Alberni-Clayoquot Regional District

Highway 4 Connector via Horne Lake Route Study

Final Report

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ALBERNI-CLAYOQUOT REGIONAL DISTRICT
HIGHWAY 4 CONNECTOR VIA HORNE LAKE
Route Study
CONCEPTUAL DESIGN AND COST ESTIMATE Final Report

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1. EXECUTIVE SUMMARY

R. F. Binnie and Associates Ltd. were hired by the Alberni Clayoquot Regional District to carry out a conceptual design study for a new highway route into Port Alberni. The proposed new road would start at the Horne Lake Intersection on Highway 19, and connect with Highway 4 near the Port Alberni Summit, or The Hump as it is better known.

A previous study was undertaken in 2005 by ND Lea Inc. for the Ministry of Transportation. This study looked at options on either side of Horne Lake that joined Highway 4 in the vicinity of Cherry Creek. As there appeared to be very little cost benefit associated with this route, the Ministry of Transportation decided to not pursue it.

The route studied by Binnie follows the existing road at the east end of Horne Lake, which then traverses across the side hill above the south shore of the lake, rising up to an altitude of 512 metres. It connects with the existing logging road network, and joins Highway 4 at Loon Lake, about one kilometer west of the summit. Constructability, overall cost and the cost benefit are some of the factors considered in this study.

We have verified that there is a route that achieves an 80-km/h-design speed, both vertically and horizontally, and the cost of this route would be approximately 37.6 million dollars. The distance from Highway 4 at Loon Lake along the new route to the Highway 19 Junction at the Horne Lake Intersection is 20.2 kilometres.

Travel distances and times of the existing routes were compared to those of the proposed route. Southbound traffic on Highway 19 from the North Island destined for the West Coast would exit onto the new route at the Horne Lake Intersection. The distance for the new route is 20.2 kilometres from the Horne Lake Intersection to the Loon Lake Junction, whereas the distance along the existing route is 45.7 kilometres. This is a reduced distance of 25.5 kilometres. The timesavings would be approximately 18 minutes.

Northbound traffic on Highway 19 from South Vancouver Island heading towards the West Coast now exits at the Qualicum Interchange. The distance from the interchange to the Loon Lake Intersection on Highway 4 is 31.3 kilometres. From the interchange to the Horne Lake Intersection, then along the new route to the Loon Lake intersection is 34.4 kilometres. Although the distance is 3.1 kilometres greater using the new route, the travel time would be two minutes shorter because the new route allows for higher driving speeds.

Binnie hired Mr. Peter Lyall of Apex Engineering to do the Cost Benefit Analysis for this project. His report is attached as Appendix “A”. Mr. Lyall used accident data, traffic counts, and delay times from the Ministry of Transportation website, to help with the cost

benefit of the new route. An assumption was made that all traffic from North Vancouver Island destined for the West Coast would use the new route. It was also assumed that the majority of vehicles traveling to the West Coast from the area south of the Qualicum Interchange would use the new route. The basis for this assumption is that the new route would be safer, takes less time, and would be more reliable than the existing Highway 4. Cost benefit figures are based on 50% and 70% of the traffic from south island using the new route. Based on these assumptions, the cost benefit ratio for the project is 1.5 for 50% and 2.1 for 70%.

2. BACKGROUND

The Alberni Clayoquot Regional District formed a committee to try to promote a new route into the Alberni Valley and other West Coast communities. The formation of the committee was primarily in response to the following issues:

- Poor reliability and accident history of the existing route
- Increased truck traffic since the closure of the railway
- Increased development in West Coast communities resulting in increased traffic flows on Highway 4
- Extensive delays on the existing route due to traffic accidents and storm events

There have been several studies done by the Ministry of Transportation, seeking a new route through the Horne Lake Corridor. E. Wolski did the Vancouver Island Link Study in March of 2004. Subsequent to that was the study done by ND Lea Inc., which was completed in August of 2005. Both of these studies found that the cost benefits of a new route were not good, with the latter report stating that the cost benefits were 0.63 and 0.86 for the two scenarios that were reviewed.

Mr. Charlie Haggard was a member of the ACRD committee, prior to his recent death. As the owner of a large trucking company in Port Alberni, his vehicles traveled Highway 4 extensively, and he was very concerned about the reliability of the existing route. With the support of the ACRD, he lobbied the Ministry of Transportation to study an alternate route from Loon Lake along the current logging roads towards Horne Lake. This route had not been considered in the previous study done by ND Lea Inc. However, the Ministry of Transportation could not be convinced to pursue the Horne Lake route any further, since the previous study had shown a very poor cost benefit.

It became clear to the ACRD and the committee that to determine the viability of Mr. Haggard's route, a more detailed engineering study was required. R.F. Binnie and Associates Ltd. were hired to do the engineering for the concept.

Unfortunately Mr. Haggard passed away in June 2007 before his vision of a new route into the Alberni Valley could be realized. This study encompasses many of the concepts he pioneered during his numerous trips over the logging roads into the Horne Lake area, and provides a viable basis for the alternate route.

The design objectives of this study are to:

- Obtain digital mapping for the study area
- Produce a digital terrain model to be used to calculate earthworks

- volumes for various options
- Establish a typical section consistent with Ministry of Transportation design requirements for this class of road.
- Achieve a design speed of 80km/h for both vertical and horizontal alignment
- Develop cut/fill volumes of various routes and develop cost estimates for each
- Determine any major stream crossings or structures that may be required for this design
- Provide access points for the logging road networks to intersect the new route

This study does not include geotechnical issues, with the exception of references to assumed material types. Nor were environmental concerns part of the scope.

3. EXISTING CONDITIONS – HIGHWAY 4

3.1 Roadway Geometry

Highway 4 from the Whiskey Creek Store to the Mount Arrowsmith/Loon Lake intersection is a very windy road. There are eight curves with slow advisories of 60 km/h, four with slow to 50 km/h advisories, and four curve signs with no suggested speed reductions. This is problematic for the many large trucks and recreational vehicles that travel the route as they sometimes travel at below the advisory speeds to negotiate the windy road. This causes queuing and frustrations to drivers as there are very limited opportunities to pass. As we will see further in the report, the accident rate through this section is quite high, and the accidents cause significant delays.

3.2 Travel Speed

The existing highway is posted at 80 km/h. The distance from Highway 19 to the Loon Lake Intersection is 31.3 kilometres and the travel time is 25 minutes. This results in an average travel speed of 75 kilometres per hour. The average travel speed is about 5 kilometres/hour less than the posted speed, and during the heavy tourist season it is often much lower than that due to motorists traveling below the posted speed.
Some of the factors that tend to reduce the traffic speed are listed below:

- Tourists parked at the east end of Cameron Lake. On a typical summer day, traffic is often parked on both shoulders, which tends to narrow the driving lanes. Also pedestrians cross the highway to gain access to the beach. This slows traffic and creates a safety problem.
- Windy road and speed advisories.
- Congestion at Cathedral Grove. The traffic speed has been reduced to 50km/h for a short section of Cathedral Grove in order to calm traffic and make it safer for park users. Traffic is often stopped through the Grove on busy summer days to allow for recreational vehicles to back out into the flow of traffic and to allow pedestrians to cross the highway.
- Steep grade on the east side of The Hump. Loaded trucks are traveling at sometimes less than 30km/hr by the time they reach the truck-climbing lane. This has a tendency to have traffic queue up behind the truck. Often, other trucks attempt to pass a loaded truck once it moves into the slow lane. This renders the passing lane unusable for other vehicles. For traffic heading eastbound going down The Hump, there is no crawl lane for heavy trucks, which must travel very slowly to negotiate the sharp turns. This causes delays for the traffic following them. Poor horizontal road alignment prevents truckers from maintaining their speed as they travel up the east side of The Hump, which also impedes the flow of traffic.

3.3 Road Reliability

Highway 4 is the only route into the Alberni Valley and all West Coast communities. It is an essential link to the West Coast. During the fall and winter of 2006-07, it was closed on many occasions, for periods of up to two days, because of major storm events or motor vehicle accidents. In the year 2007 alone, there have been at least seven major closures of the road due to motor vehicle accidents or weather events. These closures have on average lasted for periods of about two hours. This has a major impact on the following:

- The economy of the West Coast
- People trying to catch ferries, airplanes, or keep other appointments
- Emergency transportation, such as police and ambulance
- Sick or injured persons who are prevented from getting to the Regional Hospital in Nanaimo
- Commercial traffic, resulting in increased costs to trucking companies and consumers

In the analysis done by Mr. Peter Lyall, some of the more recent closures are listed with the cost impact of these closures noted. It is clear from his report that the delay rate of 97.6 hours/100km/year is quite high in comparison to other highways such as the Sea to Sky, which incurs delays of 72 hours/100km/year.

3.4 Accident Rates

The TAC Geometric Design Guide for Canadian Roads states in Section 2.1.2.7 “curve collision frequency increases with the decrease in radius of a curve”. The curvy nature and narrow shoulders of Highway 4 make driving this road very challenging. The accident rate for Highway 4 between the Loon Lake Intersection and the Qualicum Interchange is 0.64 accidents/million vehicle kilometres. This is above the provincial average of 0.5 for a two lane arterial highway. Further in this report the accident history is documented.

3.5 Cathedral Grove

Cathedral Grove is a unique provincial park that has many large Douglas fir trees adjacent to the highway. These trees are very old and have limbs or root masses that are subject to rot. In the violent windstorms that occur quite regularly, limbs often fall from trees, and on occasion, entire trees fall to the ground. The safety and reliability issues this creates are difficult to manage, as there is much resistance to removing any trees from this area.

In addition, due to the popularity of the park, there is not enough parking for the large numbers of tourists, who routinely park on the shoulders, outside the designated parking area, further narrowing the roadway. Pedestrians crossing the highway present a major hazard, especially during the heavy traffic volume of the summer months. Drivers of r

recreational vehicles that park at the rest area cannot see when backing out. Quite often, a passenger will walk into the middle of the highway to stop oncoming vehicles in order to allow their RV to back into the traffic lane. This too is a very unsafe act, but is done regularly by persons unskilled in traffic control.

The Ministry of Transportation and Parks tried to gain support for the construction of a parking area further west on Highway 4, to allow for park visitors to park off the roadway. Friends of Cathedral Grove protested this, and the parking area was never constructed. Instead, the Ministry tried to make the existing parking area safer by reducing the speed and installing traffic calming signage. This has reduced the risk and severity of accidents, but it does not address all the safety concerns. Diverting the majority of the traffic through a new Horne Lake Connector would make the area safer by reducing the amount of vehicle traffic at this location.

3.6 Passing Opportunities

Highway 4 between the Qualicum Interchange and the summit of The Hump has very limited opportunities to pass. As a result long queues develop behind vehicles that travel below the posted speed. The limited passing opportunities are at times not usable due to traffic occupying the opposing lane. With the long queuing of traffic, the two truck climbing lanes are sometimes not effective as the queue is too long to get any sort of separation. From Cameron Lake through Cathedral Grove, the road is very windy, with no passing opportunities, which creates driver frustration. It would be very difficult to construct passing lanes along Cameron Lake, as the corridor is narrow, with lake on one side and steep side hill on the other. There is a massive rock formation at Angel Rock, which makes it very difficult and expensive to make any improvements. Through Cathedral Grove it is not possible to build passing opportunities without the removal of a large number of the massive trees.

If the traffic volume in this area is reduced to mostly tourist traffic, and other travelers take a new route through Horne Lake, the current conditions on Highway 4 may suffice for many years.

4. DESIGN PARAMETERS

4.1 Design

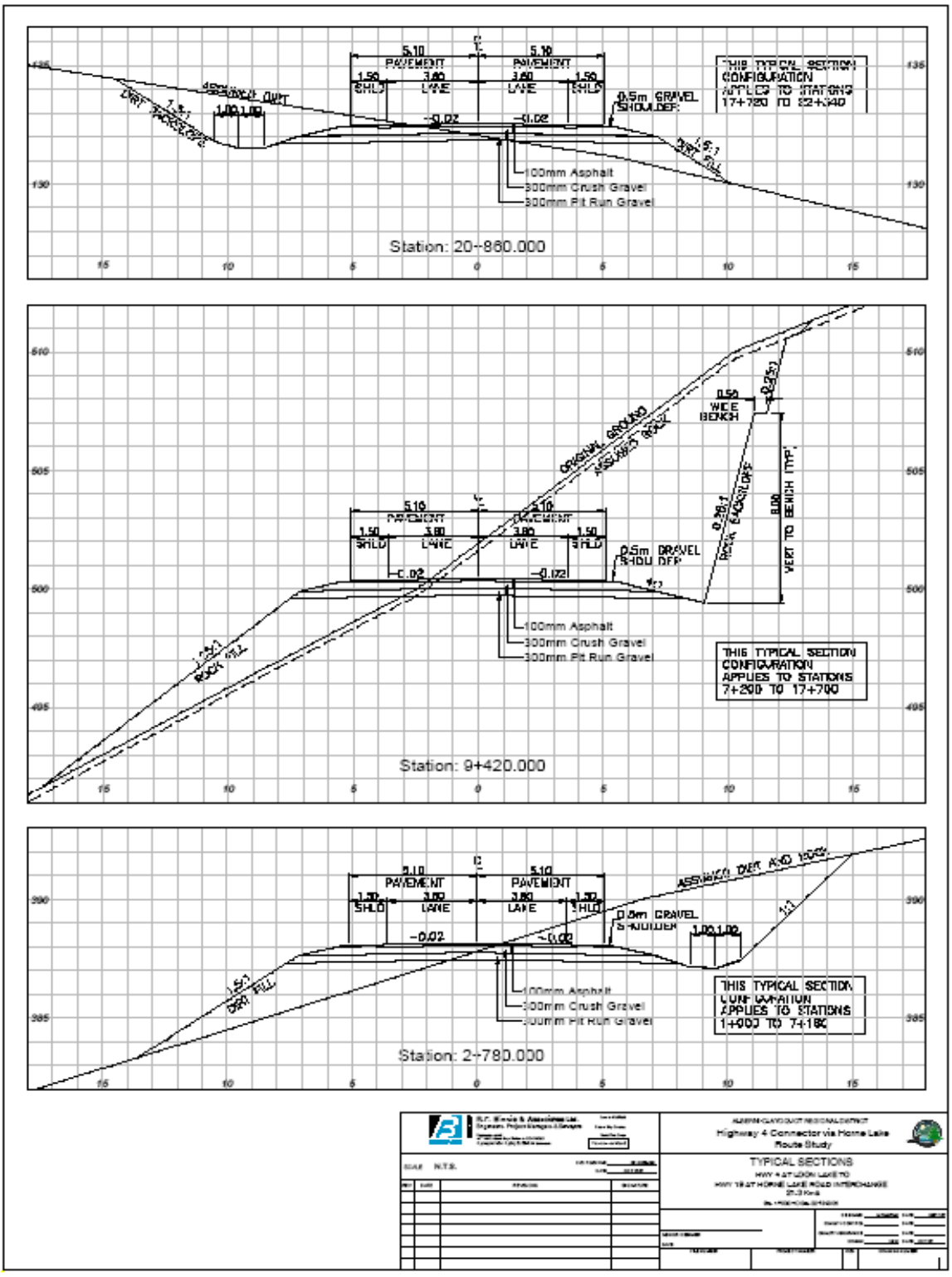
The design parameters for this project were obtained from the *B.C. Supplement to TAC Geometric Design Guide* for a Rural Conventional Undivided (RCU) Roadway Class. The previous *MOT Highway Engineering Design Manual* (Green Book) and the *TAC Geometric Design Guide for Canadian Roads (TAC)* were also drawn upon to provide design parameters for items not found in the *B.C. Supplement to TAC Geometric Design Guide*.

4.2 Typical Cross-section

The cross-section consists of two 3.6 m lanes with 1.5 m wide paved shoulders and 0.5 m of gravel shoulders. The 1.5 m of paved shoulders is the minimum width required for a shoulder bikeway. Additional cross-section elements are shown in Figure 4.1 below.
We have used three different cross-sections to determine the volumes of the various options. The first is a typical section with the entire section is rock. In rock sections, the back slope design is 0.25 horizontal to 1 vertical with 0.5 metre benches every 8 metres vertical. We have used this template where we feel the material is mostly rock. The embankment slopes when made of rock are designed at 1.25:1. We have used this template from station 7+290 to station 17+700

The second cross-section is for when there is a combination of rock and dirt. For this we have used 1:1 side slopes for the cuts and 1.5:1 slopes for embankments. The actual roadway template will be slightly different, but the assumed side slopes are a reasonable way of estimating the quantities. We have used this cross-section from station 1+000 to station.7+290.

The third cross-section is as shown below when we expect the roadway to be mostly constructed in dirt. This cross-section was used from station 17+700 to Highway 19.
The typical sections used for the three zones are shown on the following page:


5.10 PAVEMENT
1.50 SHLD
3.60 LANE
3.60 LANE
5.10 PAVEMENT
1.50 SHLD
0.5m GRAVEL SHOULDER
-0.02
-0.02
100mm Asphalt
300mm Crush Gravel
300mm Pit Run Gravel
THIS TYPICAL SECTION CONFIGURATION APPLIES TO STATIONS 17+720 TO 22+340
Station: 20+860.000
0.50 WIDE BENCH
8.00 VERT TO BENCH (TYP.)
ORIGINAL GROUND
ASSUMED ROCK
ROCK EXCAVATION
THIS TYPICAL SECTION CONFIGURATION APPLIES TO STATIONS 7+200 TO 17+700
Station: 9+420.000
ASSUMED DIRT ROAD
DIRT FILL
THIS TYPICAL SECTION CONFIGURATION APPLIES TO STATIONS 1+000 TO 7+180
Station: 2+780.000
Highway 4 Connector via Horne Lake Route Study
TYPICAL SECTIONS

4.3 Horizontal Alignment

A minimum radius of 250 m and a maximum super elevation of 6% have been used as per Table 330.01.04 from the *B.C. Supplement to TAC Geometric Design Guide.* For the most part we were able to achieve 80 km/hr in the design; however there are two curves that have a 70km/h design speed. As this is a conceptual design, we did not go to the level of designing spiral curves. All curves are simple curves as shown on the drawings. The conceptual alignment is shown at the end of this section

4.4 Vertical Alignment

TAC recommends a maximum grade of 10% for RCU in mountainous terrain. The previous MoT Highway Engineering Design Manual recommended a maximum grade of 10% for RCU in mountainous terrain, and permitted increasing the grade by 2% for grade lengths less than 500 m long. The maximum grade on this project is 9.5% and that is for a 200-metre section of profile. There are two other grades at 9.0% for very short 100 metre intervals. The conceptual profile is shown at the end of this section.

4.5 Intersection Design

We were concerned that diverting up to 3,500 vehicles per day into the Horne Lake Intersection from the south may affect the level of service. We did do a preliminary traffic study on the intersection and found that the left turn movement onto the Horne Lake Connector would operate at a Level “C”, but the overall intersection will operate at a level B. A copy of the report is included in Appendix “B”. An interchange may be required at this location in the future, depending on the growth in traffic on Highway 19 and the Connector.

At the Loon Lake end of the project, we have assumed that the new connector would be the through route and the old Highway 4 would tie into the connector with a Tee intersection. The quantities and cost estimates reflect this configuration. A better solution may be to have a roundabout at this location, but that will require further study.
We have not talked directly with the timber companies operating within the project limits. We have made an allowance for 4 intersections along the route to provide access for the logging trucks.

4.6 Structural Design

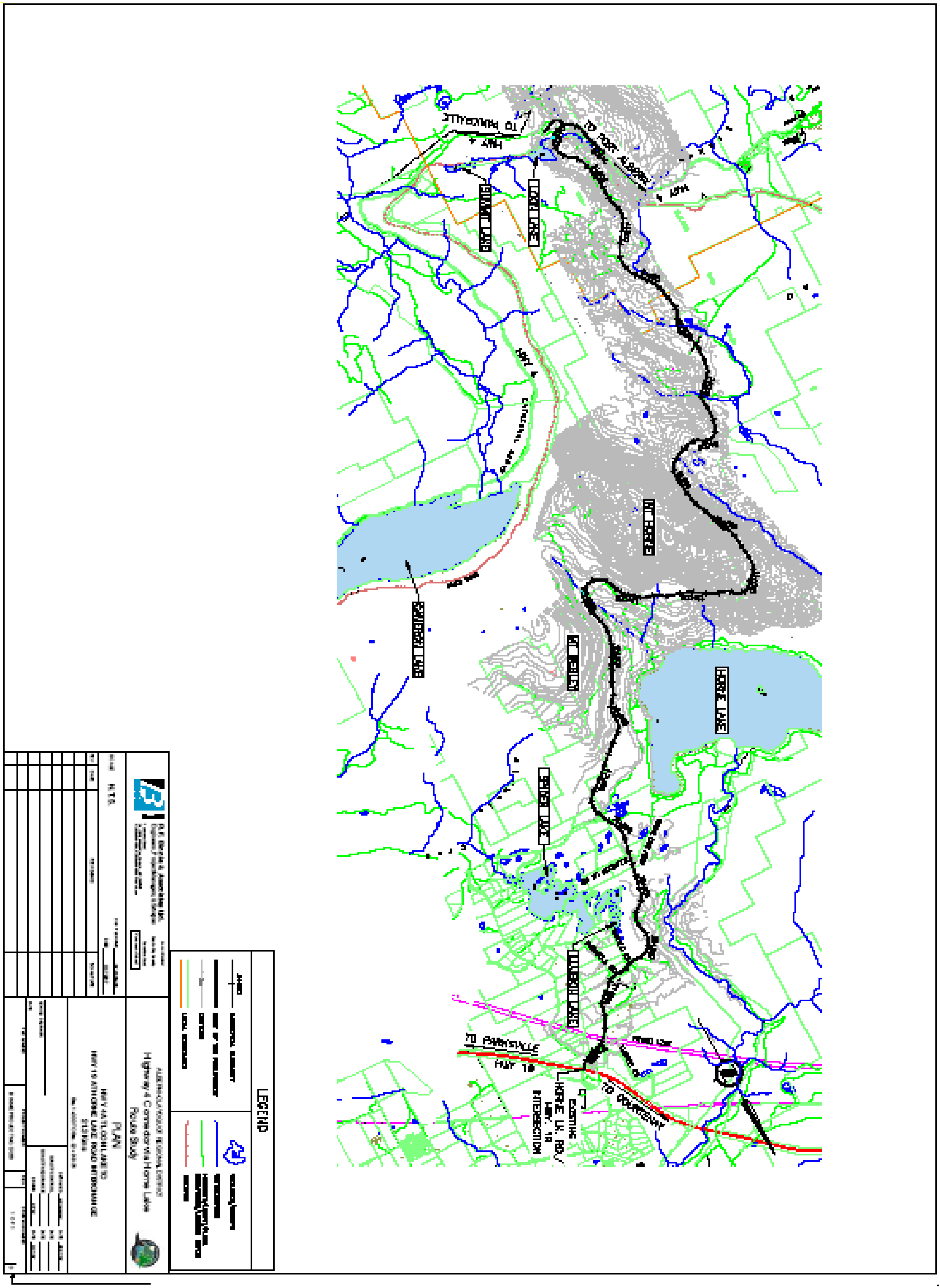
The new route crosses the existing railroad tracks at Loon Lake. Although the railroad is not currently active, we have made an allowance for the highway to pass over the railroad. We have allowed $500,000 to construct a bridge plate pipe arch over the tracks.

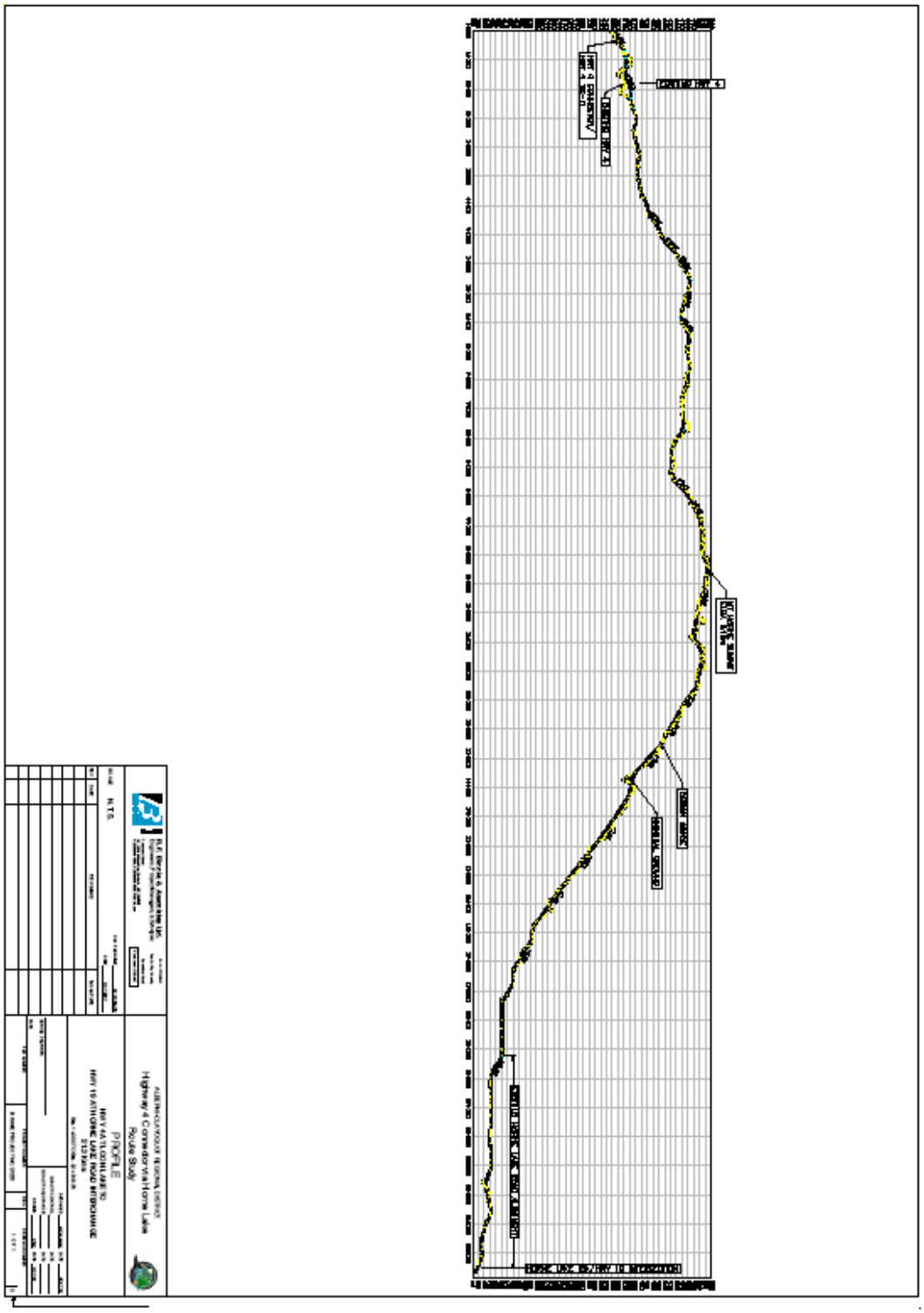
4.7 Drainage Design

There are not any river crossings required in this design. There are some creeks, which will require large diameter pipes. At station 13+800 we are crossing a gully and have assumed a 3,000 mm pipe through the embankment fill. Also at Loon Lake there is a creek adjacent to the railroad, which will require a 2,000mm culvert through the embankment fill. For the remaining alignment we have projected culverts at a nominal spacing of 300metres and nominal size alternating between 1000mm and 600mm along the entire project length to establish the drainage costs.

4.8 No Post Guardrail

This project is mostly side hill cut on one side and a high embankment on the other. We have estimated that 6,820 pieces of guardrail will be required.


TO PORT ALBERNI
HWY 4
HORNE LAKE
TO PARKSVILLE
HWY 19
TO COURTENAY
EXISTING HORNE LK. RD./ HWY. 19 INTERSECTION
LEGEND
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
Highway 4 Connector via Horne Lake
Route Study
PLAN


Highway 4 Connector via Horne Lake
Route Study
PROFILE
N.T.S.

5. ALIGNMENT OPTIONS AND CONSTRUCTION COSTS

The terms of reference for the project suggested that we first look at a route along the south side of the lake. The terrain through there is quite steep. If an alignment could not be found through this section, then this study would be abandoned. The first attempt was to stay fairly low between the 300 and 400 metre contour interval. There were several areas, where the terrain was formidable in terms of very high rock cuts, long sliver fills, and high quantities. The design from the east end of Horne Lake through to the curve around Mount Horne was a distance of about 10 kilometres and the cost estimate was well over 30 million dollars. This was not encouraging and we approached the ACRD with the results. We did look higher up the hillside and found where the contours flattened out. It appeared that a viable route might be found between the 400 and 500 metre contours. We approached the ACRD and they gave the approval to proceed further and investigate the higher option.

The second or higher option is the option that the cost benefit analysis was performed. We have discounted the first option as not worth pursuing due to the difficult terrain and high cost. The drawings, profiles, and cost estimates shown in this report are for the second option only.
Following is Quantity Summary and cost estimate for option 2.

		Horne Lake Connector			15-Oct-07
		Quantity Summary			
		Stations 1+000 to 22+300			
	Quantity	**Unit**	**Price**		**Extended**
Right of Way					
1+000 to 12+000					
Island Timberlands	49.0	ha			
12+00 to 16+700					
Crown?	22.0	ha			
16+700 to 20+300					
Crown?	10.1	ha			
Private	3.9	ha			

20+300 to 22+300					
Private (Existing R/W Widening)	3.8	ha			
Clearing and Grubbing	73.0	ha	$6,000.00		$438,000.00
Logging Road Severance					
Access Intersection	4	ea	$25,000		$100,000
New Logging Road	100	m	$500.00		$50,000.00
Pavement	46,584	tonnes	$85.00		$3,959,640.00
Guardrail	6,820	ea	$250.00		$1,705,000.00
Gravel					
25mm	86,443	m3	$17.00		$1,469,531.00
SGSB	96,580	m3	$13.00		$1,255,540.00
Shoulder	532	m3	$25.00		$13,300.00
Excavation					
Type A	522,399	m3	$20.00		$10,447,980.00
Type D	92,562	m3	$10.00		$925,620.00
Type A/D mixed	188,520	m3	15.75		2969190
Back slope Remediation		m	Varies by		$1,510,000.00
			Cut Height		

Culverts					
2000dia Creek Crossing @ 2+040	73	m	800		$58,400.00
5000dia Railway Crossing @ 2+060	65	LS			$500,000.00
3000dia Gully @ 13+850	65	m	$1,200.00		$78,000.00
600 dia	630	m	$300.00		$189,000.00
1000 dia	630	m	$400.00		$252,000.00
			Total		**$25,921,201.00**
Contingency 16%					$4,147,392.16
Detailed Design 7%					$1,814,484.07
Construction Supervision 10%					$2,592,120.10
Project Management 4%					$1,036,848.04
Management Reserve 5%					$1,296,060.05
Property Acquisition 3%					$777,636.03
Total cost					$37,585,741.45

The above table contains contingencies at the same percentages used by the Wolski and ND Lea estimating methods. We have roughly calculated the areas of land required from the various owners, but have not made an attempt to cost the purchase of the land. Similar to the Wolski estimate we have allowed a contingency of 3% of the construction cost for the purchase of land.

It is worth noting that with this design, there is a large surplus of excavation over embankment. The total unadjusted excavation is 803,481 cubic metres and the total embankment is 540,249 cubic metres. Although the cost of the truck climbing lane has not been included in the cost estimate, this large surplus could be used to widen the embankments and provide for a truck lane from station 12+000 to 17+000 as this is a fairly long climb of an average of 6 to 7% grade.

It should also be noted that a portion of the surplus rock on the project could be crushed for road gravels and pavement aggregate. We did not do any geotechnical testing to prove suitability, nor was any acid rock testing done.
The alignment options that were researched for this assignment were quite limited. We were able to find an alignment that met the criteria and had a reasonable cost estimate with our second try. This is not to say that with more investigation that there is not a better option in the same vicinity. From Highway 19 to Horne Lake, we more or less followed the existing alignment trying to make the best use of road right of way as much as possible, and achieving the design speed requirements.

From Horne Lake to the summit of 513 metres, then traversing west, down to the existing logging road network by Loon Lake did require a lot of changes to the grades and horizontal alignments. Our goal was to minimize excavations and achieve the required design speeds. In order to do this, we do have a lot of curves that are very close to each other. In the next phase of design, these need to be adjusted to try to achieve longer tangents if possible.

A better route to the Loon Lake intersection may be found beyond the summit, through the existing logging road network, to the Highway 4 intersection. We tried to steer the road to the existing railroad crossing, but in the next phase of design it may be determined that this is not the best location as the road does get close to Loon Lake. The profile crosses the railroad tracks with a 10 metre fill to allow for an overpass, which then requires a fill on the existing Highway 4. This height can be reduced, pending detail design.

View of Horne Lake from logging road looking east toward Highway 19A. The new route will traverse this side hill on the south side of the lake.

6.0 CONCLUSION

6.1 Benefits

The ACRD funded this study with the goal that a new and viable route with a high cost benefit could be found connecting Highway 4 to Highway 19. This study shows that there is a viable route with a very positive cost benefit of 2.1 if 70% of the northbound Highway 19 traffic uses the new route and 1.5 if only 50% of the traffic uses the route. It is our assumption that at least 70% of the traffic will use the new route because:

- It will be a more modern highway with an 80km/h design speed with 1.5 metre wide shoulders
- There will be less delays due to accidents and weather events as the area has mostly been logged and the right of way will be cleared wide enough that trees cannot fall onto the roadway
- The travel time will be equal to that of the existing route or marginally less

Given these benefits, it is difficult to see why motorists would choose not to use the new route. Tourists choosing to go to Cameron Lake or Cathedral Grove would still use the existing route. We do not know what percentage of traffic is destined for these areas. It may be worthwhile to do a traffic count in the summer to determine that.

The cost of the new route has been estimated at 37.6 million dollars. This estimate is largely based on 2007 unit prices. Some of the prices may seem low; however the prices do reflect the terrain and type of road to be built. The road is a new route, so drilling, blasting, earth moving, gravelling and paving costs may be lower as the work can be executed without delays caused by traffic.

It is stated in the ND Lea report that “previous studies have concluded that there is a greater economic benefit by improving the existing highway than constructing a new one”. The existing route from the Coombs intersection to Cameron Lake could be improved at reasonable cost. Passing lanes or even four lane sections could be built in the future to deal with increased capacity and safety. The road from Cameron Lake through to The Hump though, is very difficult to improve. Through Cameron Lake the road is narrow and has some massive rock formations. It is also mostly steep side hill rising from the roadway making it very expensive, and difficult to rebuild or widen while maintaining existing traffic.

Significant issues in Cathedral Grove include long delays, fatalities, and accidents caused by falling trees and limbs from the trees. There is also a great deal of congestion in the parking area of this popular site. However, as this spectacular forest is internationally renowned for its ecological value, it is unlikely that road improvements will

take place in this area.

The ACRD has funded a study to determine the location of a new route. The route that is being proposed has a good cost benefit and will help the economy of the entire West Coast continue to grow. There are an increasing number of people who use the Comox Airport to access the West Coast. When the proposed Regional Hospital is built in Courtenay, the new route will provide reliable access to the hospital site for all West Coast communities. A new route will also enable Port Alberni to be a shipping destination for goods and services produced on the northern part of the Island.

6.2 Next Steps

Following are the next steps that the ACRD would like to endorse:

1. That the ACRD be given the opportunity to meet directly with the MOT to discuss this route study.
2. That the Ministry of Transportation undertakes an additional study which would see the project included in its capital program.
3. That R.F. Binnie and Associates make supporting data including AutoCAD Drawings, CAICE files, and cross-sections, available to the Ministry if requested
4. That the Ministry of Transportation obtain better survey data utilizing Lidar or low level aerial photographs to undertake a Preliminary Design. The Preliminary Design would investigate alignment options in greater detail and also investigate geotechnical, environmental and property constraints.
5. That a more detailed survey of the existing traffic on Highway 4 be undertaken to verify assumptions made in this report. This would include traffic patterns, and cost and safety benefits.
6. That the Ministry of Transportation secures funding for detailed design, property acquisition and construction.

Multiple Account Evaluation

Horne Lake Connector

Highway 19 to Highway 4
Via Horne Lake

Prepared for:

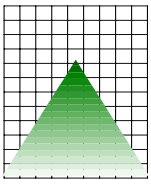
R.F. Binnie & Associates Ltd.
Parksville, BC

Prepared by:

Peter Lyall, P.Eng
Apex Engineering
Vancouver, BC

Project No. BIN-8
16 January, 2008

Apex Engineering Limited



Executive Summary

Horne Lake Connector

The project area is located on Vancouver Island north of Parksville and is a proposal for 20 km of new road linking the Island Highway at the existing Horne Lake Road intersection to Highway 4 east of Port Alberni. The intention is to provide a faster, safer connection for Port Alberni, Tofino and Ucluelet to the Island Highway and to improve reliability in the face of frequent closures on the existing route.

Short counts on Highway 4 range from about 6,000 to 11,000 AADT. The business case was prepared assuming different potential traffic diversion rates at 50% and 70% of the lower volume.

For South Island traffic, the proposed connector is a slightly longer route but has lower overall travel time, accident severity and rate associated with the combination of the Island Highway and the new connector. Traveled distance for North Island Traffic is reduced by 25.7 km, saving 18 minutes and reducing accidents through reduced exposure.

The project is viable from a benefit cost perspective, returning a B/C ratio of 1.5 at 50% traffic diversion and 2.1 at 70% diversion. Net Present Values are $17.3 and $34.6 million on an estimated $37.6 million cost.

Safety is the largest component of direct project benefits, saving an estimated 5.4 to 7.6 accidents per year. This project is unique in leveraging its safety benefit at no additional cost to the project by re-routing traffic onto the existing, safer Highway 19, the Island Highway; a high standard divided 4-lane facility with about 11,000 AADT.

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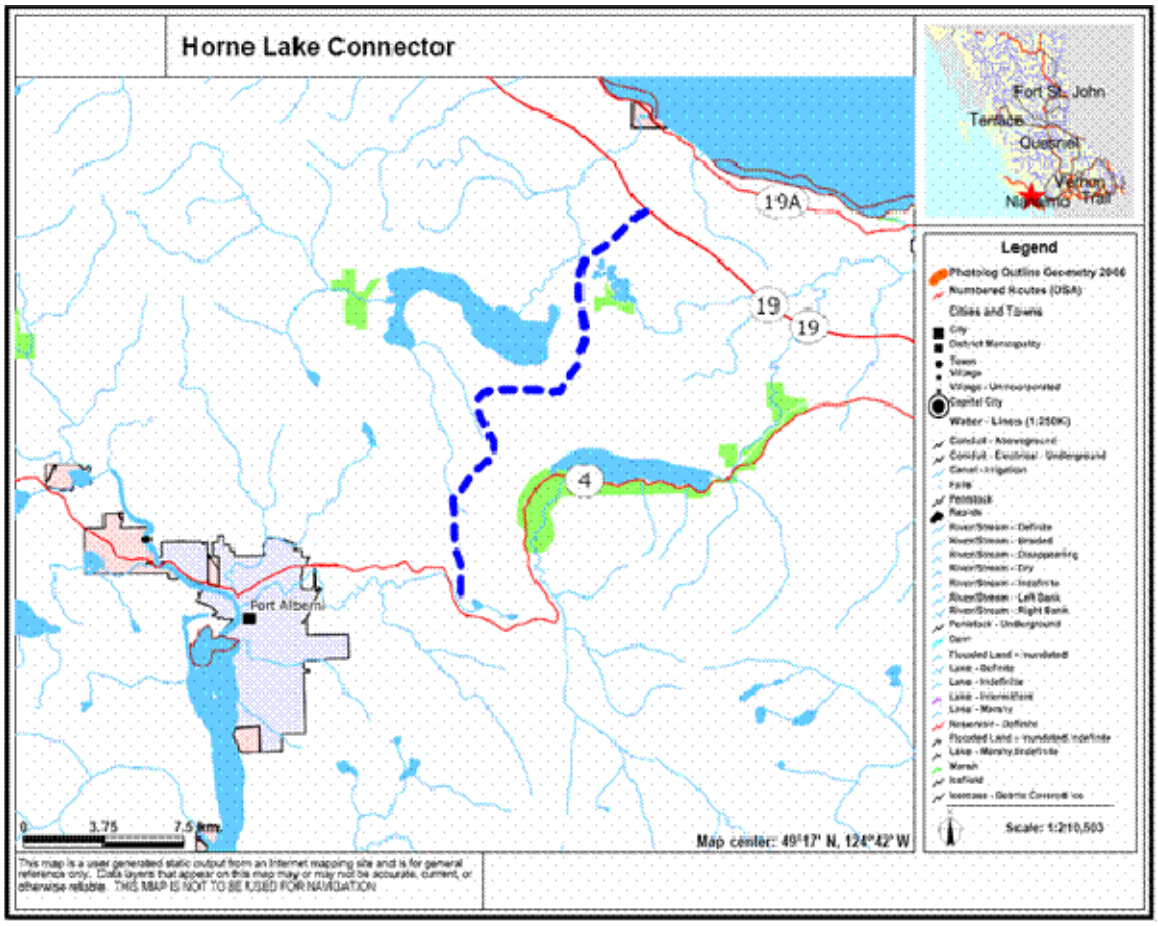
Exhibits

1 Project Description

The Project area is located on Vancouver Island north of Parksville and is a proposal for 20 km of new road linking the Island Highway at the existing Horne Lake Road intersection to Highway 4 east of Port Alberni. The intention is to provide a faster, safer connection for Port Alberni, Tofino and Ucluelet to the Island Highway and to improve reliability in the face of frequent closures on the existing route. The Connector is shown conceptually in Exhibit 1-1.

Exhibit 1-1 General Location



Highway 4 is the primary link between Port Alberni/Tofino/Ucluelet and regional services and markets in Nanaimo and Parksville. Unscheduled closures due to weather or motor vehicle accidents effectively cut off these communities from the outside.

2 General Approach

The general approach is to analyse North and South Island traffic separately since the new connector impacts each traffic stream differently. The differences in travel time and distance are summarised in Exhibit 4-3 and Exhibit 4-4 and the safety performance in Exhibit 4-2.

South Island to Alberni Highway traffic is assumed to exit the Island Highway at the Highway 4 I/C, traveling west on Highway 4 through Hilliers and Whiskey Creek to Port Alberni. With the new connector in place, South Island traffic may continue north on the Island Highway past the Highway 4 I/C on to the Horne Lake Intersection and access the new connector. This route is about 3 km longer

but shortens travel time by 2 or 3 minutes due to the higher design standards and is safer overall.

North Island traffic now travels south on Highway 19 exiting at Highway 4 onto the Alberni Highway. With the new connector, North Island traffic would exit at Horne Lake Road onto the new connector shortening travel distance by over 25 km and 18 minutes.

3 Traffic

Four short counts have been taken in 1997, 2002, 2003 and 2006 at the Arrowsmith summit near the point where the proposed connector would join Highway 4 from the north. The counts range from 6,000 to 7,000 SADT. Calibrated to adjacent counts, the AADT is approximately 5,700.

For analysis purposes, this traffic is assumed to be:

- 5% local traffic, which is not subject to diversion to a new connector (Cathedral Grove traffic for example)
- 10% North Island traffic
- 85% South Island Traffic

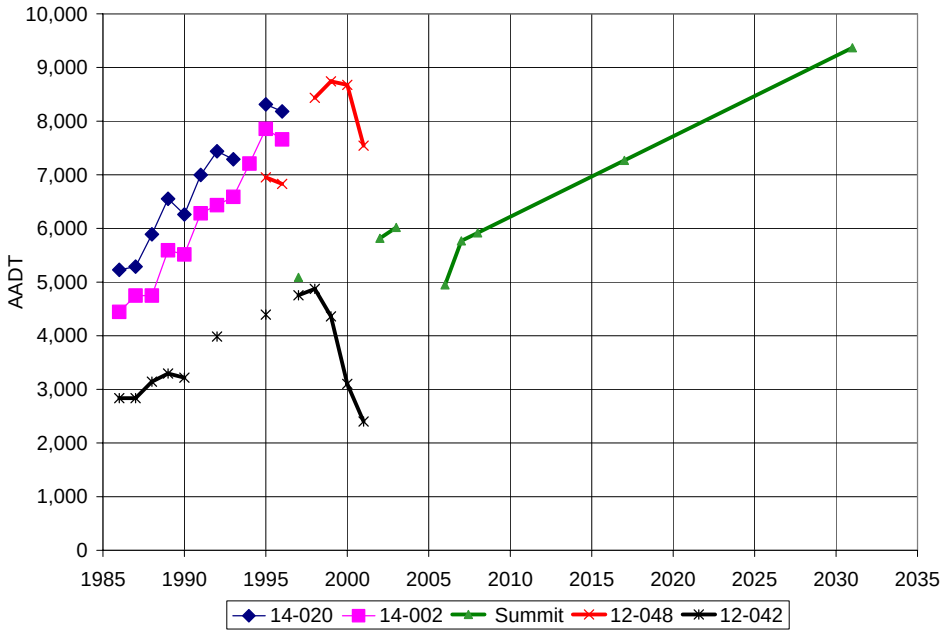
The north and south Island traffic is subject to diversion to the new connector. This business case tests the impact of capturing 50% or 70% of the through (non-local) traffic. This translates to roughly 2,700 or 3,800 AADT on the new connector. The capture rate and AADT assumptions are presented in Exhibit 3-1.

Exhibit 3-1 Traffic Assumptions

	Existing Rte Hwy 4	Proposed Horne Lake Connector 50% capture	Proposed Horne Lake Connector 70% capture
Traffic			
Counter	n/a		
Location	Arrowsmith Summit		
Last Count Yr.	2006		
Est 2007 AADT	**5,767**		
Split			
% Local Traffic	5%		
% North Island	10%		
% South Island	85%		
AADT = split x average			
Capture Rate	100%	60%	80%
Local Coombs Traffic	288	nil	nil
North Island	577	346	461
South Island	4,902	2,941	3,921
Total	5,767	3,287	4,383
Growth Rate	2.5%	2.5%	2.5%
% Trucks	10%	10%	10%

Historical and projected growth at these two count stations is presented in Exhibit 3-2. Historically, traffic has been growing at about 2.5%, which may reflect the influence of induced travel with the opening of the Island Highway. After 1999 there was a general decline in traffic volume evident at various counters between Hilliers and Port Alberni. This may be in response to a decline in activity at the Mill in Port Alberni and more broadly in forest products activity. Traffic will likely rebound and future demand growth is forecast at 2.5% per annum, but starting from a level below the historical trend line. Future population growth in Tofino/Ucluelet is forecast at 2.5% per annum.

Exhibit 3-2 Historical and Projected Traffic



Counter	Location
14-020	Hwy 4 W. of Hilliers Rd
14-002	Hwy 4 E. of Hilliers Rd
Summit	Hwy 4 Arrowsmith Summit
12-048	Hwy 4 E. of P. Alberni
12-042	Hwy 4 at Old Alberni Hwy

4 Multiple Account Evaluation

4.1 General approach

The project is evaluated in a multiple account framework, which includes financial, customer service, environmental, social and economic impact accounts. Most of the weight is given to the financial and customer service accounts since the social and environmental impacts are minor.

Benefits and costs are assessed as incremental to a base case, which assumes the existing highway continues in place. A 25-year horizon is assumed with a 6% discount rate. The direct benefits stemming from the project are primarily safety and travel time benefits. The costs evaluated include property, engineering, construction, operating and maintenance.

Benefits are evaluated separately for North and South Island traffic and then added together. Results are presented for 50% and 70% capture rates of existing traffic.

4.2 Financial Account

The financial account documents the capital and life cycle operating and maintenance costs. Exhibit 4-1 presents the capital cost assumptions used for analysis. Additional maintenance costs are assessed at $8,000/2-Ln-km for new route and $90,000/km for resurfacing every 15 years.

Exhibit 4-1 Capital Costs
($Millions 2007)

Property	$777,653
Engineering & Mgmt	$4,147,484
Reserve	
Construction	$32,661,435
Total	$37,586,572

4.3 Customer Service Account

4.3.1 Safety

The accident rates on Highway 4 and Highway 19 are based on 5 years of data from 2002 to 2006 inclusive. Within the study area, Highway 4 had 321 crashes (8 fatal) and Highway 19 had 101 crashes (1 fatal). The accident rate on Highway 4 in the study area at 0.64 acc/mvk compared to the Provincial average 0.50 acc/mvk for rural 2 lane arterials. The new connector is analysed assuming a Provincial average crash rate for a 2 lane rural arterial.

The observed and predicted safety performance is summarised below in Exhibit 4-2. The proposed connector has the potential to save 5.4 accidents/year at a 50% capture rate and 7.6 accidents/year at a 70% capture rate.

Accident severity and data by segment is presented in Appendix A..

Exhibit 4-2 Safety Performance

	Base	Proposed	Reduction
	Crash Rate (Acc/mvk)		
South Island Traffic	0.64	0.46	
North Island Traffic	0.57	0.50	
	50% Capture Rate		
	Exposure (mvk/yr)		
South Island Traffic	28.0	30.8	
North Island Traffic	4.8	2.1	
	Accidents/yr		
South Island Traffic	17.9	14.2	3.7
North Island Traffic	2.7	1.1	1.7
Total	20.7	15.2	5.4
	70% Capture Rate		
	Exposure (mvk/yr)		
South Island Traffic	39.2	43.1	
North Island Traffic	6.7	2.9	
	Accidents/yr		
South Island Traffic	25.1	19.9	5.2
North Island Traffic	3.8	1.5	2.3
Total	28.9	21.3	7.6

4.3.2 Mobility

Mobility assumptions are presented in Exhibit 4-3 and Exhibit 4-4. South Island traffic travels slightly further in the proposed case, but at a higher speed and overall travel time is reduced from 25 to 23 minutes. North Island travel time is reduced from 33 to 15 minutes and travel distance is reduced from 45.7 to 20 km.

Exhibit 4-3 Traveled Distance

	Existing	Via Horne Lake Connector
	South Island Traffic	
Segment	2356 (Hwy 4)	2353 (Hwy 19)
Start km	0.0	0.0
End km	2.6	14.4
Length (km)	2.6	14.4
Segment	2355 (Hwy 4)	New road
Start km	0.0	0.0
End km	28.7	20.0
Length (km)	28.7	20.0
Total Length (km)	31.30	34.40
	North Island Traffic	
Hwy 19 Segment	2353 (Hwy 19)	nil
Start km	25.7	
End km	40.1	
Length (km)	14.4	
Hwy 4 Segment	2356	nil
Start km	0.0	
End km	2.6	
Length (km)	2.6	
Hwy 4 Segment	2355	New road
Start km	0.0	0.0
End km	28.7	20.0
Length (km)	28.7	20.0
Total Length (km)	45.7	20.0

Exhibit 4-4 Travel Time and Speed Assumptions

Travel Speed & Time	**Existing Rte via Hwy 4**	**Via Horne Lake Connector**
	South Island Traffic	
Avg. Travel Speed (km/hr)		
Hwy 4	75.1	nil
Hwy 19	nil	108
Horne Lake Connector	nil	80
Rte Avg	75.1	91.7
Travel Time (minutes)		
Hwy 4	25.0	nil
Hwy 19	nil	8.0
Horne Lake Connector	nil	15.0
Total	25.0	23.0
	North Island Traffic	
Avg. Travel Speed (km/hr)		
Hwy 4	75.1	nil
Hwy 19	108	nil
Horne Lake Connector	nil	80
Rte Avg	85.5	80
Travel Time (minutes)		
Hwy 4	25.0	nil
Hwy 19	8.0	nil
Horne Lake Connector	nil	15.0
Total	33.0	15.0

4.3.3 Incident Delay

This is delay caused by scheduled or unscheduled incidents, which result in a highway closure. Within the 31.3 km study area of Highway 4, closure data recorded by DriveBC over the 21 months from 6 June, 2005 to 14 March, 2007, included 12 closures generally due to collisions, tree falls or weather.

Exhibit 4-5 Highway Closure Data

Number in 21 months	12
Total Hours	53.4
Average Hours/closure	4.5
Hr/100km/yr	97.6

Duration (hrs)	Date & Time	Type	Cause	Location
0.64	11/14/06 17:35	Planned	Maintenance	Cathedral Grove
3.63	11/14/06 18:57	Planned	Maintenance	Cathedral Grove
8.37	6/20/05 20:48	Incident	Collision	Ramps to and from Route 19, West of Parksville
6.80	11/29/05 10:05	Incident	Collision	Junction with Highway 4A
3.32	2/21/06 6:19	Incident	Collision	Junction with Highway 19
0.00	4/13/06 17:50	Incident	Livestock on Road	Cathedral Grove
2.50	11/4/06 20:27	Incident	Collision	Cathedral Grove
7.55	11/15/06 17:59	Incident	Debris on Road	Junction with Highway 4A
8.90	12/12/06 0:34	Incident	Heavy Rain and Wind	Port Alberni
8.34	12/12/06 0:43	Incident	Tree on Road	Port Alberni
3.05	2/28/07 18:27	Incident	Collision	Cathedral Grove
0.33	7/14/06 22:33	Incident	Collision	Coombs

When analysed in a queuing model, these closures generate 13,462 veh-hrs of delay per year. A commuter making 200 one-way trips has a 60% probability of encountering a queue and if a queue is encountered, the average delay is 2 hours and 25 minutes. A new route could potentially reduce this by 75%, saving

10,231 veh-hrs/yr with a present value over 25 years of $2.9 million. This is has been added to direct project benefits.

The study area has the equivalent of 97 hrs of closure/100 km/year. This appears initially to be well above the rate in other corridors shown below. This reflects a relatively small segment with high closure frequency. Taken at the corridor level comparable to other highways, the equivalent figures for the Alberni Highway from Highway 19 to Tofino are 104 hours of closure in 21 months over 164 km or the equivalent of 36.2 Hrs/100 km/yr. This is still moderately high for a highway of this traffic volume.

Corridor	***Hr/100km/yr***
Highway 4 – Hwy 19 to Tofino	36.2
Highway 97 Swan Lake to Monte Creek	4.1
Highway 16 Prince Rupert to Kitwanga	25.2
Highway 16 Kitwanga to Prince George	12.0
Highway 16 Prince George to Alberta	8.0
Highway 97 US Border to Kaleden	13.6
Highway 97 Kaleden to Westbank	20.8
Highway 97 Westbank to Swan Lake	60.6
Highway 99 Horseshoe Bay to Whistler	72.0

4.4 Environmental Account

Environmental impacts have not been assessed yet. The alignment generally follows existing roads from Highway 19 to Horne Lake and forest service roads to Highway 4, crossing 2 or 3 streams and following 8 or 9 km of shoreline along Horne Lake. Terrain is generally undeveloped forestlands and lowlands.

Impact categories include fish and fish habitat, wildlife habitat, ALR impacts, recreation and archeological impacts. The new alignment would be:

- Neutral with respect to fish habitat assuming full mitigation or compensation of impacts on the route.
- Slightly negative for wildlife as the connector will bisect previously intact habitat. Roads near water bodies such as Horne Lake also tend to have more animal/vehicle collisions as animals traverse the road to the water.
- Neutral with respect to ALR. The alignment does not traverse any ALR land with the exception of the existing Horne Lake Road adjacent to the Island Highway
- Recreation impacts are likely positive with the road providing better access to recreation around Horne Lake
- Archeological impacts are unknown
- Greenhouse gases - There is some reduction in fuel consumption due to the gentler terrain on the connector and the reduction in stopped delay. This is offset by the increased vehicle kilometers of travel and higher

travel speeds on the Island Highway/Connector. The overall impact is slightly negative.

4.5 Social Account

This option measure impacts to the surrounding community. In this case the project has strong support from communities west of the proposed connector. Highway 4 is the only connection to the regional airport in Nanaimo and to regional health services in Nanaimo. Fish products transported from the west coast on the Alberni Highway are particularly time sensitive and losses occur as a result of highway closures.

Other categories in this account include noise, visual, displacement and barrier effects of the highway project. These do not generally apply in this case as the connector is largely outside any developed area.

Diverting traffic away from Highway 4 through Whiskey Creek and Hilliers, would have some negative economic impacts identified in the next section. From a social perspective however, reduced traffic means less noise and a more pedestrian friendly environment. Traffic dependent business elements aside, this is a positive contribution to community values and liveability.

4.6 Economic Development Account

This account is intended to assess the broader economic impacts of a project beyond the immediate direct impacts to highway users. In this case the project supports the broader goal of improved access to the west coast of Vancouver Island along with the increasing interest in west coast recreational property and international and regional tourism. The highway provides access to the Pacific Rim National Park and Clayquot Sound recreational areas. Logging is in decline in this area but shellfish and aquaculture industries are increasing.

Locally, there are 10 to 20 highway-oriented businesses in Hilliers and Whiskey Creek, which would be bypassed by the connector. To the extent that they depend on drive-by traffic, their business will decline following the shift in traffic. Similar to Coombs, the typical outcome is a re-orientation of business towards more locally based or specific destination markets rather than a drive-by market base.

Offsetting the potential negative impact to business in Whiskey Creek and Hilliers are the benefits to businesses in Port Alberni and points west, of a more reliable highway connection to regional service centers in Parksville and Nanaimo.

5 Multiple Account Evaluation Summary

The results are presented in Exhibit 5-1. The project is viable from a benefit cost perspective. The direct benefits of the project exceed the direct costs.

The benefits stem from time and accident cost savings and are split about 60% to South Island and 40% North Island.

Timesavings to South Island traffic are about 2 min per vehicle in spite of a 3.1 km longer traveled distance by way of the new connector. The time saving stems from the higher operating speeds on the Island Highway and the new connector. North Island traffic benefits from a 25.7 km reduction in traveled distance from 45.7 km to 20.0 km and saves about 18 minutes. The low volume estimated at about 600 AADT offsets the large saving to North Island traffic. $2.9 million is added to timesavings in each case to account for reduced incident delay on Highway 4.

Accident Cost savings stem from both a reduction in accident severity and rate. South Island Traffic diverts from the 2 lane Highway 4 onto the 4 lane divided Island Highway and the new connector, both of which have lower severity and rate than the existing Highway 4. North Island traffic achieves accident reduction mostly through lower exposure due to the reduction in vehicle kilometers of travel by the shorter connector.

Reductions in vehicle operating costs are the third component evaluated for direct benefits. In this case, there is a net increase in both vehicle kilometers of travel and in the operating speed. Reduced cost to North Island traffic is offset by increases to South Island Traffic. While the new route has gentler terrain and reduced stop delay, the increased speed and distance contribute to an overall increase in fuel consumption and other vehicle costs. The net impact is minor but negative in this sub-account.

The costs include estimates of property, engineering and construction costs plus the present value of recurring maintenance and rehabilitation costs. The new road represents an incremental cost to the infrastructure provider.

Non-quantifiable impacts on the MAE chart are rated subjectively on a scale of -2 to +2 relative to current conditions without the project. This is normally done to allow comparison between alternatives. In this case, no alternatives have been proposed.

Exhibit 5-1 Multiple Account Evaluation

ACCOUNT		Diverted Traffic 50% Capture	Diverted Traffic 70% Capture
FINANCIAL		2007 Millions $	
	Discounted Cost	$35.5	$35.5
+	Maintenance & Rehab	$2.8	$2.8
-	Salvage	$6.3	$6.3
=	Present Value	$31.9	$31.9
CUSTOMER SERVICE		2007 Millions $	
	Time Savings	$24.2	$31.6
	Accident Savings	$27.9	$39.0
	Vehicle Operating Cost Savings	($2.9)	($4.0)
	Present Value	$49.2	$66.5
	Benefit/Cost Ratio	1.5	2.1
	Net Present Value	$17.3	$34.6
SOCIAL/COMMUNITY			
	Noise/Visual	0	0
	Displacement	0	0
	Barrier Effect	0	0
	Community Support	1	1
ENVIRONMENTAL			
	Fish and Fish Habitat	0	0
	Wildlife	-1	-1
	Agricultural Land Reserve	0	0
	Recreation	1	1
	Archeological	0	0
ECONOMIC			
	Local Business	0	0
	Provincial/National	1	1

Scoring	Relative to Existing
-2	Significantly worse
-1	Worse
0	Neutral
1	Better
2	Significantly better

6 Risk/Sensitivity Analysis

Exhibit 6-1 presents a sensitivity analysis of the results to changes in discount rate, construction cost and projected growth. In this case the project remains positive over the range of sensitivities tested.

Exhibit 6-1 Sensitivity Analysis

	Sensitivity Option						
	6% Discount Rate	4% Discount Rate	8% Discount Rate	+10% Construc-tion Cost	+25% Construc-tion Cost	Traffic Growth +0.5%	Traffic Growth -0.5%
	Net Present Value (millions $)						
50% Capture	14.4	13.6	11.6	10.6	5.0	7.0	6.0
70% Capture	31.7	48.1	19.8	27.9	22.3	35.3	28.4
	B/C Ratio						
50% Capture	1.5	1.4	1.4	1.3	1.2	1.2	1.2
70% Capture	2.0	2.5	1.6	1.9	1.7	2.1	1.9

The primary sensitivity tested is the assumed capture rate for traffic diverting to the new route. 50% and 70% are tested.

7 Project Implementation

The project is at the conceptual stage and no implementation plan has been developed yet.

8 Conclusions and Recommendations

The project returns positive economic benefits in the form of timesavings and accident reduction.

There are large time savings to North Island traffic since the new connector reduces traveled distance by 25.7 km and 18 minutes. This is offset by a lower volume on this direction of approach to the proposed connector, estimated at 577 AADT. For South Island traffic, the traveled distance increases slightly compared to the existing Highway 4 route but travel time declines slightly (3 minutes) due to the higher travel speeds on the Island Highway and new connector.

Safety is the largest component of user benefits. This project has a *unique characteristic of leveraging its safety benefit at no additional cost to the project by re-routing traffic onto the existing, safer Highway 19*. While the connector will have better safety performance than Highway 4, the leveraged benefits more than double the benefits of the connector alone. The combination of Highway 19/Connector has the potential to save an estimated 5.4 to 7.6 accidents per year depending on the rate of traffic diversion to the new connector. Accident savings to North Island traffic stem from a reduction in exposure while savings to south Island traffic stem from a reduction in severity and rate associated with the 4 lane divided Island Highway and the new connector alignment.

While the main impetus for this project is reliability, the determining factor in the benefit cost analysis is safety. From a benefit cost perspective, the project is feasible and returns a positive economic benefit. The Benefit Cost Ratio is 1.5 at 50% diversion and 2.1 at 70% diversion.

Cost Sharing

- Highway 4 is a designated National Highway System Feeder Route and may be eligible for cost sharing with the Federal Government under a Strategic Infrastructure Funding program.
- ICBC also has a cost-sharing program to the extent that their own analysis demonstrates a potential insurance cost saving.

Other options to the bypass should be identified and evaluated or explicitly ruled out if they are not feasible due to terrain or other limitations.

Appendix A
Accident Data

Observed Base Case
Accidents **2002 to 2006**

Highway 4 *(Existing S. Island Route)*				
Segment 2356 0.0-2.62	2.62			
Segment 2355 0.0-28.68	28.68			
Length (km)	31.30			
Service Class	RAU2			
AADT 10 yr Average	8,472			
Years	5			
Exposure (mvk)	484			
	Fat	Inj	PDO	All
Accidents	8	143	170	321
Observed Rate (a/mvk)	0.014	0.24	0.29	0.55
Severity	2.5%	44.5%	53.0%	100.0%

Highway 19				
NB Segment 2353 km 0.0-14.4	14.40			
SB Segment 2354 km 25.69 - 40.08	14.40			
Length (km)	14.40			
Service Class	RAD4			
AADT 10 yr Average	9,432			
Years	5			
Exposure (mvk)	248			
	Fat	Inj	PDO	All
Observed Accidents	1	38	62	101
Observed Rate (a/mvk)	0.0040	0.15	0.25	0.41
Rate Used for Analysis (acc/mvk)	0.0043	0.19	0.22	0.41
Provincial Avg. Severity	1.05%	45.5%	53.5%	100.0%

Estimated

Horne Lake Connector				
Length (km)	20.0			
Service Class	RAU2			
	Fat	Inj	PDO	All
Predicted Rate (a/mvk)	0.01	0.22	0.27	0.50
Severity	2.41%	43.5%	54.1%	100.0%

Combined Hwy 19/Highway 4 *(Existing N. Island Route)* Length (km)	45.7			
	Fat	Inj	PDO	All
Combined Rate (a/mvk)	0.01	0.25	0.30	0.57
Severity	2.23%	44.5%	53.3%	100.0%

Combined Hwy 19/Horne Lake Connector *(proposed S. Island Route)* Length (km)	34.4			
	Fat	Inj	PDO	All
Predicted Rate (a/mvk)	0.01	0.20	0.25	0.46
Severity	1.91%	44.2%	53.9%	100.0%