



FINAL REPORT- OCT 9, 2012

Port Alberni Port Authority
**Highway 19 Connector to Highway 4
Haggard Route Coupled with Lacey Lake Route
Route Study
Conceptual Design and Cost Estimate**

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1.0 EXECUTIVE SUMMARY

R. F. Binnie and Associates Ltd. were asked to do a further study by the Port Alberni Port Authority to do a conceptual design for a route connecting the Haggard Route to the Lacey Lake Route. The Haggard Route traversed along the south side of Horne Lake, around the base of Mount Horne connecting with Highway 4 at Loon Lake and/or the access to Mount Arrowsmith. The Lacey Lake route followed the north shore of Horne Lake then followed a logging road network towards Lacey Lake, and intersected Highway 4 at the Coombs Country Candy. The coupler route explored in this report follows the Haggard Route to and around Mount Horne, then crosses over to Lacey Lake and follows the Lacey Lake Route to the Coombs Country Candy.

The scope of the work was as follows:

- Determine if there is a viable route connecting the two previously studied routes;
- Determine an approximate cost for the route
- Provide comments on the feasibility and pros and cons of this route

Binnie did find a route meeting an 80km/h design criteria. The route begins on Highway 19 and follows the Haggard connector to Mount Horne, then connects to the Lacey Lake route. The terrain is not difficult for road building and the profile also is not extreme. From Lacey Lake, the route follows the previously designed route, crossing the railway and exiting at Coombs Country Candy. This route requires a soil steel structure for the railroad crossing if the railroad is to be maintained, and the profile grade allows for the Highway to cross the railroad. The total length of the route from Highway 19 to Highway 4 is 25.05 kilometres. The design is based on contour maps provided by Island Timberlands. The contours and digital modeling were used to determine the volume of soils that would have to be excavated to construct the road. Binnie did not do any geotechnical investigations to determine if the soil is rock or dirt and for the purpose of this report, we have determined that all the excavation volume is dirt. In the event that the material is rock, then the volumes will be significantly less because we can go with a steeper cut slope, but the unit price for drilling and blasting rock is higher. Past experience has shown that using a lower unit price for dirt with a greater volume is relatively equal to having a higher unit price for rock with less volume.

The total distance of the route that was studied in this report is 25.05 kilometres and if travelling at the design speed of 80km/h the time to travel from Highway 19 to the Coombs Country Candy would be just less than 19 minutes. The distance from the Qualicum Interchange to the Horne Lake turn off on Highway 19 is 14.2 kilometres and if travelling at the design speed of 110km/h a total travel time of about 8 minutes. The combined distance from the Qualicum Interchange to the Coombs Country Candy via the Horne Lake Route is 39.25 kilometres with a total travel time of 27 minutes. The travel distance on the existing route from the Qualicum Interchange to the Coombs Country Candy Store is 35 kilometres with a travel time of 30 minutes if traffic attains an average speed of 70km/h. The new Haggard to Lacey Lake coupler route is about 3 minutes less travel time than the existing route.

For Southbound traffic on Highway 19, or traffic travelling from Courtenay to the west coast, the distance would be 25.05 kilometres vs. 49 kilometres on the existing route. The travel time for the new

route would be 19 minutes vs. 37 minutes using the existing Highway 4, a saving of 18 minutes one way assuming an average speed of 80 km/h.

Binnie has hired Peter Lyall from Apex Engineering to do a cost benefit analysis of the various routes, based on traffic analysis and accident rates to the year 2012. The Port Alberni Port Authority has done recent traffic counts of Highway 4 on two separate days (August 29 and August 30). The counts were done from 6:00 am to 6:00 pm with the following results:

- August 29 – 7,523 vehicles with 404 semi trailers
- August 30 - 8,183 vehicles with 398 semi trailers

Average daily traffic over two days is 7,853 vehicles for 12 hour count with 5% of those vehicles as semi trailers. If we assume that there is 20% additional traffic between 6:00 pm and 6:00 am, which is a reasonable estimate based on traffic counts in the area, this would increase the average daily traffic to 9,424 vehicles per day.

The cost benefit analysis for the sites will be included as an appendix to this report.

There will be some significant challenges associated with this route such as:

- The route goes very close to Lacy Lake and through the Cherry Creek Watershed area. A road through the watershed would have an impact on the watershed and the environment.
- The maximum elevation of the route is 515 metres as we go around Mount Horne.
- The road design crosses the railroad on a fairly flat skew, which requires a soil steel structure about 70 to 80 metres long

There are some good benefits of the Haggard to Lacey lake Coupler Route such as:

- The cabins on the North side of Horne Lake will be undisturbed;
- The route travels above the cabins on the south side of the lake, so noise disturbance should not be an issue to those cabins;
- The length of the coupler route is shorter than the Lacey Lake Route by over 2 kilometres and does not require a bridge across the Qualicum River;
- For the most part, all construction can be done without having to deal with public traffic.

The approximate cost of the segments is as follows:

▪ Segment 1 (4.94KM) – Coombs Country Candy to Lacey Lake	\$15,973,000
▪ Segment 2 (6.36KM) – Lacey Lake to Haggard Route	\$16,225,000
▪ Segment 3(13.75KM) - Haggard Route to Highway 19	\$31,111,000

Total Estimated Cost for Coupler route connecting the Haggard Route and Lacey Lake = \$63,309,000.

In comparison, the Haggard Route to Loon Lake was estimated at \$37.6 million dollars. The main difference in the costs is that the Haggard Route is only 20.2 kilometres of new road construction, whereas the coupler route is 25.05 kilometres. The Haggard route utilizes 5 kilometres of existing Highway 4 from the top of the hump to the Coombs Country Candy. The Lacey Lake Route on the North side of Horne Lake was estimated to cost \$49.9 million.

The primary reason why the Haggard Coupler route is so much more expensive than the Lacey Lake Route on the North side of Horne Lake is that the Coupler route is all new construction whereas the Lacey Lake Route utilized a lot of existing roadway.

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2.0 INTRODUCTION

R. F. Binnie and Associates Ltd. were hired by the Port Alberni Port Authority 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 Coombs Country Candy Store. The route would travel along the existing Horne Lake Road to a point at Horne Lake where the route goes south and traverses up the side hill to Mount Horne, then connects with the Lacey Lake Route at Lacey Lake at which point it goes to the Coombs Country Candy. Mapping from Island Timberlands was utilized to prepare the conceptual design.

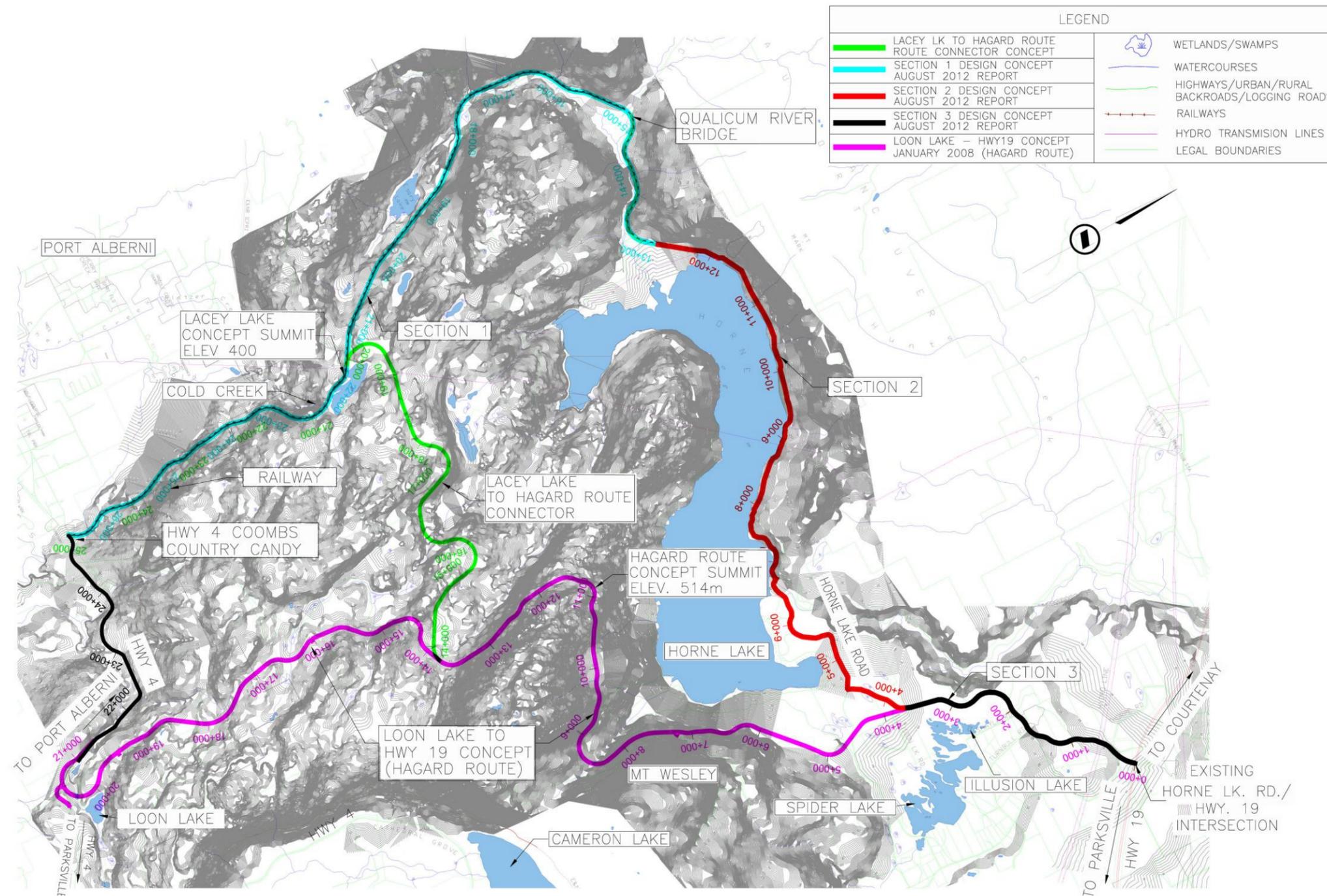
The scope of the work was as follows:

- Determine if there is a viable route connecting the Haggard Route with the Lacey Lake Route that meets an 80 km/hr. standard.
- Determine an approximate cost for the route.
- Provide comments on the feasibility and pros and cons of this route

The proposed route is split into three segments as shown in **Figure 2.1** on the following page and described below:

- Segment 1 – Coombs Country Candy Store to Lacey Lake 4.94 kilometres
- Segment 2 - Lacey Lake to Haggard Connector – 6.36 kilometres
- Segment 3 – Haggard Connector to Highway 19 – 13.75 kilometres

2.1 FIGURE 2.1 PROPOSED ROUTE



3.0 DESIGN PARAMETERS

3.1 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.

3.2 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 3.1** below.

Much of the alignment is inaccessible at this stage of the design so an assumption was made that all the material to be removed for road construction is dirt excavation, not solid rock. This then increases the cut volume dramatically. If the excavation encountered is actually solid rock, then the volume of excavated material would be roughly 50% less than the volume of dirt because of the steeper cut slopes in rock. Rock excavation is roughly 2 times the cost of dirt excavation so for estimating purposes, classifying all the excavation as dirt will provide a reasonable cost estimate for the excavation work.

An allowance has not been made for a truck climbing lane. The need for a truck climbing lane will be determined in further studies.

Clear zones and recovery zones have not been applied to the cross section elements, but will have to be considered in the ultimate design. A Clear Zone distance of 8.0m and 4:1 Fill Slopes will likely be required for an 80 km/h design speed. Where this is not feasible concrete roadside barrier would be provided.

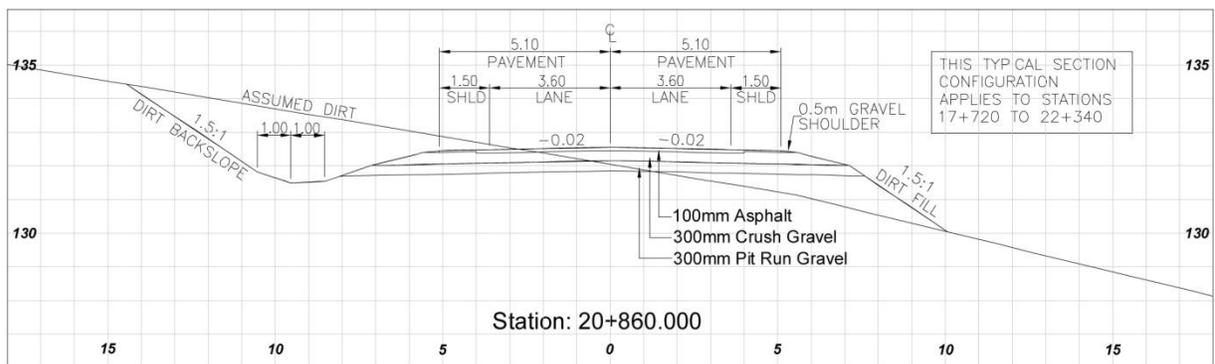


Figure 3.1: Typical Highway Cross Section

The typical section assumes 1.5:1 cut and fill slopes which would need to be confirmed during future geotechnical investigations. A 2:1 cut and fill slope may be required which would create a larger project footprint and cost. A standard pavement structure consisting of 100mm of asphalt pavement has been assumed but would also need to be confirmed by the geotechnical investigation.

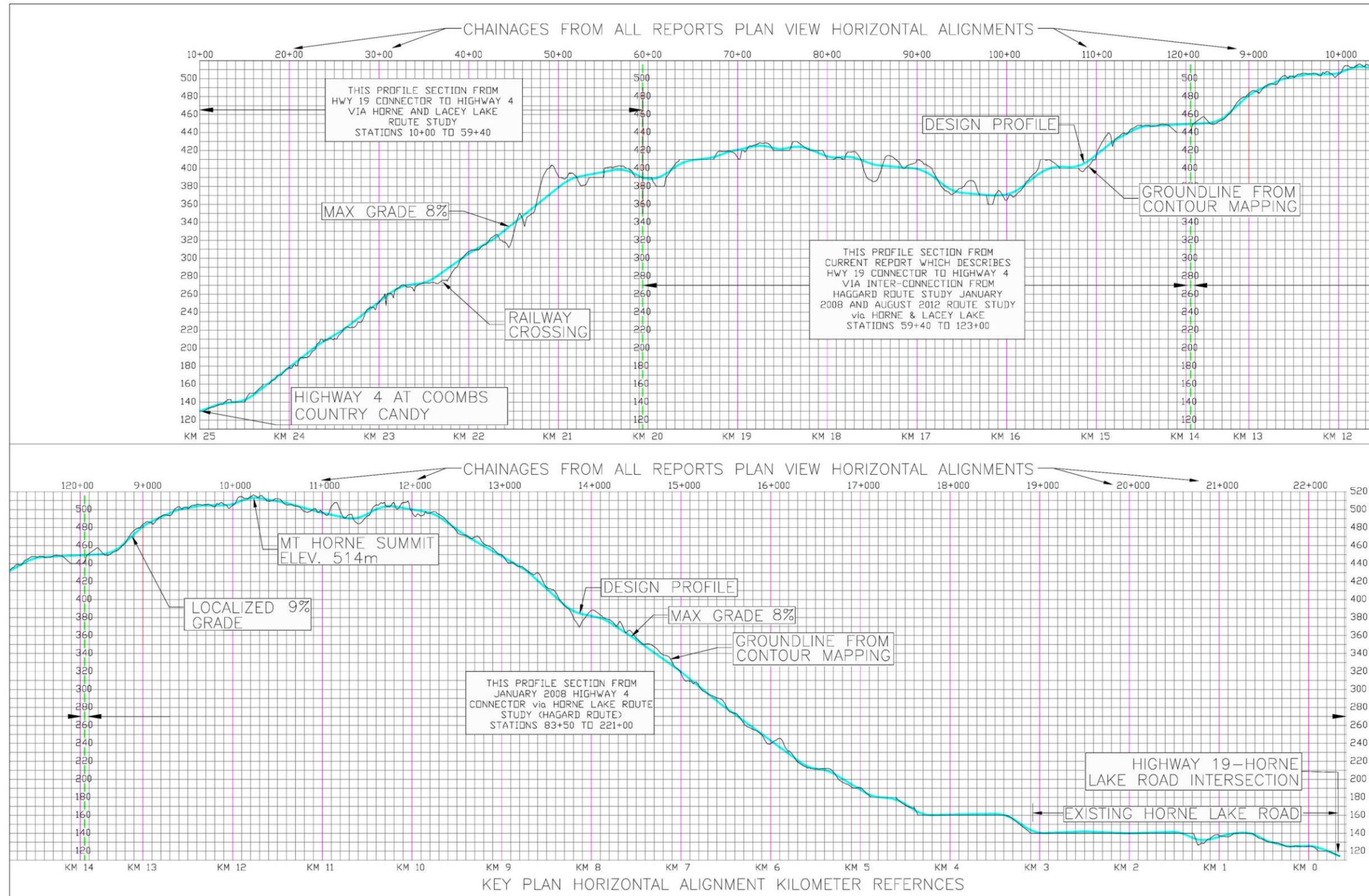
3.3 HORIZONTAL ALIGNMENT

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 which achieves an 80 km/hr design speed however it may be advantageous to have some curves designed to a lesser design speed to reduce some of the larger excavation areas. Advisory curve warning signs can be provided at the curves that do not meet the 80 km/h design speed.

3.4 VERTICAL ALIGNMENT

TAC recommends a maximum grade of 8% for a Rural Conventional Undivided (RCU) highway in mountainous terrain. The previous MoT Highway Engineering Design Manual recommended a maximum grade of 10% for RCU in mountainous terrain. For this design we have achieved a maximum of 8% throughout which the exception of a 9% grade at the eastern tie in. The proposed profile is shown in **Figure 3.2** on the following page.

3.5 FIGURE 3.2 PROPOSED PROFILE



3.6 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 of Service "C", but the overall intersection will operate at a Level of Service "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 Coombs Country Candy end of the project, a detailed analysis would have to be done to determine the best location for an intersection with Highway 4.

We have not talked directly with the timber companies operating within the project limits, but have made an allowance for 4 intersections along the route to provide access for resource roads.

3.7 STRUCTURAL DESIGN

The new route crosses the existing railroad tracks below Lacey Lake. Although the railroad is not currently active, we have made an allowance for the highway to pass over the railroad. We have allowed \$700,000 to construct a bridge plate pipe arch over the tracks.

3.8 DRAINAGE DESIGN

There are some creeks, which will require large diameter pipes. At Cold Creek, which drains Lacey Lake we are crossing a gully and have assumed a 2,000 mm pipe 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.

3.9 CONCRETE ROADSIDE BARRIER

This project is a combination of side hill cuts, small through cuts, and some gentle rolling land on the east end of the project. We have made an allowance for barrier in the areas of high embankment fills.

4.0 ALIGNMENT OPTIONS AND CONSTRUCTION COSTS

Binnie looked at two design options to connect the Haggard Route with Lacey Lake. Once the profiles and cross sections were developed, it is clear that the option selected in this report is by far the best option. The very steep terrain in segments of the study area precludes some areas for consideration.

The design has been developed with three segments with Segment 1 being from Coombs Country to Lacey Lake, Segment 2 from Lacey Lake to Mount Horne where it joins to the Haggard Route, and then Segment 3 which goes from Mount Horne to Highway 19.

Table 1: Segment 1 Quantity Summary and Estimate

SEGMENT 1: HORNE LAKE CONNECTOR QUANTITY SUMMARY				
Coombs Country Candy to Lacey Lake TOTAL LENGTH = 4.94km				
	Quantity	Unit	Price	Extended
Mobilization	LS	LS	\$1,000,000	\$500,000
Traffic Management	LS	LS	\$500,000	\$300,000
Quality Management	LS	LS	\$700,000	\$300,000
Clearing and Grubbing	19.7	ha	\$12,000	\$236,400
Logging Road Severance				
Access Intersection	2	ea	\$100,000	\$200,000
New Logging Road	170	m	\$500.00	\$85,000
Pavement	5,048	tonnes	\$105.00	\$530,040
Guardrail	2600	ea	\$250.00	\$650,000
Gravel				
25mm	18,752	m3	\$17.00	\$318,784
SGSB	20,876	m3	\$13.00	\$271,388
Shoulder	124	m3	\$25.00	\$3,100
Excavation				
Stripping	59,100	m3	10	\$591,000
Type D excavation	616,841	m3	10	\$6,168,410
Culverts				
2000dia Creek Crossing	63	m	\$800	\$50,400
Railway Crossing	1	LS	\$700,000	\$700,000
600 dia	160	m	\$300.00	\$48,000
1000 dia	160	m	\$400.00	\$64,000
			Sub-Total	\$11,016,522
Contingency 16%				\$1,762,644
Detailed Design 7%				\$771,157
Construction Supervision 10%				\$1,101,652
Project Management 4%				\$440,661
Management Reserve 5%				\$550,826
Property Acquisition 3%				\$330,496
Total cost Segment 1 – 4.94 kilometres			Total	\$15,973,957

Table 1: Segment 2 Quantity Summary and Estimate

SEGMENT 2: HORNE LAKE CONNECTOR QUANTITY SUMMARY				
Lacey Lake to Haggard Connector TOTAL LENGTH = 6.36km				
	Quantity	Unit	Price	Extended
Mobilization	LS	LS	\$500,000	\$500,000
Traffic Management	LS	LS	\$300,000	\$300,000
Quality Management	LS	LS	\$300,000	\$300,000
Clearing and Grubbing	25.4	ha	\$12,000	\$304,800
Logging Road Severance				
Access Intersection	2	ea	\$100,000	\$200,000
New Logging Road	218	m	\$500.00	\$109,000
Pavement	6,477	tonnes	\$105.00	\$680,085
Guardrail	2550	ea	\$250.00	\$637,500
Gravel				
25mm	24,080	m3	\$17.00	\$409,360
SGSB	26,913	m3	\$13.00	\$349,869
Shoulder	158	m3	\$25.00	\$3,950
Excavation				
Stripping	76,200	m3	10	\$762,000
Type D excavation	647,954	m3	10	\$6,479,540
Culverts				
2000dia Creek Crossing		m	\$800	\$0
Railway Crossing		LS	\$700,000	\$0
600 dia	220	m	\$300.00	\$66,000
1000 dia	220	m	\$400.00	\$88,000
			Sub-Total	\$11,190,104
Contingency 16%				\$1,790,417
Detailed Design 7%				\$783,307
Construction Supervision 10%				\$1,119,010
Project Management 4%				\$447,604
Management Reserve 5%				\$559,505
Property Acquisition 3%				\$335,703
Total for Segment 2 - 6.36 km.			Total	\$16,225,651

Table 1: Segment 3 Quantity Summary and Estimate

SEGMENT 3: HORNE LAKE CONNECTOR QUANTITY SUMMARY				
Haggard Connector to Highway 19 LENGTH = 13.75km				
	Quantity	Unit	Price	Extended
Mobilization	LS	LS	\$1,000,000	\$1,000,000
Traffic Management	LS	LS	\$600,000	\$600,000
Quality Management	LS	LS	\$600,000	\$600,000
Clearing and Grubbing	54.9	ha	\$12,000	\$658,800
Logging Road Severance				
Access Intersection	4	ea	\$100,000	\$400,000
New Logging Road	472	m	\$500.00	\$236,000
Pavement	15,662	tonnes	\$105.00	\$1,644,510
Guardrail	4590	ea	\$250.00	\$1,147,500
Gravel				
25mm	56,738	m3	\$17.00	\$964,546
SGSB	63,344	m3	\$13.00	\$823,472
Shoulder	350	m3	\$25.00	\$8,750
Excavation				
Stripping	164,700	m3	10	\$1,647,000
Type D excavation	87,613	m3	10	\$876,130
Back Slope Remediation	LS		1,510,000	\$1,510,000
Type A Excavation	455354	m3	20	\$9,107,080
Culverts				
3000dia Creek Crossing	65	m	\$1,200	\$78,000
Railway Crossing		LS	\$700,000	\$0
600 dia	220	m	\$300.00	\$66,000
1000 dia	220	m	\$400.00	\$88,000
			Sub-Total	\$21,455,788
Contingency 16%				\$3,432,926
Detailed Design 7%				\$1,501,905
Construction Supervision 10%				\$2,145,579
Project Management 4%				\$858,232
Management Reserve 5%				\$1,072,789
Property Acquisition 3%				\$643,674
Total for Segment 3 - 13.75km.			Total	\$31,110,893

The above tables contain 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. This will undoubtedly change when the geotechnical investigation determines the rock/soil horizons. The total unadjusted excavation is 1,809,812 cubic metres and the total embankment is 1,024,221 cubic metres. Although the cost of a 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 as required.

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 that has a reasonable cost estimate. 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.

5.0 CONCLUSION

This study shows that there is a route joining the Haggard Connector to Lacey Lake that connects with Coombs Country Candy at Highway 4 and meets an 80km/hr design speed.

More detailed work would need to be done to develop this concept into a viable design such as but not limited to survey, public consultation, design, environmental review, and liaison with all stakeholders. We would also further refine the alignment and profile and determine the need for concrete roadside barrier and confirm the pavement structure and cut and fill slopes with a geotechnical engineer.

Some of the benefits of the new route are as follows:

- The highway will meet current design standards for an 80km/h design speed and will have 1.5 metre wide paved shoulders.
- The new highway will provide a safer route for motorists which will result in less collisions and fewer delays.
- There will be fewer delays due to weather events as the area has mostly been logged and the right of way will be cleared to minimize the likelihood of trees falling onto the roadway.
- The travel time for motorists travelling from the south island heading to the west coast will be equal to or marginally less than that of the existing route. For those travelling from the north island to the west coast, the travel time will be about 20 minutes less each way.

The cost of the new route has been estimated at 63.3 million dollars. This estimate is largely based on 2012 unit prices. Some of the unit rates 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.

5.1 NEXT STEPS

The following items are suggested next steps that should be considered to further the design.

- A meeting with the Ministry of Transportation should be held to discuss the viability of this route.
- Once a preferred route is selected, survey data such as LiDAR or low level aerial photography should be obtained and a Preliminary Design should be completed. The Preliminary Design will provide a greater level of design detail and will result in a more accurate construction cost estimate. Geotechnical, environmental and property constraints should also be identified as part of the Preliminary Design.