtle Valley corridor as the clear preference, primarily due to the user benefits associated with a shorter travel distance, accident reduction, and the lower construction costs. Consequently, it was determined that the balance of the study would be based upon a comparison of the existing alignment improved to an arterial highway and the Turtle Valley corridor constructed as a freeway

The results obtained from the UBCS analysis are outlined below:

Immediate Construction

($, million)

Corridor:	Existing	Turtle Valley	Existing	Existing	Turtle Valley
Improvement:	Freeway	Freeway	4 Lane Art.	Passing Lanes	2/4 Lane Hwy.
Discounted Benefits:	$103.0	$167.2	$22.5	$3.1	$120.9
Discounted Costs:	$286.8	$180.8	$201.4	$9.9	$148.9
Net Present Value:	($183.8)	($13.6)	($178.9)	($6.8)	($28.0)
Benefit/Cost Ratio:	0.36	0.92	0.11	0.31	0.81

The above figures indicated that the Turtle Valley option was the preferred alternative, but projected user benefits were not sufficient to justify the project (traffic volumes were not large enough assuming that there was no latent demand). If the project were to be delayed for ten years (and assuming growth in traffic volumes of 3% per annum) then the benefit/cost ratio would rise to 1.36.

In order to put the analysis into perspective with other improvement options and studies underway, the following improvement options were also examined:

- 2/4 lane freeway combination through the Turtle Valley
- additional passing lanes on the existing Trans Canada Highway alignment.

The resulting net present value and benefit/cost ratio from a 2/4 lane freeway ranked this option below an initial freeway option.

The passing lane option also had a poor net present value and benefit/cost ratio. However, when sensitivity analysis was undertaken using actual accident distributions in the base case (rather than the UBCS defaults), the benefit/cost ratio improved to over 3.

Although there may be some questions regarding the magnitude of the benefits that would be generated by the passing lane option, it's low cost requires only a small increase in user benefits to meet minimum acceptance criteria. And, the UBCS analysis does not monetize the benefits attributable to increased driver comfort levels that result from assured passing opportunities at regularly spaced intervals.

It was therefore suggested that the passing lane option be re-evaluated.

Based upon the results the low-cost passing lane option along the existing alignment would appear to be the preferred short term improvement alternative. In the longer run, it would appear that any major capacity improvements should occur in the Turtle Valley corridor.

ARCHAEOLOGICAL INVENTORY AND IMPACT ASSESSMENT OVERVIEW
[TRANS-CANADA HIGHWAY, PRITCHARD TO TAPPEN]
Deva Heritage Consulting, March 1994

The Pritchard to Tappen Highway Planning Study Overview was included with archaeological impact assessments of three other highway projects.

This work consisted of an archaeological and heritage overview of two corridors:

- approximately 50 kilometres of a proposed upgrade of the existing Trans Canada Highway corridor, extending east from Pritchard to Tappen along the shores of the South Thompson River, Little Shuswap Lake, Little River, and Shuswap Lake.
- approximately 35 kilometres of proposed new alignment through the Turtle and Skimikin Valleys south of the present highway route.

Based upon the research conducted, an archaeological inventory and impact assessment of each of the corridors was considered warranted.

It was recommended that an archaeological inventory and impact assessment of the entire existing Highway 1 corridor be conducted, including re-visiting previously recorded sites. In addition, upland sites in the vicinity of Squilax Mountain, located outside the corridor, should be included in this assessment to determine if they may be potentially threatened by blasting associated with future highway improvement.

Based on archaeological potential and documented use, an archaeological inventory and impact assessment of the entire Turtle Valley corridor was also recommended.

Based on the heritage concerns of the local First Nations, it was recommended that any further heritage studies include consultation and ongoing communication with the Adams Lake, Neskonlith, and Little Shuswap Bands.

HIGHWAY 1 PLANNING STUDY, SQUILAX TO SORRENTO
Underwood - Lea, June 1991

Report #1 Background Information & Traffic Analyses

This report provided a review of the collection of information and the discussions and investigations that had taken place. The analysis of present and future traffic and highway capacity was documented.

An addendum to the report dealt with traffic signal warrants.

Conclusions

- Capacity analysis of the highway segments confirms the March 1991 Ward Consulting report conclusions that present Levels of Service are unsatisfactory and will deteriorate substantially with future traffic increases.
- A four-lane highway would provide good Levels of Service throughout the 20 year design period. Level of Service "F" at unsignalized side roads would be generally experienced by the end of the period.
- The highway intersection at the Squilax Bridge access road is unsatisfactory in terms of the existing left turn onto the highway to proceed west. Four-laning the highway would not improve this situation.
- A suitable layout for future signalization at this location should be examined.
- Design of the four-lane facility should allow for a future intersection at Garroway Road/Dilworth Road to connect to the major road network.
- Other access points may require limitations placed on traffic movements. Opportunities should be reviewed during the design process for frontage roads or other means of linking access routes to minimize the direct access to the improved highway.
- In the vicinity of Cruickshank Point, the combination of difficult terrain and highly sensitive lake shore will make compliance with the listed design standards difficult.
- The Ministry of Fisheries and Oceans have advised that they will require detailed environmental impact studies prior to responding to proposed improvement schemes along this section of the highway.

Report #2 Conceptual Planning & Evaluation of Concepts

This report documents the conceptual planning and presents the alignment concepts recommended for further investigation.

A number of concepts were considered during the conceptual planning, and six of these were examined in some detail.

The design criteria were met by all of the concepts which were examined in detail, except where upgrading of the existing highway was proposed to provide two westbound lanes around Cruickshank point. In this case design speed was reduced from 90 km/h to 70 km/h.

A preliminary report on geotechnical investigations is contained within Report #2.

Report #3 Functional Planning

Functional planning was undertaken on three basic alignments:

- Concept 6, a 110 km/h alignment through the saddle south of Cruickshank Point
- Concept 4, a 110 km/h alignment requiring significant filling into Shuswap Lake
- Concept 1 or Concept 6 modified to incorporate a tunnel at Cruickshank Point

To enable a fully informed choice to be considered between feasible alignments, functional planning actually encompassed five concepts. Concepts 6 and 4 were studied, together with Concept 1 (a 90 km/h alignment through the saddle) and two concepts incorporating tunnels at Cruickshank Point (one 90 km/h and one 110 km/h alignment).

	90 km/h alignment	*110 km/h alignment*
Saddle schemes:	Concept 1	Concept 6
Lake fill scheme:		Concept 4
Lakeside schemes with tunnels	Concept 1T	Concept 6T

Report #2 presented evaluations of several alternatives. No clear choice emerged as a recommended single concept for which functional plans should be prepared.

Factors which contributed to the lack of a single choice included:

- Limitations in available mapping which reduced the level of confidence in cut and fill estimates.
- Lack of specific information from Fisheries, and Oceans regarding schemes which affect the Shuswap Lake shoreline.
- A series of "trade-offs" in the evaluation framework between alternative concepts.
- Cost factors for the schemes which were only at an "order of magnitude" level.

Recognition that several alternatives needed to proceed on an equal footing into functional design resulted in development of plans which were not at the full level of detail which would normally be expected after selection of a single conceptual scheme.

For all functional plans, drainage was assumed to be open ditch throughout.

Each functional plan alternative included four-laning under the Squilax Bridge, with a T-intersection provided at approximately the location of the recently constructed intersection. Report Number 1 indicated that an unsatisfactory Level of Service will be experienced by peak summer traffic making the left turn from the bridge access route onto the highway westbound, even with the "protected" arrangement which is presently in place.

To achieve reasonable Level of Service and safe operational conditions for this movement through to the 2010 design year requires either the installation of traffic signals or, the construction of a one-way ramp from the westside of the new Squilax Bridge to merge with the westbound highway traffic lanes.

The latter alternative was considered preferable, but further development of this alternative was considered to be outside the scope of the study.

As indicated in Report Number 1, highway improvements should make provision for a future intersection at the Garroway Road extension/Dilworth Road location. This would minimize the need for access to the improved highway between this future intersection and Sorrento. Implementation of a parallel major road system will be important in ensuring good future highway operating conditions in this section. With an unsignalized intersection, Levels of Service in peak summer conditions for sideroad traffic will deteriorate as highway traffic builds towards the 2010 design year. If future development on the west side of Sorrento generates sufficient additional side road traffic, signalization of the Garroway/Dilworth intersection may be justified.

The functional plans developed had a common alignment at the eastern end, which could be tied into the improvement plans for the Sorrento section along the existing alignment.

If a bypass option were to be selected for the Sorrento section, all functional plan alignments developed for the Squilax-Sorrento section would require the same degree of modification to connect to the bypass.

HIGHWAY 1 PLANNING STUDY, WITHIN SORRENTO
Underwood - Lea, May 1991
HIGHWAY 1 PLANNING STUDY, SORRENTO BYPASS
Underwood - Lea, April 1992

The planning study of Highway #1 upgrading within Sorrento was a comparative evaluation, at a conceptual level of three concepts. It considered an expressway and 5 lane urban standard through Sorrento, and a Sorrento Bypass alternative. It concluded that the bypass concept satisfied transportation planning and engineering issues to a significantly higher degree. It recommended that functional planning for a bypass of Sorrento be undertaken in order to compare this concept more accurately with the urban five lane expressway hybrid concept.

The Sorrento Bypass report documents the conceptual alternatives and functional planning of a bypass option. Preliminary traffic projections were presented and assessed. Alternative bypass concepts, with horizontal and vertical alignments conforming to design standards were prepared. Conceptual interchange layouts were provided. The bypass concepts were evaluated and compared using evaluation matrices.

A recommended bypass alignment was defined. The bypass would be approximately 5 km in length, with an estimated cost of $15.5 Million.

SHUSWAP LAKE CROSSING STUDY [DRAFT 1995]
MAK Engineering, Walter Dilger Consulting Engineers Ltd, Golder Associates Ltd.
In Progress

The objective of this study was to investigate the technical and economic viability of a bridge crossing of the Salmon Arm of Shuswap Lake, as an alternative alignment for Trans-Canada Highway improvement. The study included a video camera survey of highway traffic, directed at a review of several key assumptions related to traffic data.

The present route of the Trans-Canada Highway makes an approximately 29 kilometre loop around the Salmon Arm of Shuswap Lake, passing directly through the urban area of the District of Salmon Arm [population 12,000]. Highway improvement options have for many years considered an upgrade of the existing alignment, and a proposed southerly bypass of the District of Salmon Arm. This study investigated a northerly bypass of the District of Salmon Arm, utilizing a 2 kilometre bridge across Shuswap Lake between Sunnybrae [Tappen] and Engineers Point [Canoe], and compared such an option with improvement through the urban area along the existing TCH corridor or around the community via a southerly bypass.
The concept of a bridge across Shuswap Lake had been considered previously, but rejected because of perceived problems associated with lake depth and engineering. Recent data indicating a much shallower lake bottom suggested that the northerly bypass concept should be revisited.

The study investigated the concept of a combined highway and railway bridge, reasoning that there was significant benefit to relocation of both transportation facilities out of the urbanized area and away from the waterfront.

A review of highway travel origin and destination patterns was undertaken to determine the likely amount of bypassable traffic which might be attracted to a new route, and the impacts. Data was collected using a video camera tracking system.
The work included preliminary structural investigation of bridge options, and a preliminary geotechnical assessment of abutment and lake bed conditions.

The Final Draft of the study is currently being reviewed.

HIGHWAY 1 ACCESS MANAGEMENT PLAN, SALMON ARM
Intercad, April 1994

Purpose/Objectives

The purpose of this study was to define an access management strategy and to develop an access management plan for Highway 1 between Salmon River Road and Canoe Beach Road in the District of Salmon Arm.

The Trans Canada Highway is under increasing pressure as the demand for more access grows. Increases in the number of driveways, intersections and traffic signals have reduced travel speeds and capacity resulting in congestion and accidents.

This plan will help reduce traffic accidents, injuries, and highway maintenance costs, and will prolong the life span of the existing Trans Canada Highway. Furthermore, this plan, supported by local government, will provide a consistent approach to development within Salmon Arm. This plan is to be used in determining details of individual access requirements along the Trans Canada Highway.

Analysis/Products

- Proposed land use (adjacent to the Trans Canada Highway).
- Existing driveways, roads and signal, locations.
- Future frontage/service road locations.
- Future signal locations.
- Laning, channelization.
- Road Network.

The written report addressed the following:

- Strategic needs, Service class, traffic growth.
- Existing conditions - inventory, laning, landuse, accesses, channelization, signals, traffic volumes, LOS.
- Recommendations to implement the Access Management Plan.

TRANS CANADA HIGHWAY UPGRADING
ANNIS BAY TO SICAMOUS, PRE-DESIGN REPORT
Delcan Corporation, March 1988

Delcan was retained in May 1987, to undertake the conceptual layout and detailed design for approximately 9 km of the Trans Canada Highway between Annis Bay and Sicamous. The project scope entailed upgrading the existing two lane highway from an 80 km/hr facility to a four lane freeway standard with a design speed of 120 km/hr.

The existing highway traverses a steep rock slope, has very curvilinear horizontal and vertical alignments, and the area has a number of topographical and man-made constraints. Due to the preceding, it became apparent that a detailed investigation of the proposed facility and the identification and assessment of viable alternative routes and configurations was required. Subsequently, a number of preliminary concepts were developed with due consideration given to the following: construction costs, rock excavation and mass haul balance, retaining wall and structural requirements, right-of-way requirements, environmental concerns, local access, impacts on drainage and water supply, constructability, staging and traffic flows, impact on CP Rail.

In September 1987, a preliminary report was submitted outlining two alternative concepts for upgrading this portion of the Trans Canada Highway. Alternative No. 1 considered widening and re-aligning the existing two lane roadway to an upgraded four lane freeway standard. Alternative No. 2 considered the construction of a split highway section, with eastbound traffic utilizing the existing highway (with the necessary alignment improvements) and a new two lane section constructed further down the rock slope for the westbound traffic. To verify the viability of these alternative routes, it was determined that a more detailed investigation of these two alignments be undertaken upon completion of the detailed ground surveys.

The preliminary construction cost for implementation of the four lane alternate was $24.6 million and the construction cost for implementation of the split roadway alternative was estimated at $26.2 million. The initial construction cost of the split roadway alternative could be reduced approximately $8 million by delaying construction of the eastbound lanes. Preliminary estimates indicated that the construction costs could be reduced by approximately 10% with the implementation of a lower design speed.

Based on the results of the preliminary assessment of the alternative proposals for upgrading the Trans-Canada Highway between Annis Bay and Sicamous, the following recommendations were made:

- Between STA 258 + 00 and STA 281 + 00 construct a four lane roadway section with a 2.4 metre paved median.

- At STA 271 + 75 construct a diamond interchange c/w a structural plate pipe arch underpass.

- East of STA 281 + 00 construct a split roadway section. The additional construction cost incurred would be more than offset by enhanced ease of construction and the greatly reduced impact on the highway traffic.

- Due to the severity of the existing terrain and the proximity of the highway to Sicamous, it was suggested that consideration be given to a reduction of the design speed for this section of the Trans-Canada Highway.

- It was suggested that a detailed geotechnical investigation be undertaken, and detailed design of the proposed facility commence. No further action was taken in regard to this section of highway.

HIGHWAY 1 PLANNING STUDY, WITHIN SICAMOUS
Acres International Ltd., May 1991

The Highway Planning Study within Sicamous integrated several disciplines into a single planning report. Highway planning, bridge engineering, environmental assessment, socioeconomic assessment and traffic engineering evaluations were included. Three options were selected from an initial study of six alignments and alignment combinations. Because of the difficulty in equating the engineering, environmental and socioeconomic evaluations to a common denominator, each alignment option was evaluated by each discipline separately. While this method may not have provided a definitive evaluation, it provided a clear evaluation of the positive and negative aspects of each option for each discipline.

Highway Planning
The study was separated into two topographic areas. The section west of Sicamous Channel was confined to a narrow corridor where options for improvements were based more on construction methods and impact on traffic during construction. The section east of Sicamous Channel, to the east boundary of Sicamous was not limited by topographic or engineering decisions. The impact on the environment, socioeconomic aspects, and engineering design were jointly considered to arrive at the three preferred options. The conceptual and functional engineering design was presented in a detailed plan format, with full conformance to the Ministry of Transportation and Highways design requirements.

The highway upgrade was developed in accordance with standards for a 110 km/hr limited access freeway. Traffic generation for a 20 year period was examined, and major interchange elements were analyzed to ensure a satisfactory operational level of service. LOS "A" is maintained through to the 2010 horizon year for all highway elements.

Environmental
The environmental overview included examination of physical, aquatic and terrestrial features and resources in the area, a functional environmental assessment and evaluation of the options. Data sources included literature review, interviewing resource agency staff, brief reconnaissance of the area, and contacts with locally knowledgeable people. Each option was evaluated based on anticipated impacts according to criteria in the following areas: fisheries, water quality, hydrology, landforms and soil, air quality, vegetation/wildlife, domestic animals and natural hazards.

Socioeconomic
Each highway option was evaluated based on effects in the following areas: community cohesion (group behavior and individual perceptions); accessibility to facilities and services; displacement of people; changes in employment, income and business activity; alterations in housing and residential location patterns; effects on municipal government; influence on property values; changes in rural land use patterns; compatibility with community and regional plans and growth; interaction with aesthetics, cultural and archaeological values; and the consequences of noise, water and air pollution.

TRANS CANADA HIGHWAY 1, REVELSTOKE
PLANNING AND FUNCTIONAL OVERVIEW
Klohn Leonoff Ltd., Richard James & Associates, March 1993

This overview study assesses alternate corridor options for Highway #1 through Revelstoke.

Four alternate corridors were defined during the course of the work. Corridor 'A' was separated into two alignments west of the Columbia River to compare costs. Alignment 'A1' follows a proposed alignment along the side of the mountain west of the Columbia River. Alignment 'A2' cuts through the mountain using a tunnel option. The alignments were reviewed and assessed to determine their comparative suitability.

This study included traffic engineering and analysis, environmental review and land assessment, conceptual highway geometry and design, and order of magnitude cost estimates. The focus of work was on the overall planning, feasibility and comparison of alignments. A socio-economic/cost benefit analysis was not done. The geotechnical investigation was carried out by the MoTH Geotechnical and Materials Engineering Branch.

This study included meetings with the groups that would be most affected by the future Highway #1 alignments. The comments and concerns of those groups were included in the report.

Corridor 'A' is a northern route avoiding the congested Victoria Road area. It would move the highway north of the community, cross the Columbia River below the Revelstoke Dam and rejoin the present corridor west of the Big Bend Area near the Revelstoke Park access. Corridor 'B' is the present highway corridor. Corridors 'C' and 'D' represent a southern route option which avoids the congested Victoria Road area. These options would move the highway south of the community, cross the Illecillewaet and Columbia Rivers and rejoin the present corridor west of the Big Bend Area and east at the Box Canyon area.

Corridors A, C, D identify the range of options and impacts that would be encountered in moving away from the present corridor. All of the optional alignments present challenges of topography and potential environmental impacts.

The five alignments reviewed were all set to freeway standards. The interchanges at the various proposed locations were designed as simple diamonds. The diamond interchange meets the requirements of the traffic flow and volumes. A single loop or Parclo interchange would provide a higher level of service and could be considered on a site-specific basis as an option for the west interchange.

The interchange locations were positioned to provide two access points for local traffic into Revelstoke for each alternate alignment. The west interchange locations shown for all options, other than the Parclo interchange, are set for least cost. These locations do not provide a "direct" link to Highway #23 and this may be perceived as a problem locally. However, from a traffic operation viewpoint, it is not a problem.

The existing highway corridor extends 20 km between Wetask Lake on the west and Greely on the east. The common east and west sections do not affect the comparison of the different options, and were not reviewed in detail.

Cost Estimates Summary

Alignment A1	$275 million
Alignment A2	$247 million
Alignment B	$157 million
Alignment C	$253 million
Alignment D	$305 million

CAPACITY ANALYSIS STUDY, TRANS CANADA HIGHWAY, REVELSTOKE TO THE ALBERTA BORDER
Delcan Corporation, July 1991

This report includes a capacity and accident analysis of the 221 km section of the highway between Revelstoke and the Alberta border, July, 1991.

Although a number of passing lanes and a few four-lane sections have been added in the thirty years since the highway was constructed, the Trans Canada Highway today remains essentially a two-lane facility. During the same time, traffic has grown considerably. Over the past 20 years, traffic has increased approximately 70%, with the result that during the peak summer months significant congestion and reduced operating speeds are common along much of the highway.

It is expected that the Trans Canada Highway will eventually be expanded to a four-lane facility. However, in the short term, improvements are required to provide an acceptable level of service to the traveling public during peak traffic conditions. The life of the Trans Canada Highway as a two-lane facility can be extended by constructing additional passing lanes and implementing operational improvements. This upgrading process will also defer the cost of constructing a four-lane facility.

Capacity Analysis Methodology

A capacity analysis was undertaken for four horizon years; existing conditions (1989 traffic), 1996, 2001 and 2011. As well, the implications of constructing the proposed highway through the Howse Pass were examined for the 2001 and 2011 horizon years. The sections of highway through Mount Revelstoke, Glacier and Yoho National Parks were analyzed in previous studies, and the results of those studies were incorporated into the report. (A horizon year of 2005 was used in the National Park studies).

The objective of the capacity analysis was to identify improvement requirements and the extent of affected highway. This information can then be used by the Ministry of Transportation and Highways as input to the development of a Trans Canada Highway improvement program.

The key principle underlying the capacity analysis was to identify the road improvements necessary to achieve a level of service 'C' on all sections of the Trans Canada Highway for each of the horizon years. Level of service was measured differently for urban and rural sections of the highway, as described below:

- Urban Sections: For signalized intersections, the techniques presented in the 1985 Highway Capacity Manual were used to determine the level of service for existing and forecast conditions, and to assess improvement options. For unsignalized intersections, the warrant procedures described in the manual of Uniform Traffic Control Devices for Canada were used to determine whether or not traffic signals would be required in each horizon year.

- Rural Sections: The Highway Capacity Manual (HCM) is generally used as the standard method of assessing level of service for rural highway sections. However, the HCM does not include an effective technique for analyzing the effects of auxiliary/passing lanes and does not permit variations in terrain and steep grades to be analyzed as part of an overall highway section. Throughout the length of the Trans Canada Highway between Revelstoke and the Alberta border the terrain and geometry of the highway vary almost continuously, and therefore a means of assessing level of service in more detail and with greater accuracy was required. To overcome concerns related to the Highway Capacity Manual techniques, the TRARR model was used.

Traffic Characteristics

Forecasts of future traffic conditions were developed based on an analysis of available traffic data for six locations along the Trans Canada Highway in the study corridor. The historical trend growth in hourly, daily, monthly and seasonal variations in traffic volumes and vehicle composition were determined. Estimates were developed of average annual daily traffic volumes (AADT's), design hour volumes and percentages of slow-moving vehicles on each section of the highway and for each horizon year. This information was then used as input in the TRARR analysis.

The key results of the traffic analysis were:

- Traffic volumes along this corridor are expected to increase at an average rate of 2% per year, based on the historical growth in traffic over the past 20 years.
- Peak traffic conditions along this corridor occur between 11:00 a.m. and 4:00 p.m. during the months of July and August.
- The design hour volume represents approximately 15% of the AADT.
- During peak hours, slow-moving vehicles (trucks, buses, recreational vehicles and cars towing trailers) represent approximately 21% of all vehicles along this corridor. Over the past eight years, truck traffic has grown at a rate comparable to that of total traffic.

Conclusions of Rural Analysis

The key conclusion of the study was that the entire length of the Trans Canada Highway between Revelstoke and the Alberta border must be upgraded to four lanes by 2011, in order to maintain a level of service 'C'. A number of sections require four-laning sooner and some require four lanes immediately. On other sections it is possible to add passing lanes at specific locations to achieve a level of service 'C'. As traffic increases, the number and length of passing lanes required along each section of the highway will increase, until it is not possible to add any more passing lanes without expensive construction. At this point a four-lane section is required.

The conclusions of the capacity analysis are discussed below.

- *1991*. There are 48.4 km of passing lanes (total of two-directions) on the Trans Canada Highway, representing 11% of the two-directional length (i.e. 442 km) of the highway between Revelstoke and the Alberta border. In order to accommodate existing traffic at a Level of Service 'C' during peak conditions, an additional 88.5 km of passing lanes are required. A 7.2 km four-lane section is also required through the Upper Canyon in Yoho National Park - this is currently a three-lane section, with an eastbound (uphill) passing lane for the entire length of the canyon.

- *1996.* Four new four-lane sections will be required, with a total length of 40.1 km, in addition to the single four-lane section required in 1991. These four-lane sections include 6.7 km through the Box Canyon east of Revelstoke, 11.2 km between Mount Revelstoke and Glacier National Parks, 10.2 km east of Glacier National Park and 12.0 km in the Kicking Horse Canyon east of Golden. An additional 11.3 km of new and extended passing lanes are also required by 1996, in addition to the passing lanes required in 1991.
- *2001.* The length of highway between Mount Revelstoke Park and Glacier National Park will have to be expanded to four lanes in order to accommodate the forecast traffic at a Level of Service 'C' during peak conditions. By Year 2001, the total of all four-lane sections along this highway represents 25% of the entire length of highway between Revelstoke and the Alberta border. An additional 10.5 km of passing lanes will be required along other sections of the highway in addition to those required by 1996.
- *2005.* Previous studies of the Trans Canada Highway indicate that the highway must be expanded to four-lanes through the three National Parks by 2005, a total of 94.4 km of additional four-lane highway. The results of those studies may be optimistic in terms of construction timing since the design hour volume forecasts used in those studies are lower than the traffic growth factor used in this study. Four lanes may be required sooner than by Year 2005.
- *2011.* Four lanes will be required for the length of highway between the west gate of Mount Revelstoke National Park and the Alberta border. An additional 5.7 km of passing lanes are required on the remaining two-lane section west of Mount Revelstoke National Park, in addition to the passing lanes required by 2001.
- *2001 with Howse Pass.* The Howse Pass is located on the B.C./Alberta border approximately 50 km north of the Kicking Horse Pass. A new highway link has been proposed through the Howse Pass, from the Saskatchewan Crossing service center in Alberta to a junction with the Trans Canada Highway at the Blaeberry River.

  If the proposed Howse Pass route was constructed by year 2001, the Trans Canada Highway would have to be expanded to four lanes between Glacier National Park and Donald Road by 2001, in order to maintain a Level of Service 'C'. An additional 5.7 km of passing lanes would be required between Revelstoke and Mount Revelstoke National Park, in addition to passing lanes required by 2011 without Howse Pass. East of the Blaeberry River where the Howse Pass route would join the Trans Canada Highway, passing lane requirements would be reduced by 2.9 km from those required in 2001 if the Howse Pass route was not constructed.
- *2011 with Howse Pass.* If the Howse Pass route was constructed, the entire length of highway between Revelstoke and the Blaeberry River would have to be expanded to four lanes in order to maintain a Level of Service 'C'. East of the Blaeberry River, an additional 1.9 km of passing lanes would be required in addition to the passing lanes required by 2001 with Howse Pass

Construction through the Howse Pass would generally increase the laning requirements for the section of the Trans Canada Highway west of the Blaeberry River because of increased traffic volumes resulting from traffic diverting from other provincial highways. The section of highway between the Glacier National Park and Donald Road would have to be four lanes by 2001 if a Howse Pass route was constructed. This laning requirement is ten years earlier than for the case without Howse Pass. East of Blaeberry River, the laning requirements for the Trans Canada Highway would be reduced if Howse Pass was constructed, since some traffic would be diverted to this new route, away from the Kicking Horse Pass section of the Trans Canada Highway.

In order to maximize the benefits achieved by constructing additional passing lanes as identified in this study, the planning and design of these passing lanes should be integrated with long-term plans to upgrade the Trans Canada Highway to four lanes. Adequate provision should be made for an eventual four-lane configuration, particularly where major structures and engineering works are required and where development may be expected adjacent to the highway.

Conclusions of Urban Analysis

Five major intersections on the Trans Canada Highway were analyzed to determine whether improvements would be required to maintain a Level of Service 'C' at these intersections through to Year 2011. It is important to note that the expansion of existing intersections and the construction of new access points on the Trans Canada Highway in Revelstoke and Golden may alter future traffic patterns at these intersections. Traffic volumes should be monitored to identify significant changes in traffic growth rates and to determine whether improvements are required at an earlier date.

The results of the intersection analysis are discussed below:

- The Highway 23 south and Victoria Road intersections in Revelstoke are currently signalized. Based on current economic and development projections, it is anticipated that no major improvements will be required at the Highway 23 south intersection through to 2011. At the Victoria Road intersection, signal timings will need to be adjusted and a separate southbound left turn phase may be required by 2011, or by 2001 if the proposed Howse Pass route was constructed.
- The Highway 23 north and Eastern Access Road intersections in Revelstoke are currently unsignalized. Signals would be required only if the Howse Pass route was constructed - by 2002 at Highway 23 north and by 2006 at the Eastern Access Road.
- The Highway 95 intersection in Golden is currently unsignalized. Traffic signals would be required by 2011 unless the Howse Pass route was constructed and traffic growth along this section of the Trans Canada Highway was reduced.

Conclusions of Accident Analysis

An additional component of this study involved an analysis of accident data, for the section of the Trans Canada Highway between Revelstoke and the Alberta border.

Accident data for the three years from 1987 to 1989 identified the location of accidents, the direction in which vehicles were traveling, the cause of the accident and the extent of injuries and damage. The objective was to identify high-accident locations and the likely causes of accidents at these locations. The potential to reduce the accident rate by expanding the highway to three or four lanes at these locations, or implementing other operational improvements could not be determined within the scope of this study.
An initial screening of the data identified 21 high-accident locations. Analysis of data for these locations indicated that, in general, accidents occurred at bridges and snowsheds, on sharp curves and at access points such as intersections, rest areas and viewpoints. Very few accidents occurred on long tangent sections of the highway where there were few or no accesses. The majority of accidents are attributable to driver error and adverse weather conditions. Conclusions regarding potential means of reducing the number of accidents at specific locations are discussed below.

- Flashing advance warning devices may help to reduce the number of accidents at the Victoria Road/Trans Canada Highway intersection.
- A median barrier would prevent westbound vehicles from turning left into the Illecillewaet rest area. Currently, signs are posted advising drivers that left turns are prohibited, yet many drivers ignore the signs. With proper design, the median barrier would pose only a minimal accident hazard, far less than the current accident potential at this location.
- A significant number of accidents occur at snowsheds, particularly at the five snowsheds in Glacier National Park. A major contributing factor is poor illumination in the snowsheds. The number of accidents could be reduced by installing lights inside the snowsheds, increasing the amount of reflective material identifying the median line and walls of the snowshed, and more frequent maintenance of reflectors and lighting during winter months.
- Many accidents occur on sharp curves located at the end of a number of bridges, despite signs advising drivers to reduce speeds due to the sharp curves. The majority of accidents occurring in these locations are due to vehicles traveling at unsafe speeds in adverse weather conditions. Additional warning devices may help to reduce the number of accidents. Any major improvement would require a realignment of approaches to the bridges in order to increase the radii of the curves.

This study did not contain any cost estimates for improvements.

PASSING LANE STUDY AND TRAFFIC ANALYSIS OF THE PONDING AREAS FOR AVALANCHE CONTROL, MOUNT REVELSTOKE AND GLACIER NATIONAL PARKS
Dr John F. Morrall, Department of Civil Engineering, University of Calgary, December, 1988

The Trans Canada Highway through Mount Revelstoke and Glacier National Parks has not undergone any major upgrading since it was opened in 1962. The section through Rogers Pass is unique in Canada in that it is one of the few sections of highway that can remain open in winter only by means of a continuous program of avalanche stabilization. The Snow Research and Avalanche Warning Section (SRAWS) of the Canadian Parks Service, Environment Canada, operates one of the largest avalanche stabilization programs in the world.

Since the Trans Canada Highway opened in 1962 winter average daily traffic has increased from 400 to in excess of 2,000 vehicles/day. Until recently, sections of highway not in avalanche zones have provided adequate capacity for vehicular storage (also known as ponding areas) during stabilization shoots. However, the growth of traffic coupled with an increasing percentage of trucks in the traffic stream has resulted in a shortfall of ponding area capacity. In addition to the increased number of trucks, the trucks are longer than they were when the mobile avalanche control program was established almost 30 years ago. Also exacerbating the ponding area capacity problems are the high peak traffic periods during winter holidays which have become more pronounced during the last decade.

This report is one component of an overall assessment of the Trans Canada Highway corridor in the mountain National Parks, directed at ensuring that the highway can serve the dual purposes of providing a safe and efficient trans-mountain highway corridor and access to facilities in Mount Revelstoke and Glacier National Parks.

The specific objectives of the study were as follows:

- To make traffic forecasts for the Trans Canada Highway in Mount Revelstoke and Glacier National Parks.
- To undertake a level of service analysis of the Trans Canada Highway for existing and future traffic.
- To estimate the design life of the Trans Canada Highway as a two-way, two lane facility, and how it could be extended by the addition of passing lanes.
- To review the ponding area locations and determine their stacking capacities for the avalanche control program in Glacier National Park.

The level of service analysis, and determination of the life of the Trans Canada Highway as a two-way, two-lane highway, was based on year round and summer traffic characteristics and forecasts. As traffic volumes are highest during the summer, the basic traffic problem on the Trans Canada Highway is the lack of passing opportunities required to maintain an acceptable level of service. Several analysis techniques were employed to determine the need for passing lanes, and their effect on the level of service. These techniques included the 1985 Highway Capacity Manual method, a traffic flow simulation model, and an analysis of passing opportunities based on the Unified Traffic Flow theory model.

The two problems - the winter problem of adequate vehicular storage for avalanche control, and the summer problem of maintaining an acceptable level of service by ensuring adequate passing opportunities - were linked through a common denominator, namely, passing lanes. Thus, one important aspect of the study was to determine those locations which could serve as potential sites for passing lanes during the summer and ponding areas during the winter. These sites would require highway widening which would permit an auxiliary lane to be used as a passing lane in the summer and as an additional storage lane during avalanche control in the winter.

Traffic volumes were estimated for the year 2005 based on historical data as recorded by the Canadian Parks Service, Alberta Transportation and Utilities, and the B.C. Ministry of Transportation and Highways. A detailed examination was made of the highest 50 hours of the year to determine the time and date of occurrence in order to ascertain the design hour volume. Low, medium, and high growth trends were developed for both summer and winter periods.

In terms of traffic composition, it was estimated that truck traffic will grow at a faster rate than auto traffic over the next 20 years. The net result being that trucks will likely constitute a higher percent of the traffic stream, and the average truck will be longer and heavier, by the horizon year of 2005.

Traffic forecasts for the winter period were used as input to the analysis of ponding area requirements for avalanche control. As part of the winter analysis, data was collected on traffic characteristics during the 1987/1988 season. A traffic model was developed to determine the time required to reach the stacking capacity of a ponding area for a given flow rate.

Summary and Recommendations

The traffic simulation analysis (TRARR), combined with the ponding area analysis and field engineering, indicated that twelve passing lanes (including climbing lanes) in Glacier Park (five westbound and seven eastbound), and three in Mount Revelstoke Park (one westbound and two eastbound) are required to accommodate traffic volumes at an acceptable level of service up to year 2005. The proposed passing lanes will also provide the additional highway width required to accommodate triple stacking of vehicles for avalanche control.

In order to maximize the operational benefits expected from the proposed passing lanes, it was recognized that planning and design should be integrated with the long-term plans for the Trans Canada Highway in British Columbia. The planning and design of passing lanes must also be done within the context of the long-range plans for Mount Revelstoke and

Glacier Parks. In addition, it was recommended that adequate provision for eventual twinning be made at the time passing lanes are planned and designed, especially where heavy engineering works may be required. Other construction, involving the railway or structures near the highway, should make adequate provision for a four-lane cross-section.

The following specific criteria were used to evaluate passing lane locations:

- Construction cost - The primary consideration is to minimize construction costs. For passing lanes to be a cost effective method of improving the level of service, costly structures and large cuts and fills should be avoided.
- Driver Perception - The location of the passing lane should appear to be logical to the driver. This is best achieved by locating the passing lane in an area where passing opportunities are limited, not on long tangent sections with good passing sight distance. Net passing opportunities are significantly increased by locating passing lanes in road sections with a high percent of no passing zones.
- Climbing Lanes - The Trans Canada Highway in Mount Revelstoke and Glacier Park passes through rolling and mountainous terrain. An important criterion was the retention and extension of existing auxiliary lanes on severe grades, such as the approaches to Rogers Pass. It was noted that the function of a climbing lane is to overcome delays caused by slow-moving vehicles on steep upgrades, while the function of a passing lane is to break up bunches or platoons caused by inadequate overtaking opportunities. Most emphasis in the past has been on the climbing lane function, as shown by their use on the Trans Canada Highway in Mount Revelstoke and Glacier Park. The benefits of passing lanes, in terms of breaking up platoons and providing an assured passing opportunity, has been recognized only recently.
- Sight Distance - For safety reasons, there should be good sight distance at the beginning and end of passing lanes for the diverging and merging of the fast and slow platoons.
- Major Intersections - Locations at or near major intersections were avoided unless the intersection could be moved and/or the turning movements eliminated. Where the intersection could not be avoided, a separate left-turn lane is required for consistency of design and safe operation.
- Minor Intersections - Minor intersections were not considered a constraint in locating the passing lanes as the ones which affected this study in particular are planned to be closed.
- Start of Passing Lanes - Although not a strict requirement, the start of passing lanes developed on a horizontal curve to the left have the advantage that the traffic stream is directed naturally into the outside lane.
- Structures - Locations such as bridges and culverts were avoided if they resulted in a very narrow shoulder.
- Road Geometry - Locations with substandard road geometry should be avoided as they would reduce the propensity to pass.
- Future Highway Expansion - Location of passing lanes should be compatible with the long-term development of the Trans Canada Highway in Mount Revelstoke and Glacier Park. In other words, existing sections that may require extensive upgrading

should be planned within the context of a four-lane section if it is likely to be required within the planning horizon.

California Experience with Passing Lanes

In order to answer the question "How much traffic can a two-lane highway with passing lanes handle before breaking down?", a review of the California experience was undertaken. In addition, discussions were held with senior California Department of Transportation (CALTRANS) engineers.

A recently completed highway inventory indicated that there are about 240 passing lanes in the State of California. The average AADT on the passing lane sections was found to be 5,340. However, Highway District 3 (Marysville) has 30 passing lanes with an average AADT of 7,650. In District 4 (San Francisco) and 7 (Los Angeles) passing lanes have an average AADT in excess of 12,000. Highway 41 from Fresno to Yosemite National Park is a two-lane highway with passing lanes and carries an AADT of 7,200 to 8,000 over a distance of 60 km at a satisfactory level of service. A recent study by CALTRANS proposed 99 directional passing lanes at a cost of $77 million. All projects were evaluated for cost-effectiveness, in terms of reducing delays and accidents, and the average benefit/cost ratio was found to be 3:1. The study was based on research that showed that passing lanes can improve traffic operations and safety along rural two-lane highways in mountainous and rolling terrain. Guidelines for the planning and design of passing lanes in mountainous areas have been developed by Mr Fred Rooney of CALTRANS ("Passing Lanes Along Highways in Mountainous Areas", ITE, 1988).

In summary, the California Department of Transportation has concluded that "while realignment and widening to four lanes might be the ideal solution, and indeed may be the preferred alternative for heavily congested roadways, such measures are usually constrained by costly construction, possible right of way and environmental problems, and long lead times for implementation. On the other hand, passing lanes are the type of project which function within the framework of existing facilities and tend to maximize the benefits of the initial investment. Passing lanes are quicker to implement, and because the projects are utilized in spot situations, the returns on the investment, in terms of reduced delay and improved safety, are usually attractive. While four-lane sections on new alignment can cost between $5 million and $10 million (US) per lane mile, passing lanes in mountainous and rolling terrain normally can be built for about $1 million (US) per lane mile".

Ponding Area Recommendations

- It was noted that attempting to achieve absolute safety before releasing traffic would result in intolerable delays to highway traffic, thus, the SRAWS objective of minimizing risk is considered to be the best overall approach to the problem.
- It was recommended that the Government of Canada and the B.C. Government undertake a study to co-ordinate avalanche control and traffic flow between Golden and Revelstoke. The main objective of the co-ordination should be similar to that developed by SRAWS, namely, minimization of delay, subject to the minimization of risk.

PONDING AREA ANALYSIS AND TRAFFIC MANAGEMENT PLAN, MOUNT REVELSTOKE AND GLACIER NATIONAL PARKS
Dr John F. Morrall, Department of Civil Engineering, University of Calgary 1991

This update study reinforced the conclusions of the 1988 study that the two basic traffic problems facing the Trans Canada Highway through Rogers Pass, namely the winter problem of adequate vehicle storage for the mobile avalanche control program and the summer problem of maintaining an acceptable level of service during periods of moderate to heavy traffic flow, may be linked through the use of wider cross-sections. Low-cost improvements such as passing lanes achieved through wider cross-sections, and a traffic management plan for the mobile avalanche control program can be used to extend the design life of the Trans Canada Highway as a two-way, two-lane facility to approximately the year 2005 at current traffic growth rates.
By the year 2005 the Trans Canada Highway in both Glacier and Mount Revelstoke National Parks must be upgraded to four lanes in order to maintain an acceptable level of service. If the passing lane program is not implemented in the near future its value as an interim measure to extend the life of the Trans Canada Highway as a two-lane facility will be seriously eroded.

Without the passing lane system in place the level of service during summer months will continue to deteriorate and delays to traffic during the winter months will increase during avalanche stabilization due to lack of ponding capacity within Glacier National Park. Most importantly, the margin of safety during avalanche stabilization will be eroded without capital investment in the highway system and increases to the operations and maintenance budget.

This report also recommended three future studies:

- *Highway User Fee Study*
  One method of maintaining an adequate budget for SRAWS operations and highway maintenance would be to charge a highway user fee. At the present time the highway is maintained and safe passage provided during the winter months free of charge to users. However, the Canadian Parks Service does not collect their fair share of gasoline, diesel, or license taxes. The trucking industry in particular benefits from SRAWS operations which attempt to minimize delays subject to providing safe passage. The trucking industry also is responsible for a disproportionate number of delays and incidents during the winter period. It is noted that the trucking industry will be one of the biggest losers in terms of increased delays. The increasing number of 25 metre trucks, coupled with their operational impact on the stabilization program, is one of the main factors contributing to the increase in delays and decrease in ponding area capacity. It is recommended that the Canadian Parks Service undertake a study of the level of highway user fees required to cover operations and maintenance costs in Mount Revelstoke and Glacier National Parks. Such a study could be broadened to include the considerations of converting the highway to a toll road. The 1988 study concluded that the Trans Canada Highway should be upgraded to a four-lane facility

by the year 2005 to maintain an acceptable level of service. Funding sources for the upgrading could be part of the operations and maintenance highway user fee study.

- *Trans Mountain Traffic Management and Highway User Information System*
  In order to maintain an acceptable level of service on the trans-mountain section of the Trans Canada Highway during winter months, the Federal Government, B.C. Ministry of Transportation and Highways, and Alberta Transportation and Utilities need to examine the possibility of developing a comprehensive traffic management and highway user information system as part of an Intelligent Vehicle Highway System (IVHS). The proposed traffic management and highway user information system would extend from the B.C./Alberta boundary to Hope. Highway conditions, traffic volumes, traffic accidents and incidents, and avalanche stabilization operations would be a part of the information and data base. The ultimate goals would be to set the course for the trans-mountain highway system for well into the 21st century. It is noted IVHS includes a range of technologies based on modern communications, computer and control system. The traffic monitor and automatic gates would be components of a trans-mountain IVHS. It is recommended that the Federal Government, the B.C. Ministry of Transportation and Highways, and Alberta Transportation and Utilities undertake a trans-mountain IVHS study.

- *The Summit Area*
  The Summit area is approximately 4 km long and is characterized by a number of intersections and destination points. During summer months, traffic flow is slowed by left and right turn movements in both directions of flow. In addition, pedestrians from eastbound vehicles cross the highway to visit the Summit Monument and Rogers Pass Centre. During winter months the main concerns are avalanche control, highway maintenance, and snow storage.
  Until a comprehensive traffic management plan is developed for the Summit area it is not reasonable to recommend overhead sign bridges for traffic control during ponding. Consideration of the installation of sign bridges could be part of the Summit Area traffic study along with better utilization of frontage roads and rationalization and improving intersections. It is recommended that the Canadian Parks Service undertake a traffic and transportation planning study of the Summit area. Such a study would include a comprehensive traffic management plan as well as consideration of both summer and winter operations. The planning horizon for the study should extend beyond the year 2005, the time at which a four-lane facility has been recommended.

CONCEPTUAL STUDY OF THE TRANS CANADA HIGHWAY TWINNING THROUGH GLACIER AND MOUNT REVELSTOKE NATIONAL PARKS
Reid Crowther, September 1994

This study is a companion study to the "Conceptual Study of Trans Canada Highway Twinning Through Yoho National Park".

The Trans Canada Highway through Glacier and Mount Revelstoke National Parks is the only means of access for the 60% of all visitors who stop at one or more park facilities. Parks Canada has emphasized that the Trans Canada Highway of the future must be more than a conduit that funnels traffic efficiently through the park

Parks Canada suggested a "Parkway" design concept for the Trans Canada Highway, where landscape and the view from the road are paramount.

The current trend appears however to be in the opposite direction. Conservation of wilderness and natural beauty are the primary concerns; highways and other developments within parks are now contentious issues. Hence, the move towards the narrowest possible road right-of-way that will safely move vehicles, especially, through the narrow steep-sided valleys of the Rocky Mountains where valley bottom habitat is at a premium.

Given today's emphasis on conservation and the environment, the design of a widened Trans Canada Highway through Glacier/Mt. Revelstoke Parks probably cannot incorporate many of the parkway ideals. Commercial traffic cannot be eliminated so there will always be a mix of through and visitor traffic; split horizontal alignments consume more land and isolate the areas between the roadways, and so can only be used sparingly; split vertical alignments along steep sidehills often require retaining walls which create barriers to wildlife moving in one direction or a potentially fatal drop in the other; where the new lanes closely parallel the existing highway, the alignment is already fixed.

The spirit and the ideals of a Parkway can and should be incorporated into the design where an opportunity exists. Parkway design principles can be incorporated into the design of bridges, retaining walls and roadside amenities by careful detailing of shapes and judicious choices of colours and textures. Rock cuts, earth cuts and fills can be shaped into more natural land forms.

Since the recommended new lanes follow the existing highway alignment, little can be done with the geometric design; however, some minor improvements were suggested. In most instances, the existing alignment is quite a pleasant curvilinear design dictated by the topography.

Rogers Pass - Snow Sheds

Reconstruction of, or extensions to, the existing snow sheds will be expensive and, since traffic volumes are much greater in summer than in winter, it follows that a program of sequential staged construction which could accommodate the projected summer traffic without snow shed construction until winter traffic volumes also require four lanes, would be desirable. Initially, the new lanes could be constructed at a lower level to allow future extensions to the snow sheds. The new lanes would carry eastbound traffic during summer; the existing highway would carry westbound traffic. During the winter months, the new lanes would be closed and the traffic would revert to the existing two-lane configuration. The profile of the existing highway can probably be lowered to provide 5.0 m vertical clearance through the existing snow sheds. If lateral clearance is found to be inadequate, partial reconstruction may be feasible and could be carried out prior to or in conjunction with the snow shed extensions.

An alternative scheme whereby new lanes would be constructed on the upslope side of the existing highway was also examined. This arrangement would be extremely difficult to build and would require extensive retaining walls between snow sheds. It would be much more expensive than the proposed scheme; and staged construction would not be possible.

A tunnel scheme was also examined to arrive at order of magnitude costs, but was found to be twice as expensive as the proposed scheme.

Landscape Design - General Principles Recommended

The landscape development of the roadside should reflect the character, texture, type and quantity of indigenous natural vegetation. Grasses should only be used where they are required and of proven benefit either for erosion control or for habitat enhancement. Critical to the success of the project will be the long term maintenance of the right-of-way environment. A thorough maintenance plan geared to aesthetic and functional objectives should be put in place prior to construction. It should also be monitored on a regular basis and adjusted to respond to environmental changes and viewer needs.

Clearing should be carefully controlled and selective cutting should be undertaken at pre-selected sites to produce variation on a regular basis in the tree line and to reflect the topographic character of the landscape. Plantings should be restrained, informal, and limited to locally obtained native species. Seed collection requirements need to be considered some years in advance of actual construction. The use of genetically adapted species is particularly relevant in this case.

There is currently a lack of information on the nature and distribution of special vegetation resources within Glacier and Mount Revelstoke National Parks such as rare plants, old growth forest or species which may be at the edge of their geographic range. Information on these resources is particularly needed in those eco-sites which are restricted in aerial occurrence and/or are associated with wetlands which may be affected by Trans Canada Highway expansion. Given the variation in eco-site conditions (moisture, exposure, soil conditions), a focus of reclamation research could be the selection of appropriate species for variable site conditions.

Knowledge of non-palatable, native species is a further area of applied research which needs investigation. In addition, some consideration also needs to be given to reclamation and re-vegetation standards over a specific time frame.

An opportunity exists to monitor a number of slope stabilization techniques which will be applied to highway improvement projects within the park over the next several years. Use of geotextile fabrics, soil stabilizers (tackifiers), mulches, and slope designs could be evaluated in this context. Bio-engineering methods, involving the use of vegetative materials are also an area of reclamation research which may be applicable for particular situations.

Plantings should be designed with self-sufficiency in mind. Land forms should be adjusted at the planting sites to direct surface water run-off towards the planting area. Plants should be placed in family groupings and maintained until established.

Borrow areas, if required, should be designed in irregular shapes to suit their proscribed long-term use, e.g. wildlife habitat, reforestation, or roadside visitor amenity.

Design Standards Recommendations

Two cross-sections, similar to those used in Banff National Park, are proposed. The first being a wide, depressed grassed median. The second being a narrow paved median with a raised concrete barrier.

The narrow medium with raised concrete barrier is proposed where the terrain rules out the use of the wider section or where the ecosystem requires that the land take be minimized.

If the narrow median is also used by the B.C. Ministry of Transportation and Highways to the east and west of the Parks and also on the short section between the Parks, the total length of uninterrupted median barrier could approach 75 to 100 km.

Studies in Banff National Park suggests that the concrete barrier is an insurmountable obstacle for many small animals attempting to cross the highway and may not be the best choice for a park environment.

Alternatives which might be considered are steel W-beams, steel box beams or stressed cables which provide a virtually unrestricted opening for small animals (except possibly during winter, when the barriers tend to be covered in ploughed snow). However these barriers are more flexible, and would require greater lateral clearances than the rigid concrete barrier, the median would be wider; they are not as effective in re-directing large vehicles; maintenance and vehicle damage costs would be higher; but, they may be an acceptable compromise at locations known to be favoured for cross-highway movement by small animals.

Snow clearing and winter maintenance are much more difficult where there is a raised median barrier. This has led some agencies to experiment with narrow, barrier-less medians. However, experience has shown that accident rates on four lane mountain highways without barriers are higher.

Openings in the median barrier are potential hazards but are now accepted practice for service/emergency vehicle use.

Geotechnical

The more difficult sections of highway location were addressed and conceptual design solutions were developed where geotechnical considerations are a significant aspect.

Avalanche Locations and Impact Evaluation

The scope of the report and the quality of data available did not permit detailed site specific impact evaluation. Data was presented in tabular form based on the proposed locations of the additional lanes. Avalanche zones were as identified in "Rogers Pass Snow Avalanche Atlas" by V.G. Schleiss, April 1989.

The Visitor

Almost all visitors come by car or bus, and so it is not surprising that driving for pleasure and sightseeing are the two most popular activities, and the "Park Experience" for the majority of visitors is limited to the Trans Canada Highway Corridor. It follows that, for most visitors, enjoyment of the Parks is directly proportional to the number, quality, and location of roadside amenities where they can pause at some point of interest to take photographs or to stop for a longer time to have a picnic and/or go for a short front-country stroll.

There is concern that a four-lane highway could lessen the visitors' experience and enjoyment of the Park by limiting opportunities to cross the highway to access Park resources. Such a situation can be avoided and the visitor experience can be enhanced (by twinning) by careful, well coordinated planning and design of the highway and roadside amenities.

There are opportunities along the highway where twinning could include development of outstanding visitor facilities. Most of the existing facilities are reclaimed highway construction borrow pits, construction camps and disposal areas for surplus excavation. In a few instances these facilities have been developed to provide high quality experiences but many are in poor locations and can never provide more than low quality exposure to the Park.

A system of warrants to be used in the selection and development of new sites was suggested, as a basis for future study:

- Identify and rank existing and potential roadside developments.
- Set desirable capacities for each location.
- Correlate visits per site with Annual Average Daily Traffic and, with this information, project future use and the need, location, and timing, for additional facilities. This information could be useful in deciding whether to add to an existing site or to provide a new one. For example, projections might show that an existing facility would reach or exceed its desirable capacity with one way traffic. In this situation, the first stage development coincident with or prior to highway construction, might be a new facility on the opposite side of the highway rather than a new pull-off and pedestrian link to the existing facility.
- Consider parking on both sides of the highway with a pedestrian connection (overpass or underpass) to the feature.
- Consider complementary facilities at another location on the opposite side of the highway.
- Establish a rationale for tour buses. Should buses have access to all roadside facilities or should they be limited to designated sites?

Regardless of the method used to identify roadside amenities, they must be of such a frequency and interest, and signed well in advance, that the visitor will not be tempted to use the service/emergency openings in the median to backtrack to a desirable site on the opposite side of the road.

DONALD STATION TO YOHO NATIONAL PARK - CORRIDOR REPORT
Fenco Lavalin Corp., August 1992

The Transportation Planning Overview for the Province of British Columbia published in 1988 forecasted that the two lane Trans Canada Highway should be upgraded to four lanes by the year 2000 in order to meet growing traffic volumes. The Kicking Horse Canyon section between Golden and Yoho National Park has been the site of several serious traffic accidents in which poor roadway alignment has been a contributing factor.

Summer traffic volumes in the Kicking Horse Canyon are causing driver frustration because of limited passing opportunities and slow speeds.

In the winter traffic volumes through the Kicking Horse Canyon are considerably below that of the summer, but increased road hazards due to ice, snow and rock falls also contribute to slow speeds and unsafe driving conditions.

This corridor study, recommended a route, and prepared a functional design for a selected 10 km section. The objectives of the assignment were as follows:

- Review the present Trans Canada Highway corridor between Donald Station and the Yoho Park Boundary and assess the feasibility of alternate corridors.
  Identify and recommend solutions for all transportation planning issues of concern along the selected corridor/route.
- Undertake the conceptual design work and associated cost estimates to determine the possible routes and alignments to transform Highway 1 into an Expressway using the existing corridor, alternative corridors, or combinations of the existing and alternative corridors.
- Develop the local road consistent with a limited access highway. The connecting intersections and local road network should allow for the eventual upgrade to a freeway classification.
- Undertake the functional design work for a 10 km section of existing highway.
- Ensure the flow of traffic along Highway 1 can be maintained during construction; outline possible detour routes around construction areas.

Corridor options included the existing highway, alternative alignments, a combination of both existing and alternate alignments. The geotechnical and transportation planning review of the corridor options was accompanied by a preliminary audit of potential impacts upon the environment, land use, and communities within the study area.

A comprehensive program of public consultation accompanied the technical work. This program included collaboration with the local Planning Committee and the Town of Golden, several public meetings and open house events, distribution of information newsletters, and an ongoing "hotline" to the Consultant's office.

The following corridor options were identified and evaluated:

Option 1: Upgrading the existing Trans Canada Highway.

Option 2: Constructing a new highway along the East Bench of the Columbia River, traversing the Hospital Creek Valley to join up with the existing highway in the Kicking Horse Canyon at roughly the Park Bridge (10 mile point).

Option 3: Constructing a new highway along the West Bench of the Columbia River, to join up with the existing highway at or beyond Golden.

Option 4: East of Golden, constructing a new highway along the south side of the Kicking Horse River.

Between Donald and Golden, the relative merits of each option were found to be as follows:

Option 1: The existing highway has the advantages of improving local access and showing the least potential for environmental impact, but the projected cost of improvements at the Donald Hill (to correct the alignment of the steep grade at the west bridge approach) and handling traffic through the construction area between Donald and Golden are high.

Option 2: The East Bench has the advantage of relatively low cost because of topography and low traffic interference, but its intrusion into rural residential areas and its bypass of the Town of Golden are significant disadvantages.

Option 3: The West Bench offers a safe, easy-to-construct alignment that is relatively low cost, but its intrusion into wilderness and forestry areas is a disadvantage. Furthermore, it offers no traffic benefit until it is fully completed.

Between Golden and Yoho National Park, the relative merits of each option were found to be as follows:

Option 1: The existing highway has the advantages of permitting incremental upgrading, and leaving access to local properties relatively undisturbed, but its disadvantages include significant problems of traffic management during construction, and the risks of construction above the CP rail line.

Option 2: The Hospital Creek Valley corridor bypasses the problems of construction through the lower portion of the Kicking Horse Canyon, but it also bypasses the Town of Golden, and furthermore carries a high cost projection because of the long tunnel required.

Option 4: The South Side of the Canyon has the advantage of avoiding traffic management problems during construction, and of having alignment possibilities that are unconstrained by the existing highway, but its disadvantage is intrusion into a relatively pristine, undisturbed wilderness area. It also offers no traffic benefit until it is fully completed.

The Corridor Study concluded that route studies should proceed for the West Bench, Existing Highway, and South Side corridor options, but that the East Bench/Hospital Creek Corridor should be abandoned because of its high cost, its intrusion into established rural residential areas, and its bypass of the Town of Golden.

DONALD STATION TO YOHO NATIONAL PARK - ROUTE REPORT
SNC - Fenco Inc., August 1992

This report was the second part of the Trans Canada Highway upgrading study between Donald and Yoho National Park.

The route options identified within this study flowed from the recommendations of the Corridor Report. The route options identified and evaluated included:

- Donald to Golden: Upgrade the existing highway to freeway standard, or construct a new highway along the mid west bench of the Columbia River. The latter alignment would cross the Columbia River either at Blaeberry to connect with the existing highway, or cross the river in the vicinity of the golf course to connect with the existing highway at Edelweiss.

- Town of Golden: In the short run, the only feasible option is to upgrade the existing highway to four lanes, with controlled at-grade intersections. In the long run, two bypass options were identified: the "North Bypass" would depart from the existing highway roughly 4 km north of the town, traverse the upper bench of Hospital Creek, and cross to the South over the Kicking Horse River via a high-level bridge; the "South Bypass" would exit the existing highway near Edelweiss, cross the Columbia River, skirt the town to the south, and cross above Reflection Lake Road to reconnect with either the North or South side of the Canyon. The "North Bypass" was not an option generated from the Corridor Study, but was introduced as a feasible alternative by the local planning committee.

- Kicking Horse Canyon: The "North Side" route would follow the existing highway from Golden to a new 5 Mile Bridge, through two tunnels, then use a short section of the south side of the canyon before crossing back to the north side via a second new bridge between the 5 and 10 mile points. The route would continue through two more tunnels on a significantly upgraded existing highway east of the 10 Mile Bridge.

  The "South Side" route would commence at a new high level bridge just east of Golden, and follow the south side of the canyon through a tunnel, crossing to the existing highway between the 5 and 10 Mile bridges. It then would continue on the south side through a tunnel to a new bridge crossing roughly 2.5 km west of the Yoho Park boundary.

The route options underwent technical analysis related to geotechnical and engineering feasibility, and, were evaluated according to environmental, land use, financial, and community criteria. The evaluations results are as follows:

- Donald to Golden: The existing highway would require reconstruction to meet vertical criteria, and two additional westbound lanes should be located uphill and adjacent to the existing alignment. Seven interchanges would be required and, between them, frontage roads to serve local properties. The west approach to the Donald Bridge would require realignment to reduce its grade and accident potential. Total estimated construction cost for this 32.2 km section was $264.9 million.

The West Bench route would require two diamond interchanges to accommodate existing logging and recreation traffic, and would require a number of mitigation measures to reduce environmental impacts. This route's greatest advantage is that its alignment is not constrained by existing transportation facilities. The West Bench/Blaeberry/Existing route option was estimated to cost $195.2 million, whereas the West Bench/Edelweiss option was estimated to cost $217.2 million. Right-of-way for both West Bench options falls primarily within Crown lands.

- Town of Golden: The existing highway should be upgraded to a four-lane arterial in the short term.

  In the long term, the South Bypass option is considerably more costly ($199.7 million) primarily because it is, at 13.6 km, five kilometres longer than the North Bypass, and would require more retaining walls and viaducts. It also would require mitigation measures to reduce the impacts upon fisheries and wildlife in the area, and upon the recreation area (Reflection Lake) south of Golden.

  The North Bypass route has a smaller length of steep grades, is shorter in overall length, and offers relatively easy construction. This option intrudes upon existing and potential residential development areas in the Hospital Creek Valley and an interchange near the Gareb Road subdivision would have a significant impact upon existing residential and commercial properties. Total construction cost for the North Bypass was estimated at $90.2 million.

- Golden to Yoho National Park Boundary: Generally, both sides of the Kicking Horse Canyon offer similar geometry for an alignment, so that extensive tunnels, viaducts, bridge and retaining walls would be required for both route options in order to achieve freeway standards.

  The North Side route has higher costs associated with it ($659.7 million) because it would require more viaducts and tunnels, its alignment has higher risks for interfering with CPR operations, and it would require complete rerouting of traffic during construction.

  The South Side route would require considerably more retaining walls, but fewer viaducts and tunnels than the North Side. Part of this route passes through a potential slide zone which would require further study. The possibility of requiring an extra tunnel to bypass this hazard would boost the projected cost for the route, beyond the estimate of $574.3 million. This route intrudes upon a wilderness area, and could conflict with the future development in this area.

The recommended route is as follows:

- From Donald to Golden: Re-align the highway along the West Bench from the top of Donald Hill to Blaeberry, then reconstruct the existing highway from there to Golden.

- Golden Area: In the short term, improve the existing highway to a 4-lane arterial with at-grade intersections. In the long term, construct the North Bypass.

- Kicking Horse Canyon: Construct the South Side route with a high-level bridge across the Kicking Horse River near the west end of the Canyon at Golden, and a low-level bridge approximately 4 km west of the Park boundary to bring the alignment back to the north side.

Several environmental studies to be conducted prior to construction were identified, as were mitigation measures to address environmental/land use and community impacts.

The Route Study identified a subsection of the study area to receive detailed functional design. The 3 km section immediately west of the Yoho National Park Boundary was suggested as a location for passing lane construction. The functional design phase also included a preliminary design and feasibility study for the three alternate locations for the interchange near the Gareb Subdivision in Golden.

Design Criteria

The Terms of Reference for the study called for an Expressway standard in the short term, with frontage roads.

Eventually the Trans Canada Highway could be upgraded to a Freeway classification, involving the conversion of at-grade intersections to grade-separated interchanges.

Design Criteria

Classification:	Rural Divided Expressway
Design Speed	110 km/h desirable, reduce to 100 km/h in sections where cost is prohibitive.
Paved Lane Width:	3.7 metres
Median Width:	2.6 metres minimum
Superelevation:	0.06 m/m maximum
Maximum Grade:	6%

Future Interchanges

Direct Ramps	Design Speed: 60 km/h minimum Maximum Gradient: 6%
Loop Ramps	Design Speed: 40 km/h minimum Maximum Gradient: 8%

Climbing Lane Requirement

The Highway Capacity Manual was used to assess the need for climbing lanes, based on 1991 Summer Average Daily Traffic Counts and a 3% growth in traffic to the year 2011. It was determined that climbing lanes were not needed to maintain level of service C in the year 2011.

Horizontal Curvature in the Kicking Horse Canyon

The rugged terrain in the Kicking Horse Canyon places severe restrictions on highway alignment.

A feasible alignment which matches this topography, may mean that sharper than desirable horizontal curvature must be incorporated into the final design. This, in combination with a concrete median barrier, would restrict the sight lines and safe stopping distance. It may however be possible to relax safe stopping distance requirements at the median barrier because it is unlikely that an obstacle would be encountered by a vehicle in the inside lane.

In view of the impracticality of providing horizontal curves with radii in excess of 2,200 m in the Kicking Horse Canyon, it was recommended that an analysis be carried out to assess the risks associated with the use of smaller radii curves. This analysis should compare the probability, severity and cost of accidents which may occur in two situations:

- when a median barrier is installed which results in reduced stopping sight distance, and accidents may occur due to obstacles on the highway.
- when no median barrier is installed and stopping sight distance is adequate, but median crossover accidents may occur.

Overall Geotechnical Constraints

The constraints imposed by geotechnical conditions are far less severe in the Columbia River Valley than in the Kicking Horse Canyon. In the Columbia River Valley, there is opportunity to avoid adverse ground conditions by moving the alignment to a more favorable location. In the Kicking Horse Canyon, the alignment is so tightly constrained by the severe topography that almost no opportunity is available to improve adverse geotechnical conditions.

A geotechnical investigation was carried out, and the findings reported in the "Trans Canada Highway Geotechnical Assessment for the Route Selection Study", (May 1992), which was submitted as a separate volume.

DONALD STATION TO YOHO NATIONAL PARK
COST REDUCTION REVIEW & PROJECT MANAGEMENT RECOMMENDATIONS
SNC - Fenco Inc., November 1993

The total cost for constructing a new highway to freeway standards, from Golden to Yoho Park Boundary, a distance of approximately 24 km, was close to $600 million [as estimated in the SNC - Fenco Route Study]. This amount was far in excess of what the Ministry had anticipated. SNC - Fenco was therefore requested to review their findings and investigate ways of reducing construction costs.

The Route Study options were amended in various ways. Profiles of the north and south alignments were adjusted to maximize the use of the existing highway between Yoho and Park Bridges. The median width was reduced from 5 metres to 2.6 metres, and costs were compared for 4-lane versus 2-lane construction.

The Golden to Roth Creek [1.5 km east of Yoho Bridge] alignments on the north and south side were adjusted to tie into the existing highway at the top of the hill directly east of Yoho Bridge. The design speed was reduced from a 110 km/h standard to an 80 km/h standard at the tie-in point. Whether the final decision favours 4-lane south side construction or a 2-lane north / south side construction split, there will be a one kilometre section of existing highway that will require widening to 4 lanes at an estimated cost of $11.7 million.

The reported savings as a result of changes are as follows:

Alignment	*Cost Saving*
4-Lane South Side	$23.3 million
2-Lane South Side	$9.4 million
2-Lane North Side	$12.5 million

These are not large cost savings relative to the total cost of the work, and it may be argued that they do not justify the lowering of the design speed to 80 km/h, especially if the section lies within a generally higher speed zone.

The Roth Creek to Yoho Park alignments on the north and south side of the canyon were also adjusted to tie into the existing highway. The 110 km/h design speed was maintained.

No significant savings were found on either of the two options. Using the south side option it is possible to maintain 1 km of the existing 4-lane highway. A 6% grade will be required to reach the proposed tunnel portal. Any saving gained by utilizing the one kilometre section of existing 4-lane highway was lost by an increase in excavation required to reach the tunnel portal.

The north side alignment would leave the existing highway at Roth Creek at the start of the existing 4-lane section. Moving this location further east would result in having to lengthen the tunnels leading up to the bench along the north bank of the river. Therefore, no cost reductions can be realized.

The average cost saving associated with reducing the median width to 2.6 metres is $0.8 million per kilometre. This is a relatively small cost saving when compared to the overall capital cost. SNC - Fenco do not believe that the potential saving warrants a reduction in the design standards which could result in a reduction in safety, except in short sections where the cost difference could be large and the lower standard could be tolerated.

The 4-lane north and south alignment quantities were recalculated using a 2-lane design template. The findings were as follows:

Alignment	*Length*	*4-Lane*	*2-Lane*	*Difference*
SOUTH	23.9 km	$614.1 M	$421.9 M	$192.2 M
NORTH	23.1 km	$674.9 M	$423.4 M	$251.5 M

In summary, the cost to construct a 2-lane highway was estimated at ± 65% of the cost to construct a 4-lane highway.

The profile on the south side of the Kicking Horse Canyon was adjusted to achieve a better material balance. In general, the grades were raised, increasing the structure and retaining wall costs but decreasing the excavation, overhaul, slope protection and special slope protection costs. The profile adjustments reduce the alignment aesthetics but result in a significant cost reduction.

South Side [Unadjusted, 2.6 m median]	$607.5 M
South Side [Adjusted vertical alignment, 2.6 m median]	<u>$512.9 M</u>
COST REDUCTION	$ 94.6 M

In addition, earthwork quantities were reduced by over 4 million cubic metres.

It had been suggested that a lowering of the design speed, combined with rolling grades, might result in further savings. Based on work to date it does not appear that this would be very significant.

With certain qualifications, three scenarios were recommended:

Scenario 1: Build a new 4-lane highway on the south side of the Kicking Horse Canyon. This could be done without interference from traffic which would continue to use the existing highway. This is the highest total immediate cost solution. It could take at least five years to complete depending on the rate of expenditure considered feasible.

Total cost:	$512.9 million

Scenario 2: Build a new 4-lane highway on the south side of Kicking Horse Canyon, from Golden to Roth Creek, joining up with the existing highway at Park Bridge. At the same time make immediate but minor improvements to the existing highway from Park Bridge eastwards to the top of the 8% grade. This would relieve operational problems on the section and improve safety. The present design speed of 80 km/h would not be increased.

This could be considered as Phase 1 of the total project and would cost $256.1 million, plus $12 million for the improvements to the section east of Park Bridge. The old highway west of Yoho Bridge could be closed, or limited to local access.

Phase 2 would be the construction of the section between Park Bridge and Yoho Park Boundary, also to four lanes. This would cost $256.8 million, but the decision to proceed could be delayed to limit the rate of expenditure on the total project.

Phase 1 cost:	$268.1 million
Phase 2 cost:	$256.8 million
TOTAL:	$524.9 million

In essence, this is the same as Scenario 1, but allows for a reduced immediate expenditure commitment.

Scenario 3: Construct a 2-lane highway from Golden to Park Bridge on the same alignment as the 4-lane design in Scenario 2. Improve the section eastwards at minimum cost as described in Scenario 2. Construction of a 2-lane highway on a four lane alignment will cost approximately 65% of the 4-lane design. A 2-lane tunnel would be constructed and twinned in the future. Bridges would be built as 2-lane structures on foundations and piers adequate for future four laning. Passing sections could be provided, at a relatively small cost.

The estimated cost for this work is $179.6 million, together with the $12 million cost for upgrading east of Park Bridge, for a total cost of $191.6 million.

Phase 2 would construct a new 2-lane highway with a 110 km/h design speed between Park Bridge and the Yoho Park Boundary, and would cost an additional $166.4 million.

Phase 1 cost:	$191.6 million
Phase 2 cost:	$166.4 million
TOTAL:	$358.0 million

It has been suggested that if a new 2-lane facility were to be built initially, it could serve one direction of travel, with the old highway serving the opposing traffic at a lower speed. In the winter the new 2-lane facility could be used for both directions of travel, and the old road could be seasonally closed as traffic volumes in winter are lower than in summer. In general, this may be possible provided the tangent sections are constructed with a crowned roadway instead of a crossfall normally used on a one-way side of a 4-lane facility. New alignment signing could be done for the two-way traffic conditions. One way operation would have to tolerate a yellow centre dividing line, which may require special advisory signs to remind users of the unusual markings, and precautions necessary to prevent wrong way movements.

SNC -Fenco recommended that Scenario 3 be adopted, in view of the Ministry's desire to minimize the initial expenditures, with Phase 1 being implemented first. This will give the greatest flexibility while providing a new facility to high alignment standards, designed for future 4-lane capacity.

FEASIBILITY STUDY OF TUNNEL ALTERNATIVES
HIGHWAY 1 - GOLDEN TO YOHO BRIDGE
Thurber Consultants Ltd, August 1986

The terms of reference were as follows:

- determine where it would be feasible to tunnel and avoid hazardous locations, facilitate construction and/or give improved highway alignment.
- set out conceptual alternative alignments that would result from the use of tunnels.
- prepare conceptual tunnel designs and preliminary cost estimates.

The report investigated the use of tunnels to provide alternative alignments for the upgrading of Highway #1 to a 4-lane divided standard through the most constricted section of the Kicking Horse Canyon. The study section extended from the junction with Highway #95 at Golden to the Yoho Bridge crossing of the Kicking Horse River, a length of 9 km, along the north slope of the Kicking Horse Canyon.

A functional design including preliminary data collection, site characterization, and the design of tunnels including alignment, excavation, temporary support and permanent construction, together with preliminary cost estimates. The published regional geology was detailed for the site based on field inspections that concentrated in mapping of highway and railway exposures. Bedrock units were established for exposures on the highway and systematically examined to produce a rock mechanics assessment for each unit. Strategies for alternative alignments through the study area developed.

Rock mass classifications were developed for the rock units based on field observations, laboratory testing, and the inspection of cores.

The existing highway is exposed to the physical hazards of avalanche, debris flow and rock falls. The upgrading of the highway to a 4-lane divided standard would face difficult problems in design and construction given the adjacent dilated rock bluffs, landslide terrain, steep slopes, the proximity of the CPR main line and the need to maintain highway traffic. Three alternative alignments were developed to minimize exposure to physical hazards and to areas of more difficult design and construction.

Typical rock units were delineated and rock mass classifications were developed. Tunnel excavation, temporary and permanent support requirements, were then developed for the rock units. Tunneling requirements were found to vary from top heading and bench excavation with shot-crete and bolt support in the roof for good rock, to multiple heading and bench excavation with steel sets and shot-crete support in very poor rock. Tunneling was found to be feasible at all locations. The extent of very poor rock in the deformed lower Glenogle Ogl could vary and will require detailed geology and drilling for further definition.

Tunnel portals were considered on a site specific basis. Overburden conditions are generally good with shallow cover of stiff soils with limited seepage. However, the geometry of some portals is difficult.

The preliminary tunnel designs meet alignment standards of 380 m minimum curve radius and 6% maximum surface gradient and 2% maximum adverse tunnel gradient. In particular, the use of tunnels would allow the gradient west of Yoho Bridge to be reduced to 6% or less. The completed tunnels would have an 11.3 m wide opening for two lanes of traffic, ventilation installations for larger tunnels, lighting, pavement heating near the portals and emergency services. The interior finish would be a combination of exposed shotcrete and formed concrete.

Each of the three alternative alignments could be utilized in a variety of schemes. Schemes that would reduce initial capital cost include having single 2-way traffic in a single tunnel and having all or part of the eastbound traffic on the surface. The tunnels vary in length from 170 m to 1330 m.

The alternative surface and tunnel alignments cannot be compared until the surface grade components have been evaluated as to construction feasibility, exposure to physical hazard, driving quality, and cost. The cost of individual tunnels cannot be considered in isolation without weighing the benefits that might accrue in construction of the attendant surface grade.

PASSING LANE STUDY, YOHO NATIONAL PARK

Dr. John F. Morrall, Department of Civil Engineering, University of Calgary, 1987

Phase II of the Western Trans Mountain Parks Highway Study was followed by this study. The objective was to evaluate the impact of passing lanes on the traffic level of service on the Trans Canada Highway in Yoho National Park. Specific objectives included the determination and number of passing lanes required as well as the development of preliminary design guidelines, including those for geometric design, roadway markings, and informational and regulatory signs.

Independent traffic forecasts based on historical records maintained by Parks Canada were developed for the design year 2005.

Three independent methods were employed to determine the quality of traffic flow in the design year (2005):
(i) the 1985 Highway Capacity Manual method
(ii) a traffic flow simulation model [TRARR]
(iii) an analysis of passing opportunities based on the Unified Traffic Flow theory model.

All three methods were employed because the theory of traffic flow on two-lane highways and measures of the level of service are still in the evolutionary stage. It was also noted that the 1985 Highway Capacity Manual does not allow for the evaluation of the impact of passing lanes on the level of service.

Reference documents included:
- The Arterial Highway System - Report No. 23 - A background paper for the Four Mountain Parks Planning Program by J.G. Rouse, January 1984.
- The Western Trans Mountain Parks Highway Study, Phase II.
- Proposed Improvements to the Trans Canada Highway in Banff National Park, Sunshine Road to Jasper Highway - An Initial Assessment, by Public Works Canada, August, 1985.
- Design Guidelines for Passing Lanes in the Mountain Parks by John F. Morrall, 1986.

The level of service definitions were taken directly from the 1985 Highway Capacity Manual. For the calculations the following assumptions were made:
- A directional split in traffic of 50/50.
- The terrain was considered "rolling" rather than "mountainous", although the "big hill" at Field has a significant impact on highway operations. A specific grade analysis was undertaken for the Field Hill.
- A design hour volume of 12% of the AADT was used. A common method is to use the 30th highest hour. A Public Works Canada study noted that the 30th highest hour is about 20% of the AADT.
- Base year (1985) AADT = 3,000
  Base year (1985) SADT = 6,160
  Growth Rate = 2% compounded annually

- Based on these assumptions traffic forecasts for the study were as follows:

YEAR	*AADT*	*DHV*
1990	3,310	400
2005	4,460	540

- The traffic composition was evaluated as follows:

autos and light trucks	88.8%
trucks	4.4%
recreational vehicles	6.0%
buses	0.8%
Total	100%

A separate level of service analysis was made for data collected during peak summer conditions. Average daily traffic for July 1987 at the Banff/Yoho boundary was measured at 7,200 with an overall directional split of 52/48 westbound/eastbound. Vehicle composition was 26.5% recreational vehicles, 6% trucks, 0.5% buses and 67% cars and light trucks.

Conclusions

The study showed that the three independent methods all indicated that the Trans Canada Highway in Yoho National Park could provide a level of service 'C' for the design year 2005, with the exception of the 'Upper Canyon' in the westbound direction from Wapta Lake to the junction with the Yoho Valley Road.(Level of service 'C' was selected as the threshold value for the purpose of identifying a highway section of inadequate capacity).

In order to ensure that the life of the highway as a two-lane facility is extended as long as possible, passing lanes were proposed at four westbound and six eastbound locations. The addition of the passing lanes will ensure that less than 60% of the traffic will be in platoons for the design year design hour volumes. The addition of passing lanes will also raise the percent of the highway available for passing to 50%.

Any immediate improvements in the upper canyon should be made only with adequate provision for twinning at a later stage. In order to improve the level of service and safety on this section of highway the following changes were recommended:

- Re-locate the Yoho Valley Road further to the west, or grade separate.
- Eliminate eastbound left turns from the Trans Canada Highway to the Spiral Tunnel viewpoint, and construct a car park for eastbound traffic on the old railway grade with grade separated pedestrian access to the viewpoint.
- Upgrade this section of highway from two to four lanes.

CONCEPTUAL STUDY OF TRANS CANADA HIGHWAY TWINNING THROUGH YOHO NATIONAL PARK

Reid Crowther, Golder Associates, Lombard North Group, Thurber, Haggerstone & Associates, September 1994

This Engineering Reconnaissance and Environmental Scoping Study was the first in a series of studies of the Trans Canada Highway Corridor through Yoho National Park. It was a conceptual study to be used as a reference document for the planning and implementation of future studies. It was hoped that it would ultimately recommend a set of well defined, balanced terms of reference which addresses the concerns of the environment, the visitor, highway safety, and cost. It was carried out by Reid Crowther, in association with Golder Associates, Lombard North Group, Thurber, and Haggerstone & Associates. It was completed in September, 1994.

Through the Mountain Parks, the Trans Canada Highway provides most visitors with their only Park experience. A mix of through-traffic, and visitors who often wish to travel at a more leisurely pace and to make frequent stops, and the annual traffic growth in the order of 3%, are the major reasons for the longer and more frequent periods of congestion during summer months, increasing accident rates and traffic induced stress.

Traffic forecasts confirm that twinning of the Trans Canada Highway from Banff to Revelstoke will be required by the year 2005 if current, nationally accepted capacity and safety standards are to be maintained.

The Trans Canada Highway is only one of several human developments and activities within the Kicking Horse Valley and adjacent ecosystems, e.g. CP Rail, Field townsite, Emerald Lake and Yoho Valley access roads. While the science of examining the environmental impacts of a single development or activity in isolation has been practiced for some three decades, the ability to predict consequences of multiple activities on an ecosystem(s) is poorly developed. This gap in our understanding of the sensitivity, tolerance and adaptability to changes in natural ecosystems is even more critical within the National Parks than elsewhere because the Parks were originally set aside in perpetuity to be protected, conserved and enjoyed by future generations.

The Rocky Mountain District National Parks are attempting to bridge this gap by use of a process known as "Cumulative Impact Assessment". It is anticipated that predictive models of the significant watersheds will be available within the decade to help managers and other decision makers understand some of the consequences of decisions that will change or increase human use.

In the short term several projects will begin to develop data bases that will facilitate cumulative impact assessment.

- The Yoho National Park ecological land classification update.
- The limits of Acceptable Change Exercise for the Yoho Valley.
- A study of protected biodiversity in the Beaverfoot Valley.

- A fire management strategy leading to an overall vegetation management strategy.
- Continuing focus on the Grizzly Bear and other top predators as indicators of ecosystem health is an ongoing research program involving three National Parks and the Province of British Columbia.
- Surveys of visitor satisfaction and concerns.

The broad objectives of the study were:

- to indicate where additional lanes might be located relative to the existing highway.
- to suggest major and minor points of access and turn-arounds for service vehicles.
- to prepare an environmental scoping document and to identify data deficiencies and additional studies required for the EARP process and final design.
- to prepare a geotechnical overview of conditions along the highway and to identify potential problem areas.
- to identify impacts to the visitor experience attributable to highway twinning; and, to identify options that preserve or enhance visitor experience.

Land takes are to be minimized through critical ecosystems; environmental considerations and the Park experience are of primary importance. For the most part, the new lanes are to parallel closely the existing highway; and, where possible, the highway should embrace the philosophy of Parkway design.

To provide all participants with opportunities to contribute to this study, the work program developed as follows:

- The engineers, in the first instance, developed a route location on photo-mosaics which recognized the broad environmental constraints of highway construction within a National Park setting. Conceptual schematics showed the location of the new lanes and the type of median proposed, possible interchanges and other points of access. This information was submitted to other team members and Parks Canada staff for initial comment.
- Concerns, ideas, suggestions and comments were received at meetings in Yoho and Calgary. With this input and deficiencies noted during a site reconnaissance, the plans were modified and again circulated for further comment. This iterative process continued until the proposals shown in the report were generally acceptable to all concerned.

The report was organized in four parts:

Part 1 - *The Highway* sets out broad design principles and design standards, discusses safety, access and operations, provides a brief overview of construction, and a Class D estimate of highway construction costs.

Part 2 - *The Visitor* discusses the access problems of a four-lane divided highway and suggests criteria which may form the basis of a system to identify need and location of future roadside amenities.

Part 3 - *The Environment* identifies potential environmental constraints, a scoping of data deficiencies, suggested mitigation and subjects requiring more detailed investigation.

Part 4 - *The Detailed Description* and strip maps describe the proposed alignment kilometre by kilometre, environmental assessments and comments, and existing and potential visitor facilities.

The Highway

The conceptual highway design, in the first instance, was developed with a narrow raised barrier median. This layout was progressively modified to the final proposal which incorporated sections with raised barrier median, wide depressed median, and one short section where the new lanes are separated horizontally and vertically.

Highway design principles and standards were discussed in broad terms. The design standards for the highway were based on the RTAC Manual of Geometric Design Standards with a design speed of 90 km/hr.

Parks Canada indicated a desire for a "Parkway Design. Given that, for the most part, the highway parallels the existing road, a Parkway Design will be difficult to accomplish.

Construction of the highway will not be overly difficult with the exception of the Upper Canyon of the Kicking Horse River, and the side-hill construction beneath Cathedral Mountain which will be complicated by the need to maintain traffic. Construction through the Wapta Lake area, the Kicking Horse Flood Plain and at river crossings will require controls to minimize erosion and siltation. A Class D estimate of construction places the cost of twinning through Yoho National Park at approximately $130,000,000.

The Visitor

Central to the visitor issues are the questions of access and potential noise. A four-lane divided highway, especially with a narrow raised barrier median, restricts opportunities to cross the highway. The option is to provide left-turn opportunities which in the longer term may require grade separations and service roads. These could be prohibitively expensive and totally out of scale relative to the facilities they are designed to serve. Alternative new parking areas with pedestrian underpasses would appear to be more appropriate and cost effective solutions.

The noise problem will grow with traffic volumes, and will have to be considered in future planning and design of visitor facilities.

The Environment

The Environmental Review identified potential constraints, scoped data deficiencies, suggested mitigation in some instances and identified subjects requiring further investigation. There are instances where the proposed wide depressed median appears to be in conflict with the environmental observation.

Biophysical, Cultural, Wildlife and Aquatic Resources are identified and discussed. There are several major environmental issues which have surfaced as a result of this. They include:

- Preservation of Habitat and Wildlife Corridors. The narrow raised barrier has been proposed in the past as the best solution because it has the smallest footprint and therefore minimizes land-take. Experience in Banff where the narrow median has been used, however, has been that the solid concrete barrier, continuous in the median and intermittent on the shoulders, impedes the cross movement of small animals and probably increases, directly and indirectly, their mortality rate. A more open barrier design may alleviate this problem (except in winter when snow is plowed against the barrier) but highway safety and maintenance costs, not to mention aesthetics, may be compromised.

  The decision to fence or not to fence the highway right-of-way within Yoho has yet to be made and probably cannot be made until there is a better understanding of wildlife and their movements. If the highway is not fenced, is the narrow raised barrier median appropriate despite its smaller footprint? And, even with fencing, is it the appropriate solution? Should use of this cross section be restricted to special environmental or topographical situations? Within Yoho, the choice of highway cross section may depend to a great extent on this decision.
- Loss or Disturbance of Wetlands in Sensitive Habitats, particularly along the valley floor. Restricted occurrence ecosites within Yoho need further site specific assessments as to whether they are rare within the contiguous Mountain Parks or just in Yoho.
- The Trading-off of Habitat for Enhanced Visitor Facilities. With increasing traffic volumes and the continuous noise during peak travel periods, will the existing visitor pull-offs, immediately adjacent to the highway, be satisfactory? Or, can quieter refuges be constructed? Also, where the four-lane highway eliminates access to an existing facility, can an alternative or complementary facility on the opposite side of the road be provided?
- Impacts on Wildlife Population of further resource harvesting or exploitation of the Beaverfoot Valley, future development plans of CP Rail and the proposals for enhanced visitor facilities at the Field Townsite.
- Slope Stability, Reclamation and Revegetation of disturbed terrain using native species. Future studies need to address the issues of continuing supply and planting. Strict conformance with Parks policy will require a secure and dependable supply of materials.... a process that could take many years to develop and one which must precede construction to be successful.

NATIONAL HIGHWAY POLICY STUDY FOR CANADA, 1990

This study was initiated in 1987 under the joint efforts of the Federal Government of Canada, the Provincial and Territorial Governments, and the Transportation Association of Canada. The objectives were:

- To set up the terms of reference, and to define a system of highways of national importance
- To establish minimum standards to which the highways/bridges should ultimately be constructed
- To determine those highways/bridges which are deficient in standard
- To determine the costs of a program to bring the deficient sections/bridges up to standards, and a recommended time frame
- To recommend an acceptable funding and cost sharing formula and mechanism

A National Highway was defined as a primary route that provides for the movement of people and goods by directly connecting a major centre in Canada with

- an adjoining province or territory
- a major port of exit/entry to the USA
- another transportation mode directly served by the highway mode

The minimum acceptable criteria for the National Highway System was outlined as follows:

- Geometric minimum - 2 lane Rural Arterial Undivided [RAU 100], with minimum 3.0 meter shoulder width of which 0.8 meter is paved
- Serviceability minimum - minimum operating speed of 90 km/h
- Structural capacity minimum - all weather highway capable of carrying national weights and dimension standards
- Rideability minimum - Riding Comfort Index [RCI] of 6 or greater

Design and maintenance guidelines for the National Highway System should ensure

- a high degree of uniformity in design, operation and aesthetics
- development and control consistent with the expectation of the highway user

A four priority criteria was identified for determining highway project priorities:

- safety
- highway strength
- highway service
- economic development, competitiveness and productivity

Policy guidelines for funding and cost sharing, and requirements for environmental impact assessment were included within the study.

The Trans-Canada Highway, and specifically the section between Kamloops and the Alberta border was designated as part of the National Highway System.

PROVINCIAL TRANSPORTATION PLAN
GOING PLACES - TRANSPORTATION FOR BRITISH COLUMBIANS
British Columbia Transportation Financing Authority, 1995

Transportation is critically important to the people, communities and businesses of British Columbia.
Increased personal travel has resulted in significantly more automobile, ferry and air traffic.
Increased goods movement has resulted in greater use of our ports, trucking and air services.

Provincial Limitations

In 1994/95, the province invested $1.2 billion on highways and subsidies to British Columbia's transportation Crowns. About $920 million was invested in highways, $246 million was invested in transit, and $36 million was invested in ferries. This is in excess of the approximately $1 billion per year the province collects from fuel taxes, motor vehicle license and registration fees, and highway tolls.

A good part of the infrastructure renewal problem we currently face is due to the deferral of regular maintenance, rehabilitation and replacement in the past. Doing nothing is unacceptable.

A "business-as-usual" approach will not suffice. The financial limitations facing all governments, and environmental and land use constraints, particularly in rapidly growing regions, demand new more innovative strategies, which are financially and environmentally unsustainable.

A New Approach

British Columbia needs a transportation system that:

- provides safe and convenient access for British Columbians and visitors to services, jobs and recreation.
- provides efficient access for industry to goods, resources and market.
- supports and reinforces the environmental, land use and economic development goals of the provincial and local governments.

Given the challenges and constraints, achieving this will require a new approach that emphasizes:

- making better use of existing facilities.
- giving priority to the movement of people and goods.
- integrating efficient land use and transportation plans.
- better integrating the transportation initiatives of different agencies.

- using more competitive and cost-effective methods to build and operate new facilities.
- using cleaner fuels and technologies for transportation.
- maintaining a competitive environment for air, rail, port and other commercial transportation services.
- recovering more of the costs of facilities and services from users.
- ensuring more openness and accountability in the development of transportation plans.

The Action Plan

This document proposes an action plan to manage demand, to conserve, as well as to provide new facilities. Key components of the action plan are outlined below.

A Comprehensive Travel Demand Management Program

Travel demand management (TDM) refers to a full range of measures aimed at changing travel behavior to make better use of existing facilities. It includes public education, regulations, legislation, incentives and facility improvements that encourage travelers to:

- shift from single occupant vehicles to ride-sharing, transit, cycling or walking;
- shift from peak to off-peak travel;
- reduce the number and/or length of trips taken.

Through the *Clean Vehicles and Fuels Program*, the province will be encouraging the use of cleaner burning vehicles and fuels to reduce vehicle emissions and improve air quality. TDM measures will complement this initiative.

New Transportation Infrastructure Investments

Even with efforts to make better use of existing facilities, new investments will be needed to meet our growing transportation requirements and to replace aging facilities. The province will undertake investments to:

- rehabilitate, sustain and improve the performance of existing facilities.
- expand capacity and improve service and safety on currently congested routes.
- relieve congestion in the rapidly growing Lower Mainland region.
- undertake and support the development of new facilities and initiatives to promote economic development and trade.

Maintain Existing Highway Facilities

- The province will construct intersection improvements, passing lanes, road realignments and bypasses to maintain service levels and improve the safety.
- The province will preserve the highway infrastructure through proper maintenance.
- The province will undertake bridge maintenance, rehabilitation, replacement and seismic upgrade.

Improve Service on the Trans Canada Highway

The province will upgrade Highway 1 from Kamloops to the Alberta border to improve safety and reduce travel times through areas of difficult terrain and congested sections in and around urban centres.

Trans Canada Highway Corridor Development

The Trans Canada Highway is the dominant east-west highway corridor linking British Columbia to Alberta and the rest of Canada. The highway also links communities in the province to each other and to the rest of the province, and supports resource development, tourism and other economic activity.

The portion between Kamloops and the Alberta border, is predominantly a two-lane highway. Traffic volumes are continuing to grow and, as a result, congestion during the summer months is resulting in significant delays and a relatively high incidence of accidents. In the winter months, the reliability of some sections in rugged areas is also of concern.

The long-term objective is to widen the highway to four lanes between Kamloops and the Alberta border. This will be phased in over a number of years. In the short term, the emphasis will be on passing lane development and the four-laning of sections that are most congested. Management of access and the development of complementary road networks to maintain the function of the highway will also be a priority in the short term.

In the medium and longer term, efforts will concentrate on addressing the bottlenecks and safety hazards faced in the more rugged sections of the highway, notably the Kicking Horse Pass and Three Valley Gap areas.

New Partnership Arrangements

The province's transportation plan calls for new partnerships with other levels of government, the private sector, and users.

New partnerships with other levels of government are needed to ensure that all governments and their agencies work together effectively and consistently in the pursuit of common strategies and goals. The province needs partnerships with the private sector to ensure plans are implemented in the most innovative and cost-effective way. New partnerships with users will be developed to increase accountability, particularly as beneficiaries and users are asked to contribute more to cover the cost of new facilities and services.

The Financing Plan

The province currently provides tax support to the BC Transportation Financing Authority, BC Transit and BC Ferries. These corporations will have to invest between $650 million and $700 million per year on average, over the next decade, to meet the transportation needs of British Columbians. The highway operating, maintenance and rehabilitation expenditures are in addition to these capital expenditures, there are also highway operating, maintenance and rehabilitation expenditures.

The province's goal is to finance capital and operating expenditures within the limits of its Debt Management Plan without increasing general taxes. To do so, the province will pursue the following measures:

- New sources of revenues from road users will be developed where the revenues are clearly tied to specific transportation improvements and, in the case of tolls, where free alternatives are available.
- Some costs will be recovered from direct beneficiaries of new transportation investments.
- Some of the increase in the value of Crown land resulting from new transportation facilities and services will be used to pay for the improvements.

Transportation-related services will be more aggressively marketed.

BRITISH COLUMBIA PROVINCIAL HIGHWAY PLAN, STRATEGY COMPONENT
Ministry of Transportation and Highways, June 1995

Provincial highways have long served the needs of British Columbians. Highways are the only transportation service that extends to virtually all places where people work, live or seek recreation. Provincial highways are used to travel to and from the province, to move people and goods between regions within the province, and for local trips. Provincial highways have played an important role in the economic development of the province, and have contributed, directly or indirectly, to the quality of life for every British Columbian.

Changing Goals for the Highway System

The provincial government, through consultation processes such as the Commission on Resources and the Environment (CORE), and the Protected Areas Strategy (PAS), has established up-to-date goals for the transportation system of the province. New growth strategies legislation also recognizes goals for transportation system providers. As the agency with primary responsibility for the provincial highway system, the ministry needs to translate these goals into specific objectives and programs to meet them.

This document represents a first attempt to address wide-ranging new goals, to establish performance criteria for the provincial highway system, and to address deficiencies that may exist now or in the future.

Meeting the Challenges Ahead

Difficult challenges face the province in the coming years, no less for the provincial highway system than for other areas of public service. Different challenges are faced in growing urban areas than in rural areas of the province. Visions for the future of highways and bridges must be tempered by the other claims on the public purse, and must also be sensitive to all the trade-offs needed in a complex and diverse society.

Completing the Plan Through Consultation

This document is the starting point for further consultation and discussion. Available data, expertise and input from others has been used to identify a vision for the provincial highway system and the actions required to bring it to reality. The result should be a technically sound link between the expressed goals of society and the highway transportation implications of meeting those goals. A dialogue is now possible in which all participants can test assumptions and understand outcomes, depending on the way goals are articulated and actions implemented. Completing the plan will take the efforts of all those who rely on the provincial highway system or who are affected by its operations.

What You Will Find in This Document

Challenges facing our highway system are identified. These include provincial goals and other pressures and trends. You will also find definitions and discussions of many issues related to highway planning.

The steps in the highway planning process are outlined. The important linkages between highway planning and other processes for planning and land use and settlement patterns are identified and discussed. Some of these linkages are still emerging.

The document contains a discussion of the performance criteria to be applied to the provincial highway system and how these relate to the goals established for the ministry. Basic statistics and maps of the provincial highway system form a starting point for later discussions. Maps and discussions are presented for the key performance criteria where data are currently available. The portions of the provincial highway system that are currently deficient, or are projected to be deficient in the next 25 years, based on selected criteria, are outlined.

The ministry can act through many different programs to improve the functioning of the provincial highway system. These programs are described. The descriptions include the purpose, component activities, outcomes and relationships to other programs, as well as the circumstances where the programs are most applicable.

The vision for the future is discussed, along with issues. New corridors that may be required are identified. For each existing corridor, a summary is provided of the planned actions. An overview of the next steps in the planning process is given. Consultation is key.

There are several appendices to this draft plan, which describe the background information and analysis that went into its preparation.

A bibliography is also provided for those interested in further reading in areas relevant to provincial highway planning.

A BRITISH COLUMBIA HIGHWAY STRATEGY
Ministry of Transportation and Highways, Draft, June 1994

This report sets out a Provincial Highway Strategy which is closely tied to regional economic development goals and the overall Provincial transportation strategy. The strategy takes a different form in each area of the Province - responding to regional needs, the current state of the highway system, and expected growth in population and economic activity.

For the most part, the highway system is operating effectively and is satisfying regional needs, and there are however critical segments of the system which are inadequate and fail to meet current or projected needs. The Trans Canada Highway east of Kamloops is in this group.

Highways of greatest concerns include:

- The Trans Canada Highway between Kamloops and the Alberta border.
- Virtually all highways in the Lower Mainland as far east as Langley and beyond.
- The Island Highway between Victoria and Campbell River.
- Highway 97 through the Okanagan Valley.

The Provincial Highway Strategy addresses transportation needs, and calls for more intense system management over the next 10 years, including initiatives in the following areas:

- Integrated planning and policy development.
- Support for growth management initiatives as a cooperative effort with other Provincial agencies and levels of government.
- Efforts to change travel behavior and promote transit usage.
- More effective driver education.
- Enforcement of traffic laws and vehicle weight and dimensions regulations.
- More effective information systems for drivers.
- Preservation of highway corridors through access management policy and other initiatives.
- Transfer of responsibility for sections of the highway system which are no longer serving a Provincial function.
- Support for incorporation of developed areas, and transfer of responsibility for local roads to new or expanded municipalities.
- Measures to protect long-distance travelers and truckers from major time loss caused by heavy commuter traffic on approaches to urban areas.

Some general observations are made about the budget implications of the strategy.

Highway system costs fall into three general categories:

- maintenance
- rehabilitation
- capital improvements

Based on past experience, there is a continuing need for $300 million per year in maintenance funding. There is an on-going requirement for $250 million per year for rehabilitation work -- repaving, bridge repair, traffic signals, construction of passing lanes and other minor improvements which are needed to keep the highway system functioning effectively. There is an additional short-term need for $60 million per year to support a bridge retro-fitting program which is designed to reduce loss of life and disruption in the event of a major earthquake.

The need for capital funding will average about $500 million per year, distributed roughly as follows:

Economic Development Region	Percent of Total Capital Investment
Region 1 - Vancouver Island/Coast	20 - 25
Region 2 - Mainland/Southwest	40 - 45
Region 3 - Thompson/Okanagan	15 - 20
All Other Regions	10 -15

The combined total of maintenance, rehabilitation and capital funding amounts to $1.1 billion per year. This $1.1 billion total is built on a needs-based strategy. It is also roughly equivalent to the Province's revenue from road users.

Corridor Strategy

Nine major corridors were identified including the Trans Canada Highway:

The Trans Canada Highway is recognized as the dominant east/west route through the Province, and backbone to the National Highway System. It is the principal inter-provincial truck route. It links all mainland communities in the province to the Lower Mainland, and handles commuter travel in the Lower Mainland and Kamloops as well as regional and inter-city travel.

The goals for the Trans Canada Highway are to keep the standard of service consistent with the route's function as a key inter-provincial link, and to ensure that the route's principal function is not compromised by local congestion caused by commuter travel.

The general strategy for the Trans Canada Highway is to add capacity between Kamloops and the Alberta border.

Short Term Objective

Improve speed and traffic flow to acceptable levels, address identified accident prone areas, and ensure the essential function as a reliable high speed route.

Short Term Strategy

- Incremental Upgrading
  - additional passing lanes
  - 4-lane curb and gutter construction through Golden
  - intersection improvements to increase through capacity and safety
  - resurfacing program to maintain ride and structural integrity
- Continued programs of rehabilitation and maintenance
  -develop a multi-year bridge rehabilitation or replacement program
- Access Management
  - rural sections - limit direct access to resource users, and require service roads where practical
  - urban sections - limit the extent of urban arterial standard and require service roads
  - Municipal networks - encourage development of alternate municipal routes in urban areas

Long Term Objective

Maintain traffic movement effectiveness at acceptable levels and address safety concerns. Prepare for increasing traffic volumes, and required 4-laning.

Long Term Strategy

- Corridor protection by acquiring additional right-of-way for eventual 4-laning where adjacent land is Crown owned, or being developed. Facilitate development of parallel alternative routes through urban areas. Apply access management principles as development occurs and when reconstructing or resurfacing.
- 4-Laning to provide capacity required to service traffic growth. By-passes of urban areas will be considered where the through component is significant and mobility is not achievable on the existing route.
- Major bridge replacement as technically required to support goods movement and ensure safety and reliability.

A TRANSPORTATION PLANNING OVERVIEW FOR THE PROVINCE OF BRITISH COLUMBIA
Delcan Corporation, October 1988

The immense size of British Columbia and the Province's non-uniform population distribution present transportation challenges. Seventy percent of the population is concentrated in the southwest, while the remaining 30% is spread out over the rest of the area. This factor, in conjunction with the rugged, mountainous topography and the highly indented coastline, adds to the complexity and cost of providing an effective transportation infrastructure for the Province.

Some of the key features of this Province's transportation infrastructure include:

- Over 46,000 km of Provincial roads;
- Approximately 7500 km of main line railway track;
- Year round, deep-sea ports at Vancouver (Canada's largest port in terms of tonnage shipped), Prince Rupert, New Westminster, Victoria, Nanaimo, Port Alberni, Campbell River and Powell River;
- A highly efficient coastal shipping network that includes tug and barge services and small coastal vessels;
- A highly sophisticated Advance Light Rail and Seabus System to accommodate commuter trips in the Lower Mainland along with conventional bus transit in the Lower Mainland and 35 other urban areas;
- A ferry system with one of the largest service areas in the world; the BC Ferry Corporation maintains a fleet of 38 vessels which carries in excess of 6 million vehicles and 17 million passengers annually;
- More than 200 land-based airports (including Vancouver International Airport, Canada's second busiest airport), 63 water-based facilities and 20 heliports;
- 5 Major rail companies, CN, CP, BCR, BNR and B.C. Hydro Rail.

Requirements for Continued Investment in Transportation Infrastructure

<u>Economic Growth</u>

The Royal Bank of Canada's Long-term Provincial and Industry Forecasts indicate that British Columbia's economy was expected to register a respectable real growth rate of 2.5% per annum during the five years to 1992.

<u>New Projects</u>

Development projects planned for British Columbia by both private industry and the various levels of government are scheduled for locations throughout the Province, and each will generate traffic and demands on the transportation system. Future transportation needs should be viewed in light of these developments.

Existing Infrastructure

Growth of the Province and the aging of the transportation infrastructure [bridges, roads, ferries, rail lines, airports, and transit] requires continued investment to facilitate the movement of people and goods throughout British Columbia.

Purpose of the Study

Large sums of money must be spent in the next several years to ensure that British Columbia's expanding economy and population continue to enjoy the benefits of well-maintained transportation systems. Where this money will be spent and on what systems in both the short and long-term requires careful consideration and a well thought out planning process.

This Study develops an on-going Transportation Planning Framework which the Ministry could immediately implement. At the same time, an overview of each discipline was prepared to identify issues and make recommendations on how these issues can be addressed within the Transportation Planning Framework at both the Provincial and Regional levels.

Methodology and Report Format

A multi-disciplinary study team carried out an overview analysis of each of the transportation modes. Economic factors which establish the need for transportation were also studied. Interviews with key people and agencies in the respective disciplines allowed the deficiencies and issues arising from each system to be identified.

In addition to the analysis of each transportation system, a Transportation Planning Framework was developed to provide an organization and a process which will allow the Province to formulate plans and priorities to deal with the deficiencies and issues that have been identified.

The report includes the Transportation Planning Framework and the Planning Overview of seven different transportation systems (Air, Coastal Transportation, BC Ferries, Highways, Ports, Rail and Transit) and eight Economic Development Regions. The report has been divided into 18 Volumes.

Volume 1: Executive Summary

Volume 2: A Transportation Planning Framework

This document includes a Transportation Planning Framework which brings together and co-ordinates the planning for the seven systems, and a Road Planning Organization and Methodology which establishes a framework for the planning function within the Ministry of Transportation and Highways.

Volume 3: A Provincial Overview

This document includes an overview of each system on a Provincial basis, summarized from Volumes 12-18

Volumes 4-11: Economic Development Regions

These documents (one for each region) provide a summary of each system for each Economic Development Region

Volumes 12-18: A Transportation Planning Overview

These documents provide a complete Transportation Planning Overview for each system.

Recommendations

Because the emphasis of this study was on the preparation of an inventory of trends, conditions and deficiencies, many of the recommendations identify issues or projects which require further study and analysis. There are also a number of areas where work can proceed in the short term which will be consistent with any long term strategy.

The report makes recommendations for each system of transportation on both a Provincial and Regional basis. At the same time it provides a "framework" which includes a transportation planning organization and procedure to address these issues.

Highways - Provincial Overview

There are common deficiencies evident on the entire Provincial Highway system.

- The northern Regions have structural maintenance problems resulting from the combination of heavy commercial traffic and extreme weather conditions.
- There are a number of at-grade rail crossings on Highway #16 which require grade separations. This highway also needs improvements to relieve congestion and safety problems in some of the Municipalities through which it passes.
- The Alaska Highway, which falls under Federal jurisdiction, requires upgrading and paving. Jurisdiction responsibilities still have to be resolved before this road is transferred to the Province.
- The Kootenays are plagued by alignment deficiencies resulting from the mountainous terrain and construction limitations. Highway #3 has many sharp curves and long grades which restrict travel speed. These curves and grades would be very difficult and expensive to improve.
- The Okanagan areas experience fluctuating seasonal traffic problems due to the significant increases in traffic volumes during the summer, and under-utilized routes during the remainder of the year. This is primarily applicable to the rural highway system; urban centres tend to experience daily commuter problems all year.

- The highways on Vancouver Island have frequent driveways, both private and commercial, along the majority of their facilities. These access points cause traffic congestion, accident potential and also limit the application of traffic management techniques.
- The Lower Mainland experiences extremely high traffic volumes due to daily commuting. The result is major congestion due to the limited capacity available on the existing facilities. The river and inlet crossing are a major concern because demand exceeds capacity for several hours of each day.

Provincial Recommendations

There are a number of corridors in the Province which are either already suffering congestion or will do so before the year 2000. In addition to projects which are ready to be implemented in the short term, studies need to be initiated to recommend improvements to these facilities in the longer term. These corridors include:

- Highway #'s 1, 4, 14, 17 and 19 on Vancouver Island
- Highway #99, Horseshoe Bay to Whistler
- Highway #97, in the Okanagan
- Highway #97, in the Caribou
- Highway #1, Kamloops to Alberta Border

Where economically feasible, alignment improvements and passing lanes should be incorporated on the arterial Highways to improve the level of service on these routes.

A program to eliminate the at-grade rail crossings on the trunk routes throughout the Province should be implemented, as funds become available.

Studies are required on the Highways which pass through urban areas to identify ways of relieving congestion through these centres, either by widening or finding alternative by-pass routes.

It is essential that the Province take steps to protect right-of-way where the need is verified by an appropriate planning study. Only in this way can the transportation system be implemented over the years as it is identified by the Transportation Planning Framework. If right-of-way is not protected, development will occur which may either block the transportation plan or make it prohibitively expensive.

The highways and rural roads should be studied to ensure that each route is properly classified. Some of the existing highways may better be transferred to the Municipalities.

It would be more effective to have all road funding under the Ministry of Transportation and Highways as this would provide for better co-ordination. It would also help the Ministry of Transportation and Highways to integrate the planning of roads in Municipal areas with that of the Provincial System.

Emphasis should be placed on proper maintenance of the road system. Minor improvements made at the appropriate time will provide a good return. Often when facilities are allowed to deteriorate too far they cost considerably more to fix later. It should also be kept in mind that, although new facilities are required, they add to the cost of maintenance and their need must be well justified.

A Pavement Rehabilitation Management Program should be put in place to address the problems of pavement deterioration with regard to heavy commercial traffic. The program would optimize the money spent each year to maintain an acceptable level of service in relation to the funds available.

Similarly, a Bridge Rehabilitation Program should be implemented to rehabilitate bridges for normal deterioration, strengthen existing bridges due to changes in legal vehicle configuration, and retrofit seismically deficient bridges.

A Transportation Planning Framework

The extent of the needs for new and improved transportation infrastructure clearly exceeds the financial resources of the Province in the short run. Accordingly, there is a requirement for a planning process or framework which optimizes the investment in transportation.

The seven different modes of British Columbia's transportation system presently have their own planning and operating organizations. They are also controlled by different jurisdictions including Municipal, Provincial and Federal governments.

The process required to deliver a component of the transportation system, such as a new road, bridge, ferry connection, airport improvement, etc., is an involved, multi-disciplinary, time consuming exercise. The identification of the need, development and evaluation of the alternatives, functional and final design, and construction often consume 5 to 10 years. There is a clear need for the optimization of the overall transportation system in British Columbia through an integrated, coordinated planning approach. There is a need for higher level co-ordination of the planning and deliveries systems of all modes of transportation within the Government of BC and its agencies in order to optimize the allocation of funds.

The interface between ports, rail and road are of strategic importance. Today, the emphasis is placed on transporting goods in the fastest and most economical means. The location of the facilities in each port and the ease of rail and road access to these becomes of prime importance. Careful integrated planning of port facilities in conjunction with road and rail access is needed.

With the deregulation of road and rail, freight will be competing more and more. Studies may be required to make sure one does not gain an undesirable advantage over the other through high or low taxes and user fees.

The Ministry of Transportation and Highways should have a planning framework which will identify requirements sufficiently well in advance so as to enable the planning, engineering, socio-economic, environmental and other studies to be completed in a well coordinated fashion. It also must co-ordinate the many modal systems so that there is no overlap and that the limited resources are used to the best advantage of the Province. It is therefore recommended that the Ministry implement a transportation planning framework which will integrate the planning of the total transportation system.

A transportation planning framework is both an organizational structure, and a process whereby the Government can be alerted to the factors influencing the Provincial transportation system.

A proposed Transportation Planning Framework Organization and Regional Planning Process is outlined within the report. [Figure 5.9]

Summary

This report outlines the issues which each of the transportation systems within the Province and economic development regions are facing today. It has made a number of recommendations regarding these issues. Some of these can be implemented immediately while others will require further study and analysis. It will now be necessary for the Ministry of Transportation and Highways to initiate a process to deal with these issues on a systemic basis. "The Transportation Planning Framework" recommended in this report provides both an organization and a process to do this on an on-going dynamic basis.

Exhibit 4.7 in Volume 6 and Exhibit 3.1 in Volume 15 recommend Highway 1 between Kamloops and the Alberta Border be a freeway by the year 2000.

Information pertinent to the Trans Canada Highway is illustrated on the next page. This information has been extracted from Tables 4.3 and 4.4 of Volume 6, "Economic Development Region 3, Thompson - Okanagan".

TCH Sections Experiencing Level of Service E or F [Table 4.3]

Economic Development Region #3

Route	*Location*	*No. Of Lanes*	*1987 LoS*	*2000 LoS*	*Probable Cause(s)*
1	17 km section 14 km E of Kamloops	2	D	E	High Volumes
1	17 km section E of Squilax	2-3	D	E	Alignment constraints
1	Through Sorrento Community	2-3	E	E	High Volumes, alignment constraints
1	Sorrento to Salmon Arm	2-3	D	E	High Volumes
1	Through Salmon Arm	2-3	E	E	High Volumes, multiple accesses
1	20 km E of Sicamous to Revelstoke	2-3	E	E	Alignment constraints
1	Revelstoke to Glacier Nat. Park W Entrance	2-3	D	E	Alignment constraints
1	Glacier Nat. Park W Entrance to 25 km W of Golden	2-3	E	E	High volumes, alignment constraints
1	25 km section W of Golden	2	D	E	High volumes
1	Through Golden to Yoho National Park	2-3	E	F	High volumes, alignment constraints
1	13 km section 11 km E of Yoho National Park W Boundary	2-3	D	E	High volumes, alignment constraints

TCH Sections Experiencing Problem and Major Problem Accidents [Table 4.4]

Economic Development Region #3

Route	*Location*	*No. Lanes*	*1987 LoS*	*Category*
1	Through Salmon Arm	2-3	E	Major problem
1	47 km E of Sicamous	2	E	Problem
1	Through Salmon Arm	3-4	E	Problem
1	14 km E of Glacier National Park W Entrance	3	E	Problem
1	E Gate Glacier Nat Park	2	E	Major problem
1	Through Golden	3	E	Major problem
1	10 km E of Golden	3	E	Major problem
1	Yoho Nat Park W Entrance	3	D	Problem
1	10 km E of Yoho Nat Park W Entrance	3	D	Problem
1	18 km W of Alberta Border	3	C	Problem

RECOMMENDATIONS OF THE REGIONAL TRANSPORTATION TASK FORCE FOR THE THOMPSON-OKANAGAN, July 1989

In November 1988, British Columbians were invited to participate with the provincial government in formulating a transportation plan for British Columbia. The objective of the planning process was to develop a strategic plan for the Province's transportation system which "creates a new era of economic development by building on the existing system and providing improved access to all regions of the Province."

The Province of British Columbia Strategic Transportation Plan 1990-2000, explored how best to direct future resources in building a transportation system which will take British Columbia into the next century.

A strategic transportation plan was needed because of the challenge of keeping pace with economic change. A balanced and comprehensive plan which allowed for rehabilitating, replacing, improving and expanding transport facilities was viewed as necessary.

Under the auspices of the Minister of State, regional transportation committees were formed in each of the eight Economic Development Regions. These committees were charged with the responsibility of preparing regional transportation plans with the following objectives:

- to determine the present and future transportation needs and priorities of the region
- to analyze issues and provide support documentation for recommended improvements
- to recommend to government a transportation plan for the region which includes short and long-term directions.

All modes of transportation, (air, marine, highways, rail, and transit) were considered in the review. The overall goal was to produce at a regional level a report identifying transportation priorities and initiatives. This regional strategic plan was to form part of the integrated Provincial Transportation Plan.

The Regional Transportation Plans were to reflect the views of each region and its residents. Community input formed an integral part of the process.

The Regional Transportation Plans were to be reviewed every year. Communities across British Columbia were to have regular, on-going co-opportunities to bring their views forward for full and open discussion. Regional Transportation Committee members were locally appointed and accessible year-round to meet people in their communities.

Public Hearings

Committee input was considered to be a crucial part of the process. This input was sought through written submissions and a series of public hearings held throughout the region. Coordinated by the Regional Development Liaison Officer, written submissions could be mailed in or presented orally at public meetings. The majority of the public meetings were chaired by the local M.L.A.'s serving the areas involved

Ministry of Transportation and Highways Regional and Headquarters staff presented a broad overview of the regional highways network, with a status report on proposed and on-going projects. Other modal systems serving the region were also overviewed. Representatives of the two national railways gave briefings regarding present rail development and future plans.

A joint meeting was held with the Kootenay Region Transportation Task Force to discuss mutual interests and shared concerns.

The report *A Transportation Planning Overview for the Province of British_Columbia* (Delcan Corporation, October, 1988), provided baseline information on the regional transportation system. Taking this report as a starting point, the Committee assembled additional information, identifying bottlenecks and future developmental thrusts for the road network serving the Thompson-Okanagan.

The Committee developed its own data base for assessing candidate projects. This included accident data, traffic counts and measures of utilization, project costs and scope of work, and status reports on the condition of various elements of the regional transportation infrastructure.

The Committee mapped out a strategic transportation plan for the region, a network which would serve the needs of the Thompson-Okanagan in the horizon year 2000. The task of setting priorities for improving the highway network, categorizing road sections and specific projects in terms of their short and longer term need was difficult. Over 130 individual highway projects were analyzed representing in the order of $2.7 billion worth or works. The Committee also examined local road concerns and broader policy issues.

What made this particular process and planning format unique was the utilization of the knowledge and judgment of citizens-transportation system users who live and work in the region.

<u>Existing Highway Network</u>

The Thompson-Okanagan Region has the most highly developed settlement pattern and framework of urban centers and linkages in British Columbia outside the Lower Mainland. The region is a locus of economic activity in its own right as well as serving as a corridor for travel and commerce passing between the Kootenay Region, Alberta and points east and the Vancouver area with its air, rail, water, and highway termini. The region also provides gateways to the United States, northern British Columbia and Alberta via the Caribou, Yellowhead and Trans Canada Highway Routes.

According to the Delcan report, without improvements in roadway capacity, the share of the regional road network experiencing unstable or congested service levels will increase from 25 percent of the network to 42 percent by the year 2000. This would account respectively for 34 and 40 percent of the congested and unstable conditions on the total provincial network by the year 2000. The Committee also observed that many of the road conditions in the region reflect a relative decline in spending for rehabilitation and betterment works.

The Committee noted that the Thompson-Okanagan has a large share of highways and bears a burden of inter-provincial and international truck and tourist traffic beyond that of other regions.

The Committee emphasized the need to not only catch up on deferred road rehabilitation and betterment projects but provide capacity for the traffic increases generated externally and internally. The Committee perceived a significant element in the "Freedom to Move" and "Quality of Life" equation to be the provision of safe roads.

The Committee emphasized the need for advancement and implementation of the National Highway Policy. A set of minimum design and operational standards was viewed as a desirable goal.

Immediate Priorities and the Year 2000 Strategic View

The Committee took a two-pronged approach in developing the regional strategic plan for the highway sector. Firstly, there was the immediate and short term need to deal with existing bottlenecks, summer traffic choke points and areas of high accident rates. Secondly, there was the need to look ahead to the year 2000, and formulate a strategic vision of what quality and capacity of network is required to serve future demand. This future demand will arise not just from regional growth and development of new industries and tourism opportunities but from corridor demands generated outside the region.

Immediate areas of priority include improving critical areas of the Trans-Canada Highway, Highway 3, and Highway 97. The Committee judged the most important projects to be as follows:

Highway 1:	Donald-Golden-Yoho section including Kicking Horse Canyon
	Choke points east of Kamloops and east to Monte Creek
Highway 3:	Whipsaw Creek
Highway 97:	Westwold-Monte Creek
	Osoyoos-Kelowna-Trans Canada Route 1

In the strategic longer term perspective provision of 100/110 km/h multilane highways between Kamloops and the Alberta border and in the Okanagan Valley corridor, Salmon Arm to Osoyoos, are priorities. Similarly, Highway 3 connecting the Kootenay Region

with Hope and the Lower Mainland should be brought up to standard with alignment improvements and passing lanes.
The Committee noted that the Delcan report recommended twinning of the Trans Canada Highway from Kamloops to the Alberta border; the need was acknowledged, but difficult terrain constraints would require eventual relocation on portions of new alignment.

The Committee, noting the large number of submissions dealing with maintenance, rehabilitation and improvement of local roads, saw a need to increase funding for upgrading of local and district roads. The Committee also supported and encouraged efforts to strengthen data collection and processing for network planning.

Proposed Projects

Approximately 1,400 kilometres of highway projects were considered by the Committee. Of this total, the Committee found 354 kilometres, estimated to cost $945 million, to warrant an immediate priority. Recognizing that some projects are less advanced than others in the implementation process and that design and land acquisition takes lead time, the Committee nevertheless felt that these immediate priority projects should be initiated as soon as possible. A summary of projects by priority rating is shown below.

Thompson/Okanagan: Highway Projects Summary

Category/Priority		*Cost Est. ($ Mil)*	*Distance (Km)*
A	Immediate priority	945	354
B	Project initiation 3 - 5 yrs.	333	159
C	Project initiation 5 - 10 yrs.	550	434
D	Projects as needed, feasible	789	395
	TOTAL: Categories A-D	2617	1342

In assigning priorities to individual projects, cost was an important issue in many instances.

A number of concerns related to other sections of highway and local roads were raised during public hearings. Because these sections are accounted for under normal programming for rehabilitation or paving, or in the case of local roads, would routinely be covered under district rehabilitation programs, these projects were noted by the Committee but assumed to be resolved under on-going programs.

Category A Trans Canada Highway Sections

Project Ident.	*Rte #*	*Section (From/To)*	*Km*	*Type of Work (rehab/improv/new)*
3H101	1	Campbell Crk-Monte Crk	9	Improv: 100 km Jr. Expy
3H102	1	Rte 1/97S Jct-Monte Crk	0.5	New:Interchange
3H103	1	Squilax Int.-Notch Hill-Sorrento	8.8	Improv: 100 km Jr. Exp.
3H104	1	Notch Hill-Blind Bay-Sorrento	1.6	Improv: 4/5 lane urb. Arterial
SUBTOTAL: Kamloops - Salmon Arm			19.9	

Category A (continued)

Project Ident.	Rte #	Section (From/To)	Km	Type of Work (rehab/improv/new)
3H111	1	Hospital Rd-Hwy 97B	4	Improv: 100 km Jr. Expy
3H112	1	Canoe-Annis-Sicamous	17.1	Improv: 110 km 4-ln Frwy
3H113	1	Sicamous Narrows-Stadnicki Rd	5.2	Improv: 110 km 4-ln Frwy
3H114	1	Malakwa-Revelstoke	50.6	Improv: 110 km 4-ln Expy
3H115	1	Columbia River Bridge	0.4	Improv: curve & bridge widen
3H116	1	Donald-Golden	24	Improv: 100 km Jr. Expy
3H117	1	Golden-East of Yoho Bridge	11.4	Improv: 110 km 4-ln Expy
3H118	1	Park Bridge	3.6	Improv: realign & Br. Constru.
	SUBTOTAL - Salmon Arm - Yoho		116.3	

Category B -Trans Canada Highway Sections

Project Ident.	Rte #	Section (From/To)	Km	Type of Work (rehab/improv/new)
3H121	1	Beaton Rd.-Alton	8.3	Improv: 100 km 4-ln Rural Art.
3H122	1	Monte Crk-Dry Crk	7.0	Improv: 100 km Jr. Expy.
3H123	1	Dry Crk-Pritchard	4.4	Improv: 100 km Jr. Expy.
3H124	1	Pritchard-Neskainlith I.R.	5.5	Improv: 100 km Jr. Expy
3H125	1	Neskainlith I.R.-Falkland Rd.	7.1	Improv: 100 km Jr. Expy.
3H126	1	Falkland Rd.- Chase Hill	6.6	Improv: 100 km Jr. Expy.
3H127	1	Chase Hill-Squilax	6.8	Imrpvo: 100 km Jr. Expy.
3H128	1	Blind Bay Rd-Santebin Lake	7.2	Improv: 100 km Jr. Expy.
3H129	1	Santebin Lake-Tappen	8.9	Improv: 100 km Jr. Expy.
3H130	1	Tappen-Switsemalph I.R.	7.0	Improv: 100 km Jr. Expy.
3H131	1	Switsemalph I.R.-Salmon Arm	8.2	Improv: 100 km Jr. Expy.
3H132	1	97B-Canoe	5.9	Improv: 100 km 4-ln rural Art.
3H133	1	Stadnicki Rd - Yard Crk.	8.0	Improv: 110 4-ln Expy.
	SUBTOTAL:		91.0	

Proposed Initiatives

A number of policy issues were raised at public hearings and considered by the Committee.

Signage and Safety Markings

The Committee recommended that in the interest of safety, cats-eye centre-line and shoulder/guardrail markings be used more extensively. It was also pointed out by the Committee that lane and centre-line markings within federal parks have not been conscientiously maintained.

The Committee also noted the need for better informational signs.

The Committee also noted the need for a greater number of scenic pull-offs.

Road Maintenance

The Committee expressed concerns over the shortfall in rehabilitation and repaving funds. To prevent deterioration of roads, maintenance should not be deferred. The Committee saw the need for more funding to rehabilitate and upgrade local roads.

Weight Restrictions

The Committee acknowledged the trade-offs between incremental costs for additional pavement strengthening and the additional costs to shippers during the spring weight restriction season. The Committee was of the opinion that major highways should be constructed to a standard which obviates weight restrictions.

Conclusion

The purpose of the strategic regional transportation plan is to serve the development objectives of the Thompson-Okanagan region. Maintenance, rehabilitation and upgrading of transport infrastructure reduce travel costs and friction to commercial and personal movement and expand travel alternatives. A corollary objective is the reinforcement of commercial linkages, both inter-regional and intra-regional. Components of this include the attraction of tourism revenues and the support and encouragement to manufacturing, agriculture, and resource-based industries.

The Thompson-Okanagan regional highway network serves not only the needs of its own population and resource base, but also offers a set of corridors for international and inter-regional traffic. Highways 1, 3, 5, and 97 are trunk routes of national importance. As pointed out in 1988 by the National Highway Policy Study Steering Committee, there is a need to bring this network up to a minimum standard in terms of operating speed, structural adequacy, and rideability.

Priorities include critical stretches on the Trans-Canada Highway between Kamloops and Salmon Arm, and Donald-Golden to Yoho. In the strategic network plan for the year 2000, four-laning of the Trans-Canada Highway from Kamloops to the Alberta border would be warranted.

Recognizing the additional burden which diverted rail traffic places upon the highway system, the Committee noted a federal responsibility deriving from National Transportation Act abandonment policy implying compensatory funding. Before such withdrawal of branch line rail service and abandonment of rail assets occurs however, the Committee would urge the provincial and federal governments to take policy measures which would render branch lines and short line operations more viable. These "Freedom to Move" measures include liberalizing property assessment and taxation policy at the provincial level, changing manning rules, and giving encouragement through interchange agreements which would sustain the customer/shipper base on these feeder lines.

FREEDOM TO MOVE - TRANSPORTATION IN THE 90's BRITISH COLUMBIA TRANSPORTATION PLAN

In 1988, the need for a plan to meet the challenges of the 90's was recognized and an inventory and assessment of the transportation system across the province was prepared. Eight Transportation Committees were set up - one in each of the Economic Development Regions.

These committees were to report on the short and long term transportation needs in their region, with an indication of the priorities for work proposed for the short term. Reports from these committees form the basis for a new Transportation Plan for British Columbia, a plan that recognizes regional priorities and strategies, and also provides a blueprint for future action. The primary thrust of this plan is to make the most effective use of our existing transportation infrastructure. New projects will focus on how best to move people and goods, not simply vehicles. Essential to the success of this strategy is increased and ongoing consultation with Crown agencies, other levels of government, communities and the public.

Freedom to Move - By Land

In B.C. there are 47,060 kilometres of provincial highways, 22,000 km are paved, 25,000 are gravelled. Our roads traverse some of the toughest terrain in the country. There are 2,700 bridges, 165,000 culverts, 104,000 sign posts, and an additional 19,000 km of roads under municipal jurisdiction. Traffic surveys have shown that although 85% of our roads are still operating at free flow, congestion is a major problem in certain areas - specifically the Lower Mainland, southern Vancouver Island, and in the Thompson-Okanagan area. In the North, heavy commercial traffic and severe weather conditions are the problem, not congestion.

Over 5,500 km of our roads are part of what should be designated a National Highway System. A study by the Roads and Transport Association of Canada has shown that it could cost up to $1.9 billion to bring these roads up to a uniform national standard.

In 1988, there were 1.8 million licensed motor vehicles in British Columbia (1.3 million passenger, 472,000 commercial and 15,000 motorcycles).

<u>Issues</u>

- Important components of the province's trunk highway system need upgrading to meet the demands of economic expansion and population growth.
- Many existing roads and bridges are nearing the end of their design life and will need major repair or replacement.
- Regulation of the use of roads needs to be improved in order to minimize damage and wear and tear to the road surface.

- North American highway design standards are in some cases higher than those currently used in B.C.
- Increased use of highways by pedestrians and cyclists has created a hazard that needs addressing.
- Secondary access roads to communities, industries, ports and airports need upgrading in many cases.
- There is a need to minimize environmental impacts associated with road construction.
- There is increasing demand to improve public input to the planning process for new roads and major improvements.
- In order to encourage economic growth and activity, goods need to be able to move efficiently both within and through communities.

<u>Blue Print for Action</u>

Substantial upgrading of the major trunk routes throughout the province should be given priority.

Improved access to isolated communities, scenic and recreational areas, and industrial sites should occur. There will be an ongoing role for the Regional Transportation Committees and public in the annual, medium term and long term planning activities.

New policy should be established to simplify the development and management of resource roads. Environmental and economic analysis should be strengthened in the planning process for transportation projects.

The Municipal Cost Sharing Programs should be reviewed to determine improvements that will be of benefit to the provincial and municipal road systems.

Specific goods movement routes should be identified throughout the province and necessary improvements to these routes should be undertaken. Transportation initiatives by other levels of government and by the private sector should be encouraged when these enhance or complement the provincial system.

<u>Progress Always Has A Price</u>

Through cooperative action with all levels of government and with the private sector, the province of British Columbia is committed to minimizing the price of progress.

British Columbia is committed to investing $3.5 billion in the province's transportation systems over the first five years of the plan. This commitment allows multiple-year budgeting and management of this investment, which brings several advantages:

- it contributes to the stabilization of the province's finances and the economy;
- it allows the efficient use of long term project management methods;
- it facilitates the allocation of investment funds among different transportation modes, encouraging integrated multi-modal projects.

To realize these advantages, the Freedom to Move special account has been established to fund transportation investment.

<u>Economic Development - Region 3 - Thompson-Okanagan</u>

The Transportation Committee for Thompson-Okanagan Region recommended 11 policy issues and 90 highway projects. Air, rail, transit and marine issues were dealt with primarily as policy issues, although specific support was given for several programs and specific projects that are underway or planned.

The highest priority projects, all involving highways, included:

- Highway 1: Donald-Golden-Yoho upgrading, and correction of specific choke points between Kamloops and Monte Creek;
- Highway 3: Whipsaw Creek;
- Highway 97: upgrading between Westwold and Monte Creek, and improvements to the Osoyoos-Kelowna section;

There is a belief that there has been a decline in maintenance and improvements to the traffic systems in recent years in the region. Thus, both deferred maintenance and new programs are needed. More and more traffic formerly carried by rail is shifting to truck, much of which passes through this region on its way to or from other destinations. The Committee fully endorses the concept of a National Highway System serving interprovincial and international transportation needs. The region's short term priorities expressed a need to deal with existing bottlenecks, summer traffic choke points and areas with high accident rates. The longer term priority is to ensure the provision of an adequate highway network into the 21st century. This includes upgrading Highway 1 to the Alberta border. The primary rail concerns relate to the continuing rail abandonment in the area and a desire, where abandonment cannot be stopped, to preserve the rail corridors for future transportation needs.

BRITISH COLUMBIA HIGHWAY FUNCTIONAL CLASSIFICATION STUDY
Highway Planning Branch, June 1992

The purpose of this document was to recommend a functional classification system for highways in the Province of British Columbia. Highway functional classification refers to the logical grouping of highways into classes according to the character of the service they are intended to provide. The character of service is largely dependent on the relative emphasis given to mobility on the one hand and access to land on the other.

The B.C. Transportation Plan indicated the need for a comprehensive functional classification system to provide guidance to planning. The recommended system should be sufficiently structured to provide a sound framework while being flexible and sensitive enough to meet individual regional concerns.

This study investigated and selected criteria to be used in determining the functional classification system. The criteria were applied to the provincial network, and highways of similar function were appropriately grouped. This process first identified the relative importance of each highway in relationship to other highways. This is considered the strategic component of highway classification, identifying the provincial perspective of the highway as it relates to mobility and access.

Once highways were grouped into classes identifying their relative importance the operational requirements were investigated by determining the travel demands on each segment of highway and then recommending the type of facility that should be pursued.

The correct balance between mobility and access is addressed through rural and urban planning standards which cover such issues as design speed, minimum average travel speed, access frequency, and right-of-way requirements. Highway capacity principles are used to recommend highway improvement strategies based on highway function and future traffic volumes.

Highway functional classification can be applied in planning, programming and designing highway system development, determining jurisdictional responsibility, fiscal planning, project priorities and the development of operation and service policies.

In order to recommend and defend transportation development strategies, capital programs and individual project priorities, long range highway system goals are required. A comprehensive highway classification system provides the framework within which to make these recommendations. Also, a highway classification system provides direction to Regions and Districts in the application of policy, procedures and standards.

With the recognition that efficient transportation of people and goods is of prime concern to the nation and that the highway transportation mode is of particular importance to all regions of Canada, a National Highways Policy Study established criteria and identified highways whose functions or characteristics warrant recognition in the national context, [National Highway Policy Study for Canada, Steering Committee Report on Phase I, 1988].

According to the National Highway Policy Study: Steering Committee Report - Phase 3, the "criteria adopted to select the national highway network are:

> A national highway is any existing, primary route that provides for interprovincial and international trade and travel by connecting as directly as possible a capital city or major provincial population and commercial centre in Canada with
> - another capital city or major population and commercial centre
> - a major port of entry of exit to the USA highway network
> - another transportation mode served directly by the highway mode".

The highway classification study incorporated the results of the national study as they apply at the provincial level. The highway classification system provided a framework to assist in the consistent and equitable application of maintenance guidelines. It helped to rationalize and prioritize the allocation of funding to maintain acceptable service levels, addressed the need to address changing public and government attitudes towards transportation, land use, economic development, the environment and recreation. Noise, air pollution and the transportation of dangerous goods are growing concerns. The safety of cyclists using the highway system is another area receiving increasing attention. The development of new transportation technology has led to a demand to accommodate heavier and longer trucks, and the need to conserve energy has led to the development of smaller and lighter, yet faster cars. Railway branch line abandonment is also an issue in B.C. as it creates a demand to accommodate heavy truck traffic for loads which historically were moved by railway. Access to resources and the administration and management of resource roads is another issue which needs to be placed into the context of provincial priorities.

All the above factors contribute to the need for a highway classification system.

Definitions and Concepts

Functional classification is the process by which highways are grouped into classes according to the character of the service they are intended to provide. Basic to this process is the recognition that individual roads serve travel as part of a larger network. It becomes necessary then to determine how this travel can be channeled within the network in a logical and efficient manner. Functional classification defines the nature of this channelization process and the part that any particular road should play in serving the flow of trips through a highway network.

Allied to the idea of traffic channelization is the dual role the highway network plays in providing access to property and travel mobility. Access is a fixed requirement, necessary at both ends of any trip. Mobility, along the path of such trips, can be provided at various levels, and is frequently measured by "level of service". It can incorporate a wide range of elements but the most basic is operating speed or trip travel times.

The concept of traffic channelization leads to a functional hierarchy of road classes. Higher functional classes serve larger activity nodes with the most direct routing. Smaller activity nodes may have less direct routing and would be served by a lower functional class of highway. Traffic channelization also leads to a parallel hierarchy of relative travel distances served by those classes. This hierarchy of travel distances can be related logically to a desirable functional specialization in meeting the access and mobility requirements. Higher functional classes will serve long distance to and through trips between activity nodes while lower functional classes will serve the shorter distance local trips. Local roads emphasize the land access function. Arterial roads emphasize a high level of mobility for through movement. Collector roads provide a balance between both functions.

Methodology

Highways are grouped into classes according to the character of service they are intended to provide. The methodology used in this report is as outlined in Highway Functional Classification: Concepts, Criteria and Procedures, U.S. Department of Transportation, March 1989 Version.

Rural highways were classified into five Strategic Classifications:

- Primary Highways
- Secondary Highways
- Major Roads
- Minor Roads
- Local Roads

The Trans Canada Highway is classified as a Rural Primary Highway.

Service Classifications:

- Freeway
- Expressway
- Arterial
- Collector
- Local
  - A
  - B
  - C

The Trans-Canada Highway currently has sections which serve as either an Arterial, Expressway, or Freeway. Future improvements are directed towards upgrading to a higher service classification.

CONGESTION ON B.C. PROVINCIAL HIGHWAYS - TECHNICAL REPORT
Highway Planning Branch, MoTH, June 1994

Highway congestion is a term denoting a range of traffic conditions which impede the users' desire to make trips at an expected level of comfort and mobility. The most commonly used technical indicator of comfort and mobility is the *Highway Capacity Manual*, which uses six "level of service" (LOS) definitions to define a range of conditions from LOS A, "free flow", through to LOS F, "stop and go", where the flow breaks down. The basic highway types (freeway, multi-lane signalized highway, 2 lane rural highway) and their components all have different measures which define LOS, the principal ones being density, average travel speed, flow rate, and various expressions of delay. Numerous conditions affect the calculation of LOS, including demand volumes, directional split of traffic, traffic composition, road geometry, grades, accesses, signal spacing/timing.

In B.C., minor congestion as defined as beginning at LOS D (the beginning of unusable flow), worsening to major congestion at LOS E, with "breakdown" at LOS F.
The degree of congestion can vary on an annual, seasonal, daily, or hourly basis. Urban areas are generally subject to recurring daily congestion. Congestion in rural areas typically takes the form of long queues on 2 lane highways, due to the lack of passing opportunity. This tends to occur during peak times of recreational and tourist activity. Congested facilities are capable of high vehicular throughput as volumes approach the capacity boundary, but they are much more subject to paralysis as a result of accidents and incidents. The impacts of congestion extend beyond driver frustration. Economic costs take the form of time delay and increased vehicle operating costs. Social and environmental costs are involved, but are difficult to quantify. Congestion can also have adverse effects on tourism and recreational travel.
Congestion on provincial highways compromises their function as carriers of longer distance trips. Congestion tends to worsen in parallel with continued population growth in urban areas and with continued high recreational activity in rural areas. Growth in travel demand has recently far outpaced transportation improvements.

1994 congestion on B.C. highways is illustrated in map format in this report and the methods used to quantify it are discussed.
The Trans Canada Highway, from the junction of Highway 97 east of Kamloops, through to the Alberta border, was noted as experiencing major congestion in 1994.

The traditional way to mitigate congestion has been to provide expanded highway infrastructure. Due to rising costs of construction, reduced funding levels, and concerns about social and environmental impacts, there has been recent interest in transportation systems management (TSM) and transportation demand management (TDM). TSM seeks to utilize available roadway capacity to the maximum potential. TDM seeks to eliminate unnecessary trips. Exploring all means of reducing congestion is now mandatory, but it appears that TDM/TSM initiatives will have to be balanced with the provision of additional highway capacity in order to control congestion as B.C. continues to grow in population.

A STRATEGY FOR BC PROVINCIAL WEIGH SCALES
ADI Limited, September 1995

This report and a companion report by B.C. Buildings Corporation, outlines a strategy for maintaining an effective Provincial Weigh Scale System. System requirements and capital costs over a 20 year period are summarized. The strategy is based on field surveys of existing scale facilities, the strategic role of each scale, the traffic a scale serves, the highway it protects, the level of enforcement required and economic developments in the region. Issues addressed in the report include program justification, location and need for permanent and mobile sites, strategies for long and shorthaul traffic and the role of new technologies. Strategies are presented on a corridor by corridor basis.

Program Justification

The present scale program includes 134 inspectors, 38 permanent weigh stations and 13 portable scales. Annual program costs are about $6.7million. Direct revenues from the program are approximately $13.6 million in fines and permits. The program saves an estimated $21 million/year in pavement and bridge costs and $4 million/year in accident costs.

Level of Enforcement

The level of enforcement in the Province is adequate but the distribution is not. On average, the probability of apprehension is about 5%. Longhaul traffic is typically stopped several times while shorthaul traffic may not pass a scale at all. A high proportion of shorthaul trips are made up of heavily loaded resource traffic, responsible for a disproportionate share of pavement damage and safety violations. To intercept the shorthaul component, the overall strategy includes moving away from static scales or more mobile enforcement as permanent stations are replaced.

Program Objectives

- Protect infrastructure.
- Ensure safe operation of Vehicles.
- Ensure Equitable enforcement to industry.
- Minimize cost to Province and to industry.
- Provide a service to the Public for purchasing vehicle permits.
- Ensure Driver/Operator Compliance and collect fine revenue.

Linehaul and Local Scales

The overall strategy classifies scale sites as linehaul or local scales. Physically they are similar but linehaul stations have the highest strategic priority and are intended to regulate longhaul traffic at the corridor level with 18 or 24 hour operation. Local stations operate in response to local traffic conditions and act as service points for locally based carriers.

Base of Operations

The base of operations concept is introduced as an option for replacing conventional scales with lower cost service centres in locations where a local presence is required but enforcement objectives are difficult to meet using a conventional static scale. This applies where there is a lot of local traffic unlikely to be intercepted at a single scale site and where longhaul traffic is likely to have been inspected at other sites and does not need to be stopped again.

In this concept, the local permitting and safety inspection functions are carried out at the base of operations while the enforcement functions are carried out by mobile units and partnering programs. Truck traffic does not normally enter the base of operations except for permitting, safety inspections and possibly self weighing, so the site and scale can be designed to a much lower standard.

Partnering and Mobile Enforcement

Partnering and mobile scales are successful strategies for regulating short haul traffic. Partnering and mobile scales provide more flexibility in a system where the effectiveness of static scales is often reduced by changing traffic patterns and urban encroachment. Partnering and mobile enforcement are not necessarily a replacement for local scales. Local offices accessible to trucks are still required around the Province as a service point for issuing permits, performing safety inspections and as a base for mobile operations. Issuing overweight permits in particular, requires the station to be accessible and have a scale. The key to successful partnering and mobile enforcement lies in providing the staff and the highway pullouts to conduct the programs.

The role of mobile scales is to provide enforcement in areas where traffic volume does not warrant a static scale or where local traffic does not pass a static scale.

Partnering programs appear to be working successfully in the Terrace area and should be pursued in other regions with a high concentration of local log truck traffic such as Highway 1, Golden to Revelstoke.

Capital Program

The recommended strategy identifies local and linehaul sites and the regional priority of needs. A rough cost estimate of $1.7 million/year for a 20 year capital replacement program should be offset by increased fine and permit revenue and improved enforcement.

Technology

The trucking industry in 10 years time will be a highly automated and service oriented industry. Weigh stations will need to make use of Automatic Vehicle Identification (AVI) technology to reduce the delay to commercial carriers and allow inspectors to concentrate on other safety issues. High volume or congested stations will also need to make use of weigh in motion (WIM) to increase their capacity. With AVI technology, delay to longhaul traffic is reduced and scales are free to concentrate on local traffic. At present there is no way to easily distinguish longhaul from local traffic and when a scale is open, all traffic must report.

Highway 1, Kamloops to Alberta

The Golden scale is a major port of entry to the Province and earns roughly $800,000 in permit and fine revenue annually. The recommended option is to close the scale to eastbound traffic to simplify access and site circulation difficulties and plan for a future eastbound scale in the Revelstoke area. A Revelstoke scale on Highway 1 would capture any traffic entering the corridor from Highway 5, the Okanagan by Highway 97 or Highway 23 and cover the large unprotected eastbound section of Highway 1 from Kamloops to the Alberta border. It would also reduce the need for a southbound Highway 5 scale approaching Kamloops. For the Golden scale, the longer term plan should be to relocate the scale in conjunction with development of the TCH through the Kicking Horse Pass in order to intercept trucks before descending the long grade into Golden.

The Kamloops scales are well located to capture traffic from a number of highways. These scales should be considered linehaul facilities with 24 hour operation and a high level of service and inspection capabilities. A southbound Highway 5 scale into Kamloops is not recommended. A new Revelstoke scale in conjunction with existing Kamloops scales would intercept regional traffic flows more effectively.

HIGHWAY TRUCK REST AREAS - TRANS CANADA HIGHWAY
Martin J. Davidson, April 1989

This report deals with a study of highway truck rest areas on the Trans Canada Highway from Calgary, Alberta to Revelstoke, British Columbia. The prime objective was to establish the requirements for future truck rest areas in light of impending hours of service regulation changes.

Research for this report was obtained through driver surveys, interviews with industry representatives and Government officials, and field observations.

Existing facilities from Calgary to Revelstoke vary in spacing from 1 to 39 km. Not all rest areas provide the same degree of service to the user. It is recommended that a roadside rest area be available in the direction of traffic flow every 50 km, and it should include a telephone, potable water and lighting. Major off road rest stops (commercial operations) should be provided every 150 km and services should be the same as those found at the roadside rest areas with the addition of fuel and restaurant services, long term rest areas and well defined parking. The practice of switching should no longer be tolerated within the boundaries of National Parks. It is conceivable that the trucking industry would accept Golden, British Columbia as a site in which to conduct the switching operations for trips between Vancouver and Calgary.

Both the driver surveys and truck traffic counts are suspected of having accuracy limitations, and it is recommended that comprehensive driver interviews and vehicle counts be conducted at mandatory truck stops (such as Government weigh scales) in the area of interest to strengthen the data within this report.

WESTERN TRANS MOUNTAIN PARKS HIGHWAY STUDY
N. D. Lea and Associates Ltd., 1983

Upgrading of the Trans Canada Highway is driven primarily by the increase in traffic volumes, by the projected increase in traffic volumes, and by the need to enhance the safety of the system. This study was commissioned in response to the following recommendation made by an Environmental Assessment Panel studying the proposed upgrading of the Trans Canada Highway in Banff National Park:

> That Transport Canada undertake such studies as are necessary to provide advice on various transportation options through the Rocky Mountains, in order that Parks Canada, Public Works and others are aware of possible future highway or other transportation demands on National Park lands.

Phase I identified the deficiencies in a highway network of approximately 5,600 km in British Columbia, Alberta and the six National Parks located near the B.C./Alberta border (Banff, Jasper, Yoho, Kootenay, Glacier and Mount Revelstoke).

Phase II provided advice on various transportation options through the Rocky Mountains, and then evaluated them in the context of federal/provincial jurisdictions and interests.

Phase II covered a network of 3,716 km of rural highway. What was referred to as the Mountain Parks Zone contained 1,274 km of highway in eastern B.C., western Alberta, and Jasper, Yoho, Banff, and Kootenay National Parks. Traffic forecasts were made to the year 2000.

Two types of deficiencies were identified; pavement surface and highway capacity. Pavement deficiencies were identified by estimating pavement deterioration based on the existing surface condition and pavement age. The levels of service on each highway section were calculated using the procedures established in the 1965 Highway Capacity Manual. Within the Mountain Parks Zone 20 capacity-deficient sections were identified.

Phase II included an economic analysis, directed at evaluating the potential costs and benefits to road users of improvements (4-laning or adding passing lanes) to the 20 capacity-deficient highway sections. Benefits were defined as savings in vehicle operating costs, accident costs and travel time as a result of the proposed improvements. Costs were defined as costs to design and construct the improvements and to maintain the facility, less any salvage value at the end of the analysis period. The analysis was done using the Highway User Benefits Assessment Model (HUBAM). The work included various sensitivity analyses.

The results of the economic analysis indicated that 16 of the 20 sections had a benefit/cost ratio of 1.0 or greater.

The following table lists the 20 projects in decreasing order of their benefit/cost ratio:

Hwy.	*Location*	*From*	*To*	*Length (km)*	*B/C Ratio*
3	B.C.	Southwest of Sparwood	Rest area at Sparwood	9.1	7.1
95	B.C.	Windermere Road	Golf Course Road	16.2	6.4
3	B.C.	Rest Area, Sparwood Jct.	Michel	6.7	5.7
3	B.C.	Michel	B.C./Alberta Border	13.4	4.9
3	B.C.	Jct. 95A East Cranbrook	Fort Steele Interchange	6.9	3.1
3	Alberta	Sentinel	Coleman	11.4	3.0
1	Parks	18.4 km W. of Banff	Castle Mountain	20.1	2.8
95	B.C.	Golf Course Road	Radium Junction	3.9	2.3
1	B.C.	Begin. of Long Tangents	Oldman Creek	14.8	1.9
1	Parks	Lake Louise	Jct. Hwy 93 to Jasper	6.1	1.8
3	B.C.	Ha Ha Lake Road	Wardner Road	8.0	1.6
1	Parks	Castle Mountain	Lake Louise	22.1	1.4
93	Parks	Junction of Hwy. 93A	Jasper Townsite	6.9	1.1
1	B.C.	Donald Overpass	North of Golden	16.7	1.1
1	B.C.	Begin. Curve at Beavermouth	Donald Overpass	7.8	1.1
1	B.C.	East Boundary of Glacier Park	South of Columbia Reach	7.8	1.0
1	Parks	Jct. Hwy. 93 to Jasper	B.C./Alberta Border	6.8	0.6
1	B.C.	Golden	East of Park Bridge	17.1	0.5
1	Parks	Upper Canyon	B.C./Alberta Border	6.2	0.5
93	Parks	Junction with Hwy. 1	Bow Pass (Pass. Lanes)	40.6	0.2
93	Parks	Junction with Hwy. 1	Bow Pass (4-Laning)	40.6	0.0

The total cost for the above projects was estimated at $441 million.

Conclusions

- It was estimated that 20 sections of highway in the Mountain Parks Zone either are, or will become deficient in terms of highway capacity during the period 1985 to 2000. These 20 projects total 249 km of which 109 km are located in the National Parks, 129 km in British Columbia, and 11 km in Alberta.
- The analyses done in the study indicate that the most effective means of eliminating these deficiencies is by widening from two to four lanes (undivided).
- The development of new routes through the Rocky Mountains (Elk Pass on Highway 43, and Howse Pass) would have little effect on reducing traffic volumes on existing routes. In addition the capital cost required to construct any new routes would outweigh potential benefits to road users.

- Other options such as inducing a mode shift from automobile travel to rail and bus, and widening lanes and/or shoulders would postpone the need for increases in capacity for three to four years at most.
- The traffic volumes on all but one of the 20 projects are now, or will be before the year 2000, above the practical limit below which passing lanes are effective.
- Widening the 20 deficient sections would not generate additional traffic demands that would result in adverse impacts on other parts of the highway network in British Columbia or Alberta.
- Much of the highway network in the Mountain Parks Zone needs to be resurfaced. In many cases resurfacing has been deferred, particularly in British Columbia. It was estimated that over the next 15 years the investment (1984 dollars) of $130 million would be required.
- Unless traffic volumes increase at significantly higher rates than those forecast by the study, the capacity of most (75% ±) of the Phase II highway network is adequate to at least the year 2000. Over the next 15 years approximately 17% of the network in the National Parks will become deficient, whereas the capacity of 25% and 23% of the networks in British Columbia and Alberta respectively will need to be increased.
- Approximately 36% (1,340 km) of the Phase II study network is in need of resurfacing. In many cases the pavement life is being extended beyond its normal expectancy and resurfacing programs are not keeping up with the rate of pavement deterioration.

TWO-LANE HIGHWAY CAPACITY AND LEVEL OF SERVICE RESEARCH PROJECT, PHASE III - FINAL REPORT
Transportation Association of Canada, September 1991

This document represents the third and last phase of the Transportation Association of Canada's [TAC] "Two-Lane Highway Capacity and Level of Service Research Project". The project, initiated in 1982, was comprised of three phases:

- Study Design
- Data Collection
- Data Analysis, evaluation of the U.S. Highway Capacity Manual, and development of a Canadian methodology.

Highway capacity is defined as the maximum number of vehicles which can pass a given point on a highway in a specified time period. Level of service (LOS) is a means of rating the quality of operational conditions of the traffic on a highway. Although rural highways are generally upgraded long before their capacity is reached, the ultimate capacity of a highway is used to compute the utilization and to plan future construction.

Level of service definition has one major objective -- to permit traffic operations on disparate highway sections to be compared equitably. Accomplishing this task requires the identification of suitable measures of effectiveness (traffic factors correlated with LOS) and the definition of values, or combinations of values, which define equivalent overall traffic conditions. A typical means of employing LOS is to use geometric and traffic data to rank all sections of the highway system and identify sections requiring attention. A model which overrates the operations on a highway section will tend to hide potential problem spots, while underrating the quality of operations can lead to wasted effort and resources spent examining and, potentially, implementing, unnecessary upgrading projects.

The Highway Capacity Manual has served as the international standard for capacity and level of service computation methodology. The extent to which the 1985 Highway Capacity Manual is applicable in predicting and rating rural highway capacity/LOS for Canadian conditions is of considerable interest. Also of interest is the variability in traffic characteristics among the regions of Canada.

The objectives of this report were to summarize the work performed and results achieved in the two-lane highway capacity and level of service research project and to develop recommendations for promising avenues of future research.

Site Selection and Description

Phase I [Development of Work Scope and Plan] of the project proposed an extensive field data collection program, designed to gather sufficient Canadian traffic and driver perception data to permit development of a Canadian capacity/level of service methodology. Each province was contacted and provided a list of suitable candidate data collection sites for the study. The 43 sites used in the data collection effort were chosen to accurately reflect the diversity of terrain and geometric design prevailing in the Canadian rural highway network.

Phase II [Data Collection] of the project was conducted over the summer of 1985. Two distinct categories of data were gathered:

- objective traffic data
- driver perception data.

Traffic Data

The objective traffic data was gathered using tape switches for axle detection and a mobile computer for data recording. The system was employed to sense and record a 100% sample of vehicles passing the data collection site, in both directions.

In order to maximize accuracy; the traffic data collection system recorded each vehicles' characteristics individually, rather than following common practice of reducing the data to pre-defined "bins" as part of the collection process. The data collection at each site was broken into manageable sessions, typically one hour in duration, to facilitate data reduction and analysis.

The data was reduced and analyzed to provide three distinct files for each data collection session. The first is an individual vehicle file, containing an ordered list of characteristics such as time of arrival, vehicle type, speed, etc. for each vehicle passing the site. The second file contains aggregated statistics, such as flow rate, mean and standard deviation of speed and headway, etc. for the entire session. The third file contains most of the session-level statistics, disaggregated by vehicle type.

Driver Perception Data

The task of collecting driver perceptions was conducted with the objective of identifying and quantifying the factors influencing the level of service perceived by highway users and correlating the results to the measured traffic data.

A list of questions was developed which asked the surveyed drivers to both quantify various traffic factors (such as the percent of time spent traveling in a platoon) and to rate the annoyance or frustration felt as a result of the factors.

The driver perception data collection sites were located close enough to the traffic data sites to permit correlation of the two data sets but sufficiently distant that the act of stopping and interviewing drivers would not substantially affect the traffic characteristics measured at the axle sensor location.

At most of the sites, the surveys were conducted by flagging down a random sample of the passing traffic and interviewing the drivers directly. Concerns for safety at the high traffic volume sites in Ontario prompted the development and use of a mailback survey, rather than roadside interviews. These surveys were conducted by recording license plates and mailing out questionnaires to the registered owners.

Data Analysis

The resources available for data analysis were insufficient for the original objective of developing a Canadian capacity/level of service methodology. An outline for the methodology of using the data for such a development task was developed. The plan called for the use of the driver perception data to set the criteria limits and, if applicable, criteria weights, for the various levels of service. A model for predicting the parameter values from general highway/traffic characteristics was needed, in order to compute the input data for evaluating the level of service.

The objective of the analysis conducted in Phase III of the project was to assess the ability of the 1985 Highway Capacity Manual method to predict the observed traffic characteristics and, by extension, its applicability as a means of predicting level of service on Canadian highways.

The first step of the analysis was to compute the predicted average running speed and percent time delayed (platooning) values and the predicted level of service for each data session using the 1985 Highway Capacity Manual methodology. The speed and platooning predictions were then mathematically compared to the equivalent observed values. The third task was to assess the accuracy of the HCM LOS predictions, based on a comparison of the LOS from the predicted and observed speed and platooning values.

Another task was to evaluate the possibility of using correction factors or other calibration tools as a means of improving the predictive ability of the Highway Capacity Manual procedure. It was found that the HCM general terrain LOS reduction factor for rolling and mountainous terrain was an important source of error and that the use of the level terrain computations for all sections improved the predicted-observed correlation, especially for platooning rate. The result for travel speed was less significant.

Conclusions and Recommendations

The primary conclusion of the traffic analysis is that the 1985 Highway Capacity Manual level of service methodology does not provide a sufficiently accurate representation of traffic operational characteristics in Canada. Predicted platoon delay values were generally much higher than observed, while speed prediction errors were more random in nature.

An investigation of the component model parameters revealed that the general terrain category (level, rolling or mountainous) capacity reduction factors used in the Manual were important sources of error, especially in platoon prediction, and that the "level" terrain designation should be used regardless of the actual terrain characteristics. Attempts to improve the Highway Capacity Manual travel speed predictive abilities met with little success and it is postulated that travel speed is more influenced by local factors (than is platooning) and may not be predictable from general characteristics.

A number of recommendations were generated:

- A comprehensive analysis of the driver perception data should be undertaken, with the objective of relating frustration levels with measured traffic characteristics. The findings would assist in understanding the relationship between traffic factors such as passing opportunities and the level of service experienced by highway users.
- The traffic database is lacking in high traffic volume observations at most of the sites. This limits the range of service levels observed at each site and diminishes the prospect of developing a full-range capacity/level of service methodology for Canada. It is recommended that a small supplementary data collection effort, concentrating on high volume locations and times, be undertaken to correct this data shortcoming.
- There is no recognized means to account for the effects of winter conditions on traffic operations on rural highways. This factor could be of particular importance in Canada, where a large percentage of traffic operations must cope with a variety of winter driving conditions. It is recommended that a small, well-designed winter data collection project be conducted, with the objective of quantifying the effects of the most prevalent winter factors, such as low temperature and low friction factor.
- As new capacity/level of service methodologies are developed, the trend is toward input data requirements which are too expensive to collect for most routine analyses. Computer simulation is perhaps the best means of economically putting these advanced procedures into general use. The highly detailed traffic data set gathered for this project provides an opportunity to develop and/or calibrate a more accurate rural highway traffic computer simulation model.

BRITISH COLUMBIA SPEED FLOW RELATIONSHIPS
MAK Engineering, ADI Ltd., & Professor John Morrall,
with an Overview by Peter Bein, December 1993

This document provides a background analysis of the preliminary speed-flow curves in the April 1992 version of the Ministry Guidebook for the Economic Appraisal of Highway Investments, which are also incorporated into the User Benefit Cost Spreadsheets (UBCS) software.

MAK Engineering indicated that:

- TRARR 3.20 needs changes before it can be applied to vehicle speed prediction in British Columbia
- eight problem areas created by improper use of TRARR contribute to a significant over-estimation of vehicle speeds, most markedly at higher traffic volumes in rolling and mountain terrain
- until TRARR is improved, the World Bank micro-transitional speed model should be used for predicting truck downgrade speeds
- speed simulations should be done more carefully, by sub-dividing highways into road sections with uniform characteristics, and collecting site-specific data to determine speed, headway and platoon size distribution
- traffic growth on congested facilities should not be modeled by spreading the peak hours; instead, travel time adjustment for congestion should be used in cost-benefit analysis to avoid a large error in estimated speed and travel time.

The Economic Analysis Project made the following conclusions:

- vehicle speed data should be collected at typical British Columbia highway sites to verify speed-flow curves recommended by MAK for future versions of UBCS
- speeds at congested traffic flows should be calculated from adjusted travel time, as recommended by MAK, with adjustment coefficients calibrated to different types of highway facilities in British Columbia
- all completed cost-benefit analyses involving a significant percent of trucks in sustained rolling and mountain terrain should be re-evaluated; this includes the Pritchard to Tappen section of Trans-Canada Highway.

The following recommendations were made to the Operations Division of the Ministry:

- quality control of consultants' speed simulation studies, and of planning and design conclusions based on such studies, should be strengthened
- expanding speed data collection and analysis capability at the Regional Office level should be considered to improve site-specific traffic speed information for planning and design
- planning and design already completed for various projects based on TRARR 3.20 should be re-visited; this includes passing lane warrants, and new facility and geometric improvement design in rolling and mountain terrain.

SPEED FLOW RELATIONSHIPS ON RURAL ROADS IN BRITISH COLUMBIA
MAK Engineering, with an Overview by Peter Bein, 1994

Background

Vehicle speed-flow relationships play a crucial role in the appraisal of highway projects. Approximate speed-flow curves were incorporated into the Economic Analysis Guidebook and its companion UBCS software. Because of a lack of actual speed measurements on British Columbia highways, the curves were based on simulations with TRARR and the 1985 Highway Capacity Manual/software.

In 1993, a series of studies was initiated to verify the assumed speed-flow curves and to refine them if necessary. The first study indicated that there were problems with the modeling capability of TRARR, and a number of corrections were recommended.

Field measurements of traffic speeds under typical British Columbia conditions were considered essential to evaluate the quality of the studies. MAK Engineering was hired to carry out a series of traffic speed measurements on selected highway sections in the winter and summer of 1994. This report summarizes the results of work done by MAK Engineering.

Study Objectives

This study was initiated to verify or override speed-flow curves used in Ministry economic appraisals of rural highways, as previously derived with traffic simulation software and the Highway Capacity Manual methodology. The objective was to develop speed-flow curves from the measurements on appropriate highway sections in British Columbia. A secondary objective was to compare empirically developed speed-flow curves for the winter and summer conditions.

Study Rationale

Field studies of traffic flow are the best base for developing speed-flow curves representative of terrain, road geometry and traffic conditions. Traffic studies performed in the past usually focused on a single traffic parameter. Conventional radar speed studies do not provide information on the type of measured vehicle, traffic volume, or level of service, which can be expressed by percent of vehicles following. Radar speed measurements, when detected by drivers, cause significant traffic slow downs, and are not reliable. Short counts and permanent counts measure volumes without relation to other traffic parameters. Classification and gap studies also measure only single traffic parameters.

Findings

This study was the first empirical evaluation of traffic speeds as a function of traffic flows on rural highways in British Columbia. The measurements were made using a method which did not influence traffic speed. These measurements indicate that commonly accepted speed-flow curves do not agree with the actual highway observations.

The measured curves are generally flatter than recommended by the HCM. This agrees with recent international experience which supports revisions to Chapter 3 of the Highway Capacity Manual. The TRARR software simulations also cannot produce realistic relationships. Actual free-flow speeds are significantly higher than assumed in the Guidebook and UBCS. In many cases the empirical curves are level in the range of traffic flows measured. For commuter traffic on a level 4-lane undivided highway, vehicle speed was found to be an increasing function of traffic volume.

The volumes encountered during the tests were not sufficient to determine capacity or speed near capacity. The empirical data indicated that actual highway capacity is significantly higher than assumed in British Columbia.

The revisions of the speed-flow relationships have a major effect on the calculated travel time savings in project appraisals. Previous economic analyses (which used the curves in the Guidebook and UBCS) overestimate travel time savings, promoted an investment in capacity and yield exaggerated benefits of passing lanes.

Recommendations

The use of TRARR should be discontinued until such time as a satisfactory upgrade is available from the software developers.

The speed data collected should be supplemented with measurements on congested urban sections in order to estimate the flow at breakdown point, speed at capacity and the capacity itself. This should be carried out as a first priority so that complete speed-flow curves could be constructed.

The assumed speed-flow curves in the Guidebook and UBCS should not be used until revised. If appraisals are carried out in the meantime, the curves should be replaced with a best possible substitute based on this report.

The actual speed measurements should be reviewed and an assessment made of the implications for design standards, passing lanes, highway safety and cost benefit appraisals.

Comprehensive field measurements, which are less expensive and more effective by comparison, should replace desk studies of highway speeds. If simulations are considered necessary, they should be verified with speed measurements.

KAMLOOPS INTEGRATED TRANSPORTATION PLAN - [TRAVELSMART]
KAMLOOPS OFFICIAL COMMUNITY PLAN [KAMPLAN]
Urban Systems Ltd.,City of Kamloops
In Progress

The following is a brief outline of the objectives:

Integrated Strategy
- To recognize the strong link between land use patterns and travel demand;
- To develop an Integrated Land Use and Transportation strategy which balances the community desire for livability with its need for mobility.

Land Use Planning Policies
- To provide clear direction for revising long term growth management policies, taking into account transportation implications.

Transportation Systems Plan
- To formulate a long range plan for transportation systems, considering all modes of travel (private auto, commercial vehicles, bicycles and pedestrians), with realistic and publicly acceptable mobility goals
- To investigate the potential for implementing travel demand management measures which are practical and effective
- To provide direction for implementing access management measures.

Transportation Model
- To develop a working model, (EMME/2).

Comprehensive Scope
- To design a planning process capable of being expanded to address other important considerations including, environmental factors (air quality, energy consumption), and other major infrastructure services such as water, sanitary sewer and drainage.

Consultation
- To recognize the importance of effective consultation; to design and implement a consultation program aimed at providing information, obtaining input and gaining widespread support for the plan by key stakeholders, including the public, City Council, Senior administration, Provincial agencies, private development sector.

This plan will serve as input for a revised Official Community Plan for the City of Kamloops, also in progress under the direction of City of Kamloops staff.

REGIONAL GROWTH MANAGEMENT STRATEGY
Thompson Nicola Regional District, Graham Murchie and Associates
In Progress

Purpose

To prepare a Growth Management Strategy that will address a broad spectrum of land use/growth related issues, such as resource use, transportation, the environment, social and economic development, infrastructure options, land use, housing, and finances, in an effort to promote sustainable settlement that will result in the efficient use of land resources, public facilities and services in accordance with the Provincial Growth Strategies Statutes Amendment Act 1995 (Bill 11). The work will include the preparation of a more specific Sub-Regional companion strategy for the South Thompson Valley.

Background

Since the elimination of Regional Planning in the mid 1980's, there has been a recognized need for more coordinated planning by the regional district and its member municipalities on strategic issues that transcend local boundaries. There is also the need for a reliable link with affected first nations, provincial and federal agencies whose participation and cooperation are necessary to implement and realize the benefits of a Regional Growth Management Strategy.

Regional District growth has included development of new areas, expansion and diversification of existing areas. There is a resultant need to recognize and assess impacts of growth on the provision of services.

General Plan Area

The boundaries of the Growth Management Strategy will include the entire Thompson Nicola Regional District, thus providing the framework necessary for better coordinated planning between the region's electoral areas and its member municipalities. The subject area is comprised of a mixture of crown, municipal, provincial and regional lands.

Relevant Land Use Management Documents

The following documents will provide an informational framework for the strategy's preparation:

- Regional District Land Use Bylaws, Plans and Studies
- Municipal Land Use Plans and Studies Official Community Plans
- Provincial/Federal Agency Plans, Local Resource Use Plans, Kamloops Land and Resource Management Plan, Fraser Basin Management Program - Strategic Plan
- Regional First Nations Land Use and Planning Studies

Objectives

- To provide a framework to effectively manage regional growth and sustainability over the next 20 years.
- To adopt a consultation plan that will provide for and facilitate a wide range of regional participation in and support for the strategy.
- To identify the sectors and geographic location of existing economic growth and development.
- To identify the sectors and geographic location of opportunities for economic growth and diversification.
- To include comprehensive statements with respect to the direction of the region's economic, environmental, financial, institutional, social and urban development.
- To identify existing population growth patterns, future growth trends and provide projections for the period covered by the strategy including their impact on matters such as housing, transportation, services, parks and natural areas, and economic development.
- To recognize and consider supporting and integrating federal, first nations, municipal, provincial and local government planning documents and programs related to air/water quality, economic development, the environment, financial matters, energy use/conservation, recreational/green space, regional servicing/infrastructure, resource use, transportation, cultural heritage, housing/urban development wherever practical.
- To address the provision of regional services and infrastructure recognizing their direct correlation to growth and planning and the need to ensure that such facilities can be provided in a timely, economic and efficient manner.
- To encourage a range of land uses, settlement patterns and recreational opportunities in appropriate areas of the region.
- To maintain the integrity of and encourage the effective use and enhancement of the region's renewable and non-renewable resource base including ground and surface water.
- To provide an acceptable implementation agreement and equitable dispute resolution process.

To translate the growth strategy into land use policy/designation amendments to existing plans/studies wherever necessary.

SOUTH THOMPSON VALLEY AND PINANTAN
OFFICIAL COMMUNITY PLAN
Thompson Nicola Regional District, May 1995

The Official Settlement Plan was converted to an Official Community Plan. The Official Community Plan reflects the current MSN Plan. The document contains only very general transportation statements.

Outstanding Issues:

It is the intention of the TNRD to undertake further review of this Official Community Plan following preparation of a Regional Growth Management Strategy. There will be an opportunity within the Transportation Component of the Regional Growth Management Strategy to review and comment on regional transportation network issues and concerns. This input would then be reflected in an amended South Thompson Valley & Pinantan OCP.

VILLAGE OF CHASE OFFICIAL COMMUNITY PLAN
Urban Systems Ltd.
In Progress

The Chase Official Community Plan is currently being re-drafted to reflect the new Councils' views on community growth. The main issues are as follows:

- Strip commercial development along Shuswap Avenue
- Future urban growth areas are restricted by the ALR, Thompson River, and Little Shuswap Lake, and the Trans Canada Highway
- No significant MSN issues were reflected in the first draft

The new draft may include new issues affecting Trans Canada Highway planning.

SOUTH SHUSWAP OFFICIAL COMMUNITY PLAN
[BLIND BAY/SORRENTO]
Columbia Shuswap Regional District, Urban Systems Ltd., March 1995

Ministry of Transportation and Highways - Role Outline

- Mandate is generally to provide and maintain the Provincial transportation network in conjunction with the economic development of the Province
- Responsibilities include the planning, construction and maintenance of highways (including the Trans Canada Highway), roads, ditches, and lake access rights-of-way with the Plan Area.
- MoTH also performs the Approving Officer function per the Land Title Act for subdivisions within the Plan Area. The Ministry is currently studying the Plan Area section of the Trans Canada Highway. Options which have been put forward include, upgrading the highway at its current location, re-routing traffic with a bypass option through one of two proposed corridors; one planned for lands adjacent the existing Sorrento community, and one planned for lands located further away near Tappen.

Trans Canada Highway - Official Community Plan Objectives

- To fully recognize the important influence, now and in the future, of the Trans Canada Highway on the Plan Area, including but not limited to:
  - transportation and mobility within the Plan Area for local residents
  - economic development potential associated with the highway
  - land use patterns, especially in close proximity to the highway.
- To recognize that from the perspective of the Ministry of Transportation and Highways, the primary function of the Trans Canada Highway is movement of traffic as an important link in the Province's highway network.
- To encourage localized upgrading of the Trans Canada Highway to resolve safety concerns.
- To pursue a bypass corridor option at Sorrento to improve safety and to facilitate development of the Sorrento Town Centre Plan.
- To provide for safe and convenient access from roads within the Plan Area to the Trans Canada Highway.

Policies

The Plan encourages the Ministry of Transportation and Highways to consult closely with the South Shuswap Planning Committee, the general public, the Regional District, as well as other Provincial agencies in the formulation and implementation of plans for upgrading the Trans Canada Highway through the Plan Area, with particular attention to:

- a Sorrento bypass corridor - alignment and access points
- access from the Trans Canada Highway to local roads
- access from the Trans Canada Highway to adjoining properties
- timing for implementation of the upgrading plans.

OKANAGAN/SHUSWAP LAND RESOURCE MANAGEMENT PLAN [LRMP]
In Progress

Growing demand for an improved land use planning system led to the creation of the Commission on Resources and the Environment (C.O.R.E.), the initiation of a Provincial Land Use Strategy and development of new processes for resource planning, including Land and Resource Management Plans (LRMPs).

Land and Resource Management Planning is an integrated, sub-regional, consensus building process that produces a Land and Resource Management Plan for review and approval by government.

LRMP - The Plan

- *Land*: Includes all Crown land, including Provincial Forests, Protected Areas and foreshore of rivers and lakes. Provincial Forests include land within Timber Supply Areas and Tree Farm Licenses. With participation of local governments the resulting plan can assist with planning for the use and development of private land.
- *Resource*: Addresss all Crown resources including wildlife, timber, scenery, rangeland, mining, water, fisheries, recreation, tourism, agriculture and development.
- *Management*: Determines where and to what degree logging, mining, outdoor recreation and other land and resource activities may occur.
- *Plan*: Provides recommendations which may range from full protection to a mixture of industrial and commercial uses.

The LRMP is a strategic level plan. It will provide general management direction and objectives for the area as a whole and for specific zones. It will represent all resource interests including a wide variety of provincial and federal government agencies, local governments, First Nations, as well as stakeholder groups, - representatives of the community, industry, labor, tenure holders, recreational users, and environmentalists. It is based on the principles of integrated resource management, - the identification and consideration of all resource values, including social, economic, and environmental needs, in land use decision making. It is a subregional plan. Land use allocations will be made at a level where the area is of sufficient size to allow for proper evaluation of the appropriate use, yet allow for flexibility in achieving a balance among economic, social and environmental interests.

LRMP Participants

The public, aboriginal groups and government agencies are the key participants. There are a range of options for public involvement. Public participation will include parties with an interest or stake in the outcome.
First Nations are encouraged to participate to ensure that decisions are sensitive to aboriginal interests. The plan will not prejudice land claims but can be used to implement joint stewardship agreements.

All levels of government may participate. The role of the government is fourfold:

- as a participant directly affected by planning decisions
- as a provider of technical support and process administration
- as a decision maker at the ministerial level
- as the implementor of the approved plan

LRMP - Planning Issues

Following are some of the issues that have been identified by recent strategic planning initiatives in the Okanagan/Shuswap LRMP area.

- *Health and Stability of Local Economies*
  The diverse economy of this area maintains several industries. The main industries are forestry, agriculture, tourism, manufacturing, and those which service a large retired population. Maintenance of community employment is a concern, particularly in communities which are not as diversified as others.
- *Water*
  Ensuring an adequate supply of good quality water for agriculture and domestic consumption is an ongoing concern.
- *Protection of Biodiversity and Old Growth*
  Many wildlife species depend on biologically diverse forests and require dead or dying trees for at least part of their life cycle. To maintain old growth forest habitat it will be necessary to ensure that there is a distribution of old growth forests within watersheds that represent different biogeoclimatic subzones. Protected Area Strategy candidate areas will need to be reviewed and evaluated in terms of conservation and socio-economic impacts.
- *Population Growth*
  The Okanagan/Shuswap is one of the fastest developing areas. Expanding population places significant demands on numerous resources.
- *Increasing Demand for Naturally Appearing Landscapes*
  The tourism and outdoor recreation sector is increasingly concerned about the impact of road building and logging practices on visible landscapes. Natural appearing landscapes are an important marketing feature of most commercial outdoor recreation developments.
- *Range*
  Approximately one-third of the cattle ranchers have forest-based range tenures in the Okanagan/Shuswap area. Forest range management is a major issue for these operations.
- *Forest Health*
  Forest pest infestations, and the Mountain Pine Beetle in particular, have resulted in an accelerated cut in some areas, altered harvest patterns in others, and have the potential to create long-term timber supply problems.
- *Wildlife Habitat*
  The Okanagan has the largest number of rare, endangered and threatened species in British Columbia. This is due to the limited range and relative rarity of ecosystems, and the high level or urban development and population growth. Identification of the required habitats and protective measures need to be developed.

DISTRICT OF SALMON ARM, OFFICIAL COMMUNITY PLAN, 1992

The District of Salmon Arm completed its Official Community Plan in 1992. Since then it has been amended for legal reasons, but without fundamental changes. Therefore the Ministry's position, as outlined in the response dated April 1, 1992, remains unchanged.

Issues include:

- TCH bypass of Salmon Arm
- Unresolved MSN issues
- Highway Service/Commercial landuse zones along much of the TCH frontage within Salmon Arm.
- Town Center Commercial - Parking Standards
- Interim improvements to the existing TCH alignment (Hospital Road to 30th Street N.E.); Access Management Plan
- MoTH long range plans for Highway 97B

The Ministry's position with respect to the Trans Canada Highway 1 and Highway 97B corridor protection is as follows:

Subdivision, Zoning, Access and the protection of Highway/Service Road rights-of-way requirements will be addressed through the Development Approvals process in accordance with the Ministry's Corridor Protection/Access Management Strategies. Depending on the size, scope and location of development proposals, construction of service roads may be a condition of development approvals. Each proposal will be evaluated on an individual basis.

DISTRICT OF SICAMOUS OFFICIAL COMMUNITY PLAN
Urban Systems Ltd., May 1995

This was the first Official Community Plan for the District of Sicamous since its incorporation on December 4, 1989.

Land Use

- The Trans Canada Highway is a significant influence on the land use pattern in Sicamous and it provides the only access over the Channel to the Westside. Although the Ministry of Transportation and Highways has recently improved the intersection with Old Spallumcheen Road, it remains a major constraint for the future development of Westside.
- Westside is designated as a Special Planning Area because it is largely undeveloped and has severe topographic constraints. Access to the area is restricted to Spallumcheen Road which is generally considered sub-standard because of the poor, albeit recently improved, intersection at the Trans Canada Highway. The Ministry of Transportation and Highways has made it clear that significant development should not be permitted to occur in Westside until the proposed Main Street Bridge (over Sicamous Channel) is in place.

Transportation

<u>Background</u>

Sicamous has evolved based on its location relative to the area's transportation network. The District recognizes the importance of transportation planning and the need to work cooperatively with provincial and federal agencies to protect transportation corridors and rights-of-way.

The District of Sicamous, upon the request and advice of the Ministry of Transportation and Highways, would like to extend and designate Rauma Avenue as part of the District's major road network plan. On the other hand, the Agricultural Land Commission has not consented to this designation and has expressly asked for its removal. The District will work closely with these agencies to arrive at an acceptable solution.

<u>Objectives</u>

- It is Council's objective to work with the Ministry of Transportation and Highways and establish a transportation network which supports development and promotes safe and efficient traffic circulation.
- It is Council's objective to enhance pedestrian opportunities and create a bicycle network within the District.

Policies

- It is the policy of Council that the District's major road network be as set out on the Land Use Map.

  It is the policy of Council that the major road designation of Rauma Avenue and its extension is for information purposes only and that the District will work closely with the Agricultural Land Commission and the Ministry of Transportation and Highways with respect to this designation.
- It is the policy of Council to expand the existing pedestrian and bicycle network as the District's financial resources permit.
- It is the policy of Council to amend its Subdivision and Servicing Bylaw to incorporate bicycle lanes into the District's roadway standards.
- It is the policy of Council to encourage the Ministry of Transportation and Highways to construct a new bridge over the channel. This new bridge would be an extension of Main Street.

Resolved Issues:
General agreement has been reached to limit Westside development because of poor roadway access. The new sewage treatment plant location may have effectively limited Highway 1 improvement alternatives through Sicamous to the existing alignment option. Development approvals should be cognizant of this.

Outstanding Issues:
The MSN Plan requires continued discussion with the District of Sicamous.

- The designation of Solsqua - Sicamous Road as a major road north of Highway 1 is proposed, and generally agreeable to MoTH, as an alternative to the previously proposed Green Road/Boutwell Road connection.
- The alignment of the proposed extension of Parksville Street west of Highway 97A requires further planning. Roadway continuity and efficiency could be compromised.
- Finlayson Road is shown incorrectly as a major road between Shuswap Avenue and Paradise Avenue.
- The proposal to designate Rauma Avenue as the major north-south road east of Highway 97A is opposed by the Agricultural Land Commission. MoTH will need to work closely with the District of Sicamous to explain the transportation need and preference, and hopefully gain ALC acceptance of this corridor as a MSN element.

CITY OF REVELSTOKE OFFICIAL COMMUNITY PLAN [1995 DRAFT]

The Official Community Plan (OCP) is a policy tool used to guide future growth, to ensure that development proceeds in an orderly and efficient manner.

General Description

Revelstoke is located approximately 640 km east of Vancouver and 400 km west of Calgary. The community boasts a spectacular setting on the Columbia River between the Selkirk and Monashee Mountain ranges. The Revelstoke region's resources contributed much to the development of the community. Mineralization in the surrounding mountains stirred early activity in the area. The forests of the Revelstoke area are comparable to those found in Coastal BC. Extraction and processing are traditional activities in the community. The water resources of the Columbia River have been utilized extensively for hydro-electric production. Transportation corridors run east-west and north-south and include the Trans Canada Highway and Canadian Pacific Railway.

Historical Development

Revelstoke's history dates back to gold and base metal mining activity and the building of the Canadian Pacific in the late 1800's.

By the turn of the century, forestry and lumber processing became the second major industry in Revelstoke. From 1900 to 1960, the community grew at a gradual steady pace with railway and forestry continuing to be the mainstays of the economy. Between 1960 and 1965, the community experienced rapid growth as a result of the construction of the Trans-Canada Highway through the Rogers Pass and the expansion of the CPR

During the 1970's, there was little growth in the railway and tourism sectors. However, with construction of the Mica Dam in the early 1970's and the start of the Revelstoke Canyon Dam in the late 1970's, there was a significant increase in the importance of construction in the community. Clearing of reservoirs created by the dams also brought substantial growth in the forestry sector.

The early 1980's were a relatively buoyant time for the Revelstoke economy with the development of the Goldstream Copper Mine, construction of the Revelstoke Dam and the commencement of the Rogers Pass Tunnel Project and double tracking by CP Rail. The mid 80's saw an economic downturn, then resurgence.

Revelstoke continues to look to its natural resource base to sustain the community's economy. Local processing of materials is a key area of emphasis. Tourism will also continue to play a major role.

Community Vision

A vision for Revelstoke has been accepted by Council and is set out as follows:

> "Revelstoke will be a leader in achieving a sustainable community by balancing environmental, social and economic values within a local, regional and global context."

Guiding Principles for Development
The community vision can be translated into a number of considerations to be taken into account as new development occurs. These considerations should then be applied to the provision of services, including development of the transportation network.

Transportation
Revelstoke is dependent upon the various transportation links present within the community. The City is bisected by two highways - the Trans Canada Highway which traverses the community in an east-west orientation, and Highway 23 which connects Mica Creek north of Revelstoke with the Columbia/Kootenay region to the south. The CPR main line also connects Revelstoke with points east and west. The Revelstoke airport serves the air transportation needs of the surrounding region.
Highways are the most prominent transportation links.
The Revelstoke Major Street Network is important to the community. It allows the safe and efficient movements of vehicles, and provides separation between potentially conflicting traffic types (local residential traffic and truck traffic). The Network designates roads which may be eligible for funding from the provincial government. Over the long-term, the Network becomes entrenched in the community as development proceeds around it. Therefore, decisions made today will have long-term implications for the community.

The Ministry of Transportation and Highways has completed preliminary studies on upgrading the Trans Canada Highway. These studies examined four options:
- the existing corridor.
- north of the existing corridor through Westside Road/Columbia Park areas.
- south of the existing corridor through Arrow Heights (just south of Illecillewaet River).
- south of the existing corridor through Arrow Heights (just south of Nichol Road).

Highway upgrading along any of these routes has the potential to create significant land use, social, environmental, economic and other impacts in the community.

Non-automobile forms of transportation also play a significant role in the community. Cycling and walking provide not only enjoyment and exercise but also reduced demand for roads and parking, energy conservation and environmental benefits through reduced air emissions. A proposed public transit system would have similar benefits.

Revelstoke community objectives include:
- establishment of a road network that will guide development and provide for safe and efficient traffic circulation.
- measures which ensure that the Trans Canada Highway upgrading maximizes benefits and minimizes costs with respect to land use, social, economic, environmental and other issues and concerns.
- retainment of important railway and air transport links with areas outside Revelstoke.
- demand management for automobile use as the primary mode of transport through emphasizing alternative modes of travel including walking, cycling, and public transit.

OPPORTUNITIES FOR WILDLIFE AND RECREATION DEVELOPMENT IN THE COLUMBIA RIVER WETLANDS
Pedology Consultants, Quadra Economic Consultants Ltd., Robinson Consulting & Associates Ltd., Glen Smith Wildlife Resource Consultant Ltd., January 1983.

Columbia River Wetlands Proposal

Stretching 180 km north from Canal Flats to the Mica Reservoir in the East Kootenay region of British Columbia, the Columbia River wetlands comprise a 26,000 hectare floodplain of outstanding natural environment.
About five percent of the area has been subjected to incursions such as railways and roads, agriculture, settlements and small industrial developments. For the most part, the wetlands remain in their natural, dynamic state.

Wildlife and Habitats in the Wetlands
The Columbia River wetlands are a rich mosaic of diverse and important wildlife habitats. Of five major habitats classified for the floodplain, marshes comprise 35 percent or 9200 hectares; other water habitats (flowing and standing waters) comprise 31 percent or 8200 hectares; treed areas comprise 23 percent or 6000 hectares; shrubs, meadows, ponds, swamps, and unvegetated areas collectively comprise six percent or 1700 hectares; and man-modified lands constitute five percent or 1200 hectares. More than 60 percent of the wetlands is capable of supporting waterfowl and 75 percent has seasonal capabilities to support important species.
Waterfowl, is the most abundant and observable species group, utilize the wetlands for breeding and brook-rearing, for refuge during the flightless period of their molt, and for feeding and resting during spring and fall migrations.
Up to 90 percent of the elk, 70 percent of the white-tailed deer and 15 percent of the moose of the upper-Columbia basin depend on these wetlands for winter survival. The wintering elk represent approximately one-third of the elk population of the East Kootenays, which in turn comprises 75 percent of the provincial elk numbers.
The wetlands are of local and regional significance to waterfowl and other birds. For waterfowl, they are an important component of the Pacific Flyway - increasingly so as many wetlands are lost to other uses. Further, all the criteria for designation as wetlands of international significance developed by the International Conference on the Conservation of Wetlands and Waterfowl are met by the Columbia River Wetlands.

Present Use of Wetlands
Following a dramatic influx of tourists and associated rapid population growth in the 1970's, a 1980 regional planning report on the upper-Columbia recommended the preservation of existing resources, and enhancement of tourist attractions complementary to those uses.
With only limited access to the wetlands available, consumptive recreational activity such as hunting and fishing is light. On the other hand, non-consumptive recreation activities, such as wildlife viewing, account for some 86,000 recreation-days annually. Projections indicated that there would be a demand of 180,000 recreation-days by 1990.

Development Opportunities

The wetlands offer an outstanding opportunity for wildlife enhancement and recreation development. Hydrologic constraints generally preclude development for other purposes within the wetlands.

One of the key enhancement techniques available for selected portions of the floodplain is water level management. Waterfowl production could be greatly improved by stabilizing water levels during critical nesting periods. Water manipulations could, by encouraging vegetation which is preferred winter feed for elk, deer and moose, benefit those species also.

Development which would enhance non-consumptive recreation activities in the wetlands would complement, and be complemented by, the majestic mountain scenery and those amenities which attract visitors to the nearby national and provincial parks.

Strategic Plan and Recommendations

Realization of enhancement opportunities will evolve through a strategic plan based on an inventory and classification of habitats. The key elements of the planning strategy are:

- securing the land base for wildlife.
- identifying specific opportunities for enhancement.
- prioritizing enhancement projects.
- monitoring and evaluating projects as they are developed.

These planning elements are aligned with the following recommendations for implementation of the strategic planning process.

- The Fish and Wildlife Branch of the Ministry of Environment should be assigned responsibility to manage the Crown lands in the Columbia River wetlands, and that the Branch should seek assistance from others in obtaining control of undeveloped strategically located private lands if necessary.
- The Fish and Wildlife Branch, in conjunction with other agencies having responsibility for wildlife and recreation management, should undertake preliminary design, cost, feasibility, and prioritization studies for wetland development projects - giving full consideration to potential integration of other interests such as forestry and agriculture.
- A long-term budget should be developed for capital works and annual operating costs, and funding should be sought from provincial and federal revenues and other public or private agencies.
- An ongoing monitoring program should be initiated to ensure orderly, efficient, and effective project development.
- The wildlife and recreational opportunities available in the Columbia wetlands are exceptional. Preservation and careful development will ensure important contributions to regional, provincial, national and international goals. Resource commitments required to begin the development process entail little direct financial or economic cost, yet the benefits from development are potentially very large. In view of this it is recommended that the necessary commitments be made and the development process be initiated.

TOWN OF GOLDEN OFFICIAL COMMUNITY PLAN [1993]

Guiding Principles

Guiding principles were developed through examination of a number of factors, which included:

- opinions, needs and desires of local residents expressed during public consultation.
- past trends - development which has taken place in the past will influence future development. As well, existing infrastructure will help determine where growth will occur.
- sound community planning principles, taking into account land use planning, engineering and municipal finance considerations.

While encouraging orderly development of the community, the Plan must also be flexible enough to allow Golden to react to changes in the economic, social and environmental conditions and priorities.

Impacts of Road Network Changes on Land Use Patterns

The Major Street Network plays a significant role in the overall development and land use pattern of Golden. Some uses benefit from being located adjacent to major streets, while others may be negatively affected.

Recognizing the importance of the major street network to the community and its influence on adjacent land uses, it is important for the Town to take an active role in transportation planning so it understands the implications of any anticipated changes.

Development in Potential Natural Hazard Areas

Some of the natural attributes that make Golden special also contain potential hazard areas, such as floodplain and steep unstable slopes.

The Town must identify hazard areas in the Plan and must deal with development applications in these areas with caution.

Ensure an Adequate Supply of Land is Available to Accommodate Future Land Uses

To ensure an adequate land supply exists within Golden, the Town should assess its current land inventory, and determine if there is enough vacant land to meet the anticipated demand.

Expanding the Town boundary may be an option once all lands within the current boundary have been examined, and it has been concluded that expansion is necessary to accommodate future growth.

Continue to Improve the Visual Appearance of Golden

Golden has made significant improvements to its visual appearance over the last several years. Special attention is to be paid to the highway corridor where the majority of visitors gain their initial impression of the Town.

Address the Town's Various Infrastructure Needs

Since 1985 Council has been very innovative in its efforts to accommodate future development through infrastructure improvements. Council is committed to continuing this program as growth occurs, and to provide the improvements based upon the Town's ability to pay.

Fringe Area Developments and Boundary Extension

The Town is committed to working with approving agencies that manage development on lands adjacent to Golden. Fringe area growth should be managed.

Transportation

Golden's economy is dependent on various modes of transportation. The road system can significantly impact the quality of life. Golden's location at the intersection of the Trans Canada and the Kootenay Highway means there is a potential for conflict between local traffic and through traffic.

In recent years, studies have been undertaken to examine the implications of constructing highway bypasses. The most recent study has looked at options for constructing a Trans Canada Highway bypass that would dissect the northeast quadrant of the Town, and then run north of Golden's present boundary.

While the Town acknowledges the obvious safety benefits associated with any realignment of the highway, there is concern over potential negative economic impacts on the business community along the Trans Canada Highway. The Town would like to promote a balanced approach to considering the costs and benefits of the bypass.

Long range plans for the Kootenay Highway also include a bypass of the commercial areas. The right-of-way has been purchased and the route is designated on the land use map.

It is Council's objective to:

- encourage the public to provide input into any Transportation Plan for Golden.
- provide a safe, accessible transportation system for the citizens of Golden.

It is the policy of Council:

- To encourage the Ministry of Transportation and Highways to initiate a public consultation process that coincides with any planning for a Trans Canada Highway bypass at Golden.
- That the major street network is depicted on the Land Use Map. The major street network is included on the Land Use Plan for information and does not form part of the Official Community Plan.
- That future road links within the municipality be designed so as to minimize any conflicts between through and local traffic.
- To encourage the Ministry of Transportation and Highways to upgrade the bridge over the Kicking Horse River instead of constructing a Kootenay Highway Bypass of the Commercial Area.

BACKGROUND REPORT YOHO NATIONAL PARK MANAGEMENT PLANNING PROGRAM
Dave Poll, Judy Otton,Western Regional Office, Parks Canada, August 1986

This report contains a synthesis of information to be considered in the formulation of the park management plan for Yoho National Park. It supplements information contained in a series of background papers which were the subject of public review and comment in 1983.

Purpose of the Background Report

This background report summarizes the most recent information available on natural resources, visitor use, existing facilities, recreational opportunities and planning considerations in Yoho National Park. The comprehensive working document on which this summary is based contains baseline data that will be used to assess the environmental and socio-economic implications of the proposals in the park management plan.

The information in this report will be useful in reviewing the core concept for Yoho National Park.

Appendix

- **Additional Studies**

Report	Date	Location
Status Report - Three Valley Lake Project, Preliminary Design	1993	N

- **List of Other Related Studies and Reference Material**

Environmental & Socio-economic Assessment of Highway Upgrading & Realignment in Three Valley
Acres International Ltd., 1991

Pavement Management System Update: Alberta & Pacific Yukon Regions
Parks Canada, 1995

Snowshed Inspection & Study, Trans-Canada Highway, Glacier National Park
UMA Engineering Ltd., 1994

Planning & Design of Passing Lanes for the Trans-Canada Highway in Yoho National Park
National Research Council, Canada, 1990
Dr. John Morrall, Wayne Thompson

STATUS REPORT - THREE VALLEY LAKE PROJECT
PRELIMINARY DESIGN
Highway Engineering Branch, Kootenays Region, May 1993

Six options were developed to increase the capacity and decrease closures due to avalanches in the Three Valley Lake segment of the Trans-Canada Highway, along a length of 7.5 kilometres. All options considered a 4 lane freeway configuration.

Options were developed for design speeds of both 90 km/h and 110 km/h.
The estimated construction costs, excluding right-of-way, range from $100 million to $145 million.
Environmental, social, and some engineering issues [largely associated with geotechnical considerations] remain to be addressed.

Preferred Option F affords the most protection from avalanches, and is estimated to be the least expensive. This option necessitates the acquisition of the existing motel complex at the east end of the lake. The comparable option to avoid the motel is estimated to cost $7 million additional. A design speed of 110 km/h is estimated to increase the cost by approximately $10 million over a 90 km/h alignment. A phased construction program is feasible.

The options evaluation matrix is illustrated below.

EVALUATION MATRIX

Option	*A*	*B*	*C*	*D*	*E*	*F*
Location	Upper	Lower	Split	Lower	Lower	Lower
Design Speed	110	110	110	90	110	90
Motel Complex	Around	Around	Around	Around	Through	Through
Cost [Millions]	$145	$117	$140	$107	$110	$100
Geotechnical concerns	Highest	Moderate	Highest	Moderate	Low	Low
Avalanche protection	Least	Moderate	Least	Moderate	Best	Best
Retaining wall height@motel	High	Moderate	High	Moderate	N/A	N/A
Portal cut height	High	High	High	High	Lowest	Lowest