ALASKA – CANADA RAIL LINK STUDY

PHASED MULTIMODAL INTEGRATION
WORK PACKAGE B3(b)
LIFE-CYCLE CAPITAL COST ESTIMATION

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1.0 Introduction

This study is part of the Alaska Canada (ALCAN) Rail Link Feasibility Study Project. A major benefit of this proposed rail link system will be to strengthen the economies of Alaska and the Yukon.

With the rail link system natural resource development will play an important part in the anticipated increased economic activity in the North. In turn, this will lead to the inbound movement of materials and supplies to create and sustain resource-oriented projects and the outbound movement of shipments of the resources developed.

These markets, in some cases, will be within North America and can be transported to the larger North American rail network via the ALCAN Rail Link. Many other markets, however, are located off-shore and resources moving to these destinations will travel via deep sea ship. Similarly, many inbound supply shipments will either be imported in deep sea vessels or transported by coastal marine carriers.

The importance of minimizing substantial transportation costs will dictate that most bulk resource commodity exports will need to be transported by the most efficient land link to reach the most cost effective port access to deep sea shipping. Similarly, large volume materials shipped in break-bulk, such as large diameter steel pipe from North American or offshore steel mills, will need to access destination points by the most efficient combination of deep sea vessel receiving terminal and inland truck and/or rail transportation to destination.

This portion of the study, composed of work packages B3b Life-Cycle Capital Cost Estimation, B3d Life-Cycle Operating Expenses Estimation and B3f Life-Cycle Cost of Service Estimation, estimates the life cycle capital costs, operating expenses and unit cost of service over a 50 year analysis period for a selection of rail/port route scenarios between major interior resource centres, the ALCAN Rail Link system and regional port facilities (**Figure 1.1**).

This document defines each of the rail-port route options analyzed and estimates associated capital costs based on data provided by the project team and analysis conducted within this work package. Capital costs, at U$ 2006 price levels, have been disaggregated into sub-categories to provide insight into their allocation.

Under separate cover, work package B3d Life-Cycle Operating Expense Estimation provides a similar estimate of operating expenses for each rail-port route scenario considered. Work package B3f uses the output of packages B3b and B3d to generate an estimate of discounted life cycle capital costs and life cycle operating expenses to provide an estimate of unit cost of service for each scenario.

Life cycles capital costs and operating expenses have been estimated within this work package or extracted from other sources within the ALCAN Rail Link Project Team.

In this work package and the companion work package B3d, traffic projections generated by the ALCAN Rail Link Project have been used in the estimation of capital costs and operating expenses and the development of rail-port route scenarios. Estimates include both inbound and outbound traffic to a variety of origin/destinations within Alaska and the Yukon, including the Crest Iron Ore Mine. Projected dry bulk traffic from the Crest Iron Ore Mine is two to three times greater than the combined traffic from all other sources, and tends to dominate the analysis where it has been considered.

Figure 1.1 - Study Area

2.0 Traffic Forecasts

Traffic forecasts, used as input to this analysis of capital costs and for the companion analysis of operating expenses, were provided by the Alaska-Canada Rail Link Project as used in the rail cost model developed under work packages B3c and B3e. These forecasts generally consist of outbound resource shipments from the hinterland of the Alaska – Canada Rail Link Study Area and inbound shipments originating either elsewhere in North America or from offshore sources.

For purposes of this study and the analysis of transport costs for the scenarios, the forecast traffic provided was grouped into two categories meaningful for cargo handling analysis: general cargoes and dry bulk products. These groups comprise the following cargo categories:

General Cargoes

- Pipe
- Industrial Products and
- Intermodal Traffic

Dry Bulk Products

- Crest Iron Ore
- Other Mineral Products and
- Coal.

Pipe refers to specialized inbound products to facilitate pipeline development in the north. Industrial products include fuel and equipment, both of which move in comparatively small volumes. Intermodal traffic refers to general cargoes moving either in standard containers or in some cases in break bulk mode.

Crest Iron Ore denotes the large volume of iron ore product output from the Crest Mine. Other mineral products refers to outbound mineral concentrates including copper, lead, zinc and others. Coal refers to outbound coal, likely thermal grade.

Traffic projections in Figures 2.1 and 2.2 include all traffic on the proposed ALCAN Rail Link system under the high traffic scenario. It is necessary to include all traffic, even traffic not using the scenarios destination port, as costs/expenses will be shared with non-port traffic impacting the overall rail cost of service.

Figures 2.3 and 2.4 present the traffic forecasted to move through the destination port in each scenario. This traffic represents all of the coal and iron ore, the majority of the mineral concentrates, a portion of pipe traffic but does not include intermodal and industrial products. Intermodal and industrial products traffic access the ALCAN Rail Link system from land based origin-destinations and do not pass through a port. In most cases traffic volumes remain constant throughout the scenarios, however, some mineral concentrates are so proximate to Hyder-Stewart and Prince Rupert that they move through these port regardless of the destination port for that scenario.

Figure 2.1 displays the annual traffic volumes for the entire ALCAN Rail Link system by commodity, excluding traffic generated by the Crest iron ore mine. From this Figure it can be seen that:

- **Pipe traffic** occurs over the initial two years of the planning period and is in the range of 500,000 to 750,000 tons per year
- **Industrial products traffic** flows occur during the thirty year period (year 6 to 36) and peak at 2.5 million tons in planning years 10 and 11
- **Intermodal traffic** flows occur over the 50 year cost analysis life cycle. This traffic peaks at 3.1 million tons in year seven and remains at that level for the balance of the 50 year life-cycle period.

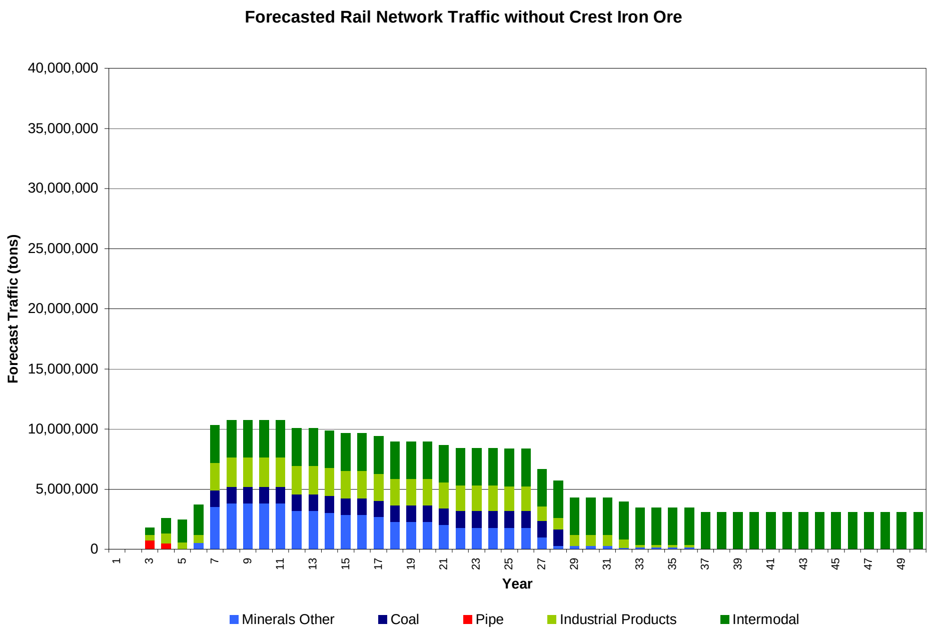


Figure 2.1 - Annual Rail Network Traffic Volumes without Crest (tons per year)

Figure 2.2 displays the annual traffic volumes for the entire ALCAN Rail Link system by commodity, with the inclusion of dry bulk traffic from the Crest iron ore mine. The remaining traffic commodity flows and timing of their output are identical to the information depicted above in **Figure 2.1**.

In this cost analysis the Crest Iron Ore traffic is assumed to flow through the system as follows:

- Years 3 and 4 at seven million tons per year;
- Years 5 and 6 at fourteen million tons per year;
- Years 7 and 8 at twenty – one million tons per year; and
- Year 9 to the planning horizon (year 50) at twenty – eight million tons per year.

From this data it is clear that the Crest Iron Ore traffic dominates the traffic forecast and provides the large majority of the transportation demand that would generate the requirement for incremental rail infrastructure and equipment investment and for increased port capacity expansion and / or development in the study region.

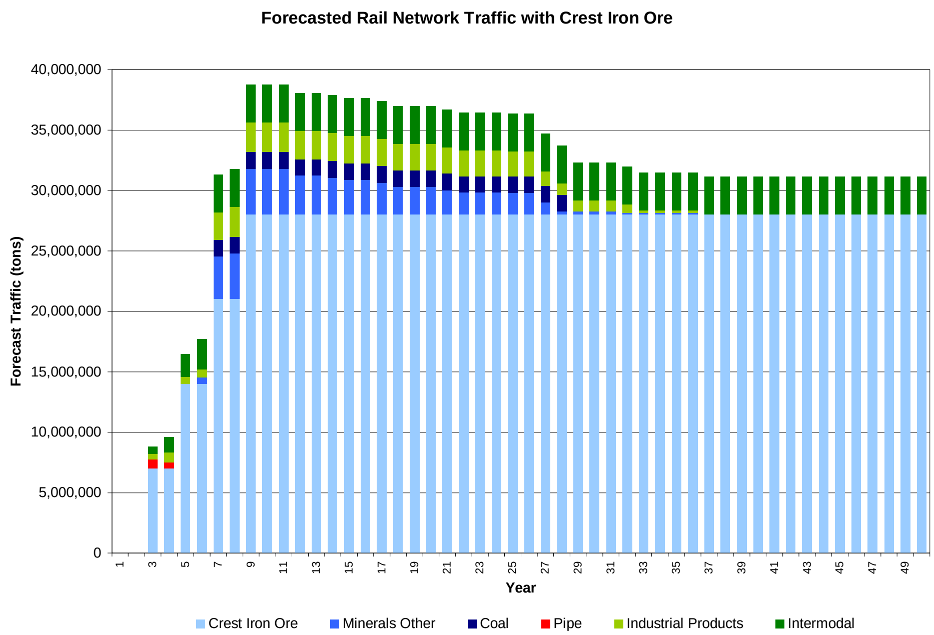


Figure 2.2 - Annual Rail Network Traffic Volumes with Crest (tons per year)

Figure 2.3 displays the annual traffic volumes moving through the destination port via the rail network by commodity, excluding traffic generated by the Crest iron ore mine. From this Figure it can be seen that:

- **Pipe traffic** through the port still occurs over the initial two years of the planning period but drops in volume to the range of 200,000 to 300,000 tons per year.
- **Industrial products traffic** and **Intermodal Traffic** are not projected to move through the destination ports, instead, moving in/out of the network via the continental rail network
- **Coal and Mineral Concentrates,** in the order of 3-5 million tons per year dominate non-Crest traffic but for a shorter period of approximately 20 years.

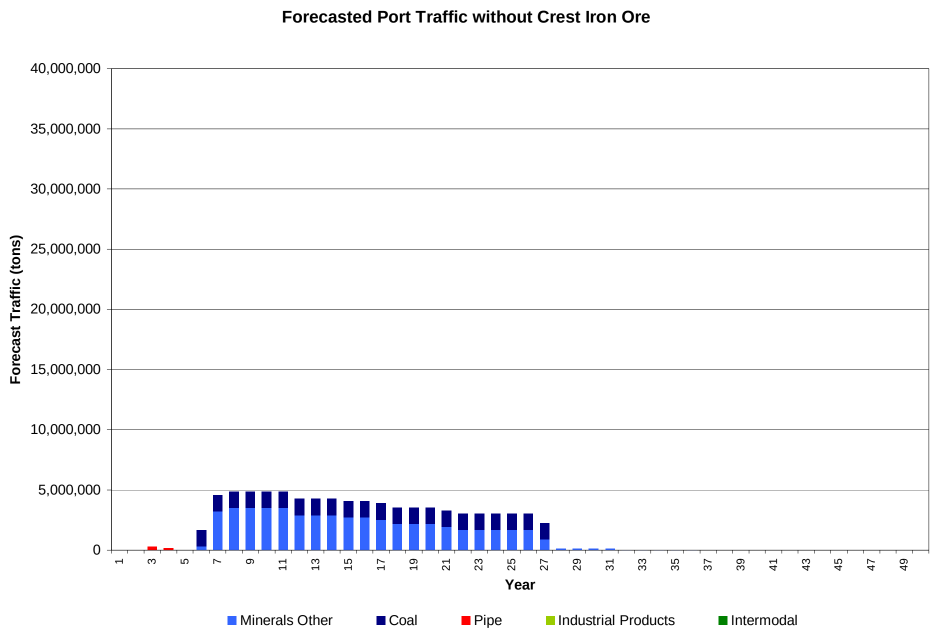


Figure 2.3 - Annual Port Traffic Volumes without Crest (tons per year)

Figure 2.4 displays the annual traffic volumes for the destination port by commodity, with the inclusion of dry bulk traffic from the Crest iron ore mine. To a greater degree than seen in Figure 2.2, Crest iron ore dominates the traffic projection for the destination ports from a volume / weight perspective. It should be noted, that as mineral concentrates are much more valuable per ton then iron ore, from a value point of view their contribution is much greater than when measured by tonnage.

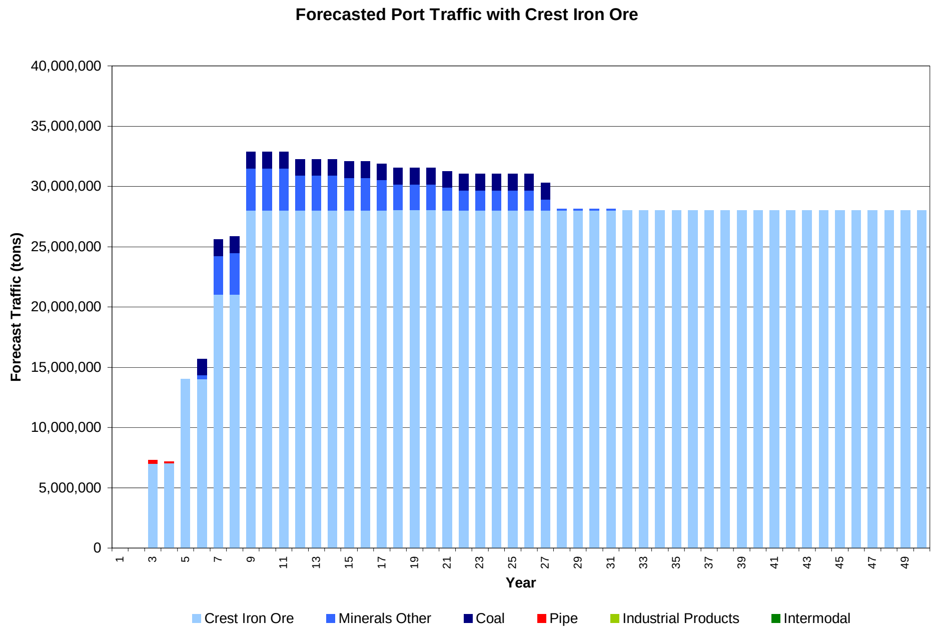


Figure 2.4 - Annual Port Traffic Volumes with Crest (tons per year)

The traffic forecasts were used to determine the number of cars and locomotives required to carry the volume of commodities. These in turn influenced the amount of fuel and labor needed to operate the trains. All of these values were then used to calculate the associated capital costs in this report and the operating expenses in the companion volume. Finally, as illustrated in **Figure 2.5** the unit costs are calculated and reported in work package B3f. Thus, traffic forecasts play an important role in the results of this study.

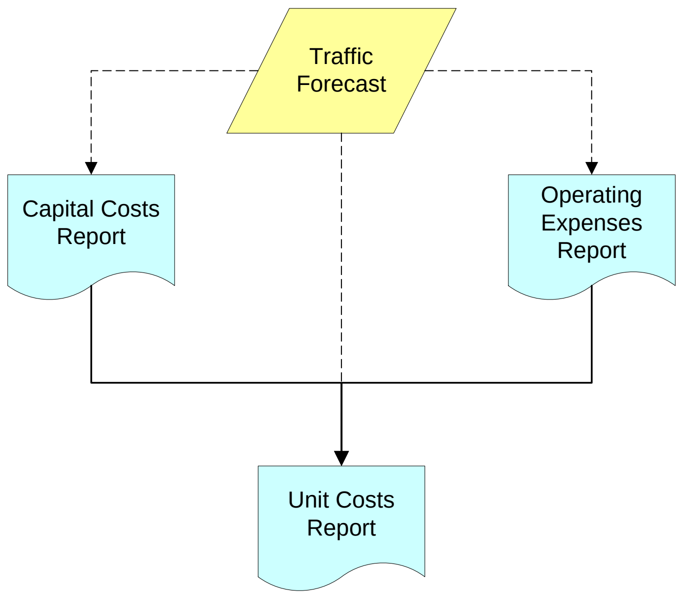


Figure 2.5 - Reports with Input from Traffic Forecast Data

It is noted that the traffic forecast with the Crest Iron Ore shipments is aggressive and when added to the other traffic commodity segments presents a challenge to be accommodated at some of the ports (or port pairs) under review. For example in Figure 2.4 the peak projected traffic level through the port is just under 33 million tons per year. On a comparison basis this level of traffic is more than twice the maximum traffic level recorded at the Port of Prince Rupert in the late 1990's. For comparative purposes the forecast 33 million ton throughput would be equivalent to more that half the present level of bulk traffic moving through the Port of Vancouver.

3.0 Rail - Port Scenarios

Based on traffic projections presented in Section 2.0, a number of rail-port route scenarios were developed for analysis between interior resource and population centers and regional port facilities. Each scenario included the ALCAN Rail Link mainline plus additional rail links, if required, to connect to port facilities and resources. A map of all links considered in the analysis is presented below in **Figure 3.1**.

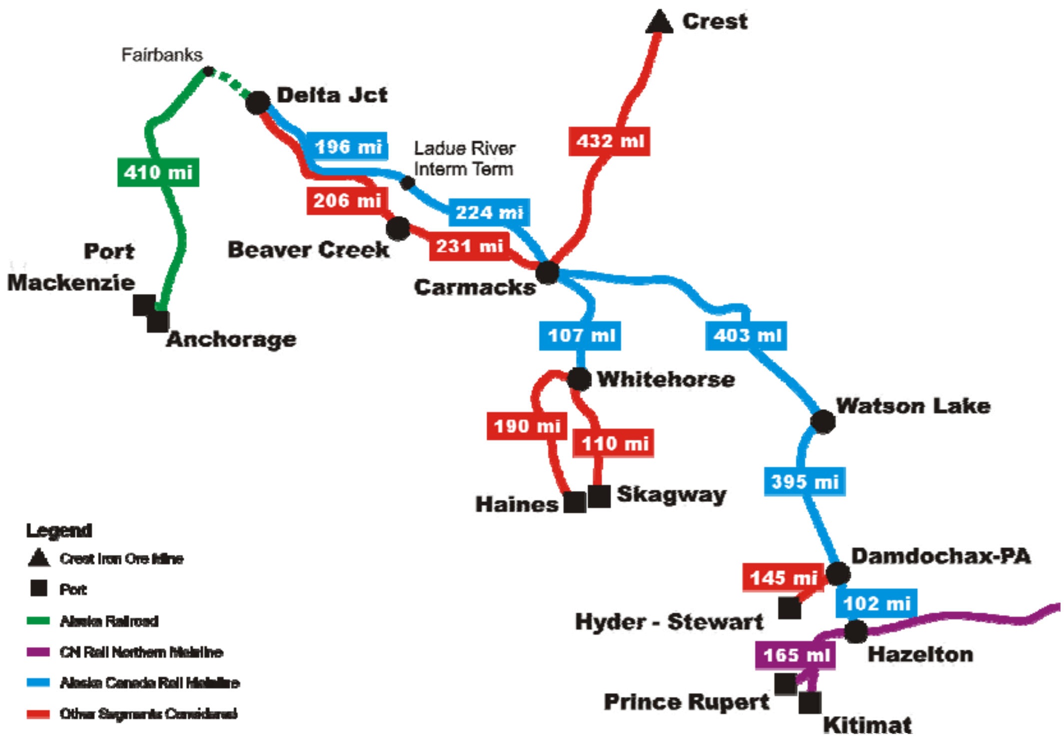


Figure 3.1 – Rail Network Segments Analyzed

The scope and capital costs of the ten scenarios comprised of rail and port component that were analyzed in this work package are presented below. Each scenario presents capital costs for proposed rail network and port facilities based on traffic projections outlined in Section 2.0. In most cases, scenarios have been developed with and without Crest Iron Ore traffic; generally this has a minimal impact on the rail network (except for the Crest spur line) but does impact proposed port facilities.

For the purposes of analysis, the proposed scenarios focus on one port area per scenario, however, in reality, traffic would likely flow to several ports based on the strengths of each facility and their proximity to the origin/destination of the traffic.

The limited potential for expansion has lead us to not include a “with Crest” scenario for Hyder or Skagway, as it is our belief that facilitation of a 28 million ton iron ore bulk terminal at these locations, in addition to 3-5 million tons of other cargo, is not likely.

The scenarios as presented below provide a set of mutually exclusive options for comparison of port/rail configurations for the ALCAN Rail Link Project. The proposed ten scenarios analyzed, as named for the port served, include:

- Scenario 1 Skagway (without Crest)
- Scenario 2 Port Mackenzie – Anchorage via Beaver Creek (with Crest)

- Scenario 2a Port Mackenzie – Anchorage via Beaver Creek (without Crest)
- Scenario 3 Port Mackenzie – Anchorage via Ladue River (with Crest)
- Scenario 3a Port Mackenzie – Anchorage via Ladue River (without Crest)
- Scenario 4 Haines (with Crest)
- Scenario 4a Haines (without Crest)
- Scenario 5 Hyder-Stewart (without Crest)
- Scenario 6 Prince Rupert (with Crest)
- Scenario 6a Prince Rupert (without Crest)

Capital costs for the rail network were estimated via several sources from within the ALCAN Rail Link project team. Track capital costs were estimated by UMA Engineering as part of B1 work packages or by Yukon Engineering Services (YES), as part of this work package. Where track capital costs were estimated by UMA as part of the B1 work packages, costs have been transposed directly. For segments that were not estimated under the B1 work packages, high level cost estimates were developed by YES as part of this work package. It is anticipated that the level of precision of the estimates in this work package will be lower than the estimates in the B1 work packages by UMA due to limited base data.

To estimate sustaining track capital costs over a 50 year analysis period, the rail cost model developed by Innovative Solutions under work packages B3c/B3e was used. Each of the scenarios listed above were analyzed using the rail cost model. Results, combined with initial track capital cost estimates, are reported in the following sections.

In addition, the model provides a range of values based on three “management strategies”. These “management strategies” vary the style of operation of the railroad, generally trading off higher capital costs coupled with high reliability and speed versus lower capital costs associated with lower reliability and speed. Resulting capital cost estimates for all three strategies are the same, but operating expenses in work package B3d vary significantly. For more information on the strategies, refer to the Alaska Canada Rail Link Feasibility Study Cost Analysis Report, part of work package B3c/B3e by Innovative Scheduling.

Port facility scope and capital costs have been estimated by Banjar Management based on engineering judgment and work completed under work packages B2a/B2d/B2g. In some cases the potential of moving all traffic through one port may prove difficult. Limitations of proposed sites have been noted, but barring sufficient data, only a limited planning level analysis of each port site was possible.

The requirements for life - cycle capital expenditures were evaluated on a port - by - port basis using the traffic forecast volumes described above. The present level of port infrastructure was considered to accommodate demands without and with the Crest iron ore volumes. Prince Rupert for example has comparatively well developed rail to ship handling facilities for bulk products while Port Mackenzie has a moderate level of bulk handling capacity. However both Haines and Hyder would require new infrastructure to handle large scale bulk export shipments. Skagway presents a different situation. While it has a de - commissioned bulk terminal that could be re furbished to accommodate moderate volumes of outbound bulk traffic the port capacity is limited by constrained back - up land, challenging berth construction issues and potential conflicts with its cruise passenger business and impacts on nearby commercial and residential land uses.

Life - cycle capital costs include the sum of initial capital (phased if deemed appropriate) and the future capital outlays required to sustain cargo handling activity to the planning horizon.

Capital costs for proposed port facilities for each scenario are presented within the following sections.

3.1 Scenario 1 - Skagway

In Scenario 1, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then to Skagway via an upgraded White Pass Railway. For the purposes of this analysis, up to 5 million tons of projected non-Crest Iron Ore rail traffic was applied to the proposed rail network to Skagway. However, due to limitations on port expansion capacity discussed below, only a portion of the proposed traffic volume could be handled by full potential expansion of port facilities at Skagway. The major network components of Scenario 1 are presented below in **Figure 3.2**.

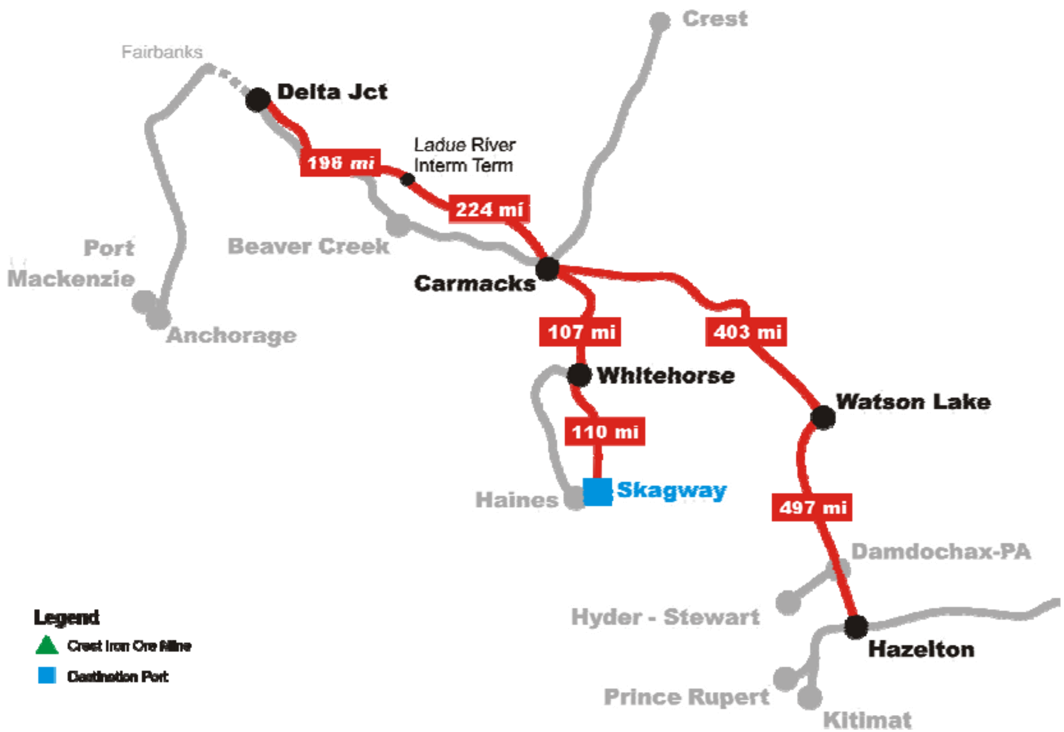


Figure 3.2 - Scenario 1 (Skagway) Network Components

3.1.1 Life-Cycle Rail Network Capital Costs

Based on results from the rail cost model, undiscounted life cycle track capital costs, including initial and sustaining capital, have been estimated for each segment of the Scenario 1 rail network and are presented below in **Table 3.1**. Total track capital costs for Scenario 1 are estimated at U$11.6 billion.

Table 3.1 - Life- Cycle Track Capital Costs by Segment (Skagway – No Crest)

Skagway Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,220	$8.5	36%	UMA
Watson Lake-Carmacks	403	$3,510	$8.7	30%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	18%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	9%	UMA
Skagway-Whitehorse	110	$129	$1.2	1%	UMA
Whitehorse-Carmacks	107	$553	$5.2	5%	UMA
Total	**1537**	**$11,593**	**$7.5**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 1 and are presented below in **Table 3.2.**

Table 3.2 – Total Life-Cycle Rail Capital Costs (Skagway - No Crest)

Skagway Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$10,933
Sustaining Track Capital Costs	$661
Total Capital Costs	**$11,593**

3.1.2 Port Facility Improvements

As reported in Work Packages B2d and B2g, the Port of Skagway has limited expansion potential due to the lack of incremental back up land and berthing areas, plus, conflicts with the passenger cruise business and anticipated issues of environmental approval for industrial facilities at the mouth of the Skagway River.

Although some expansion is possible, this would likely be limited to either accommodation of some portion of the proposed mineral concentrate traffic volume, or the coal traffic. For the purposes of this analysis we have estimated the life-cycle capital costs of facilities to handle 1 million tons of coal and 500,000 tons of mineral concentrates. This volume of traffic is not the same as accommodated in other non-Crest scenarios, therefore, results are not directly comparable.

These facilities would include on-dock and off-dock coal storage, rail unloading systems, covered mineral storage, ship loading equipment and bulk + cruise berth improvements. This concept is similar to Scenario 3 – Moderate Volume Concentrates plus Coal as presented in the "Yukon Ports Access Strategy Report (Draft)" for Yukon Economic Development.

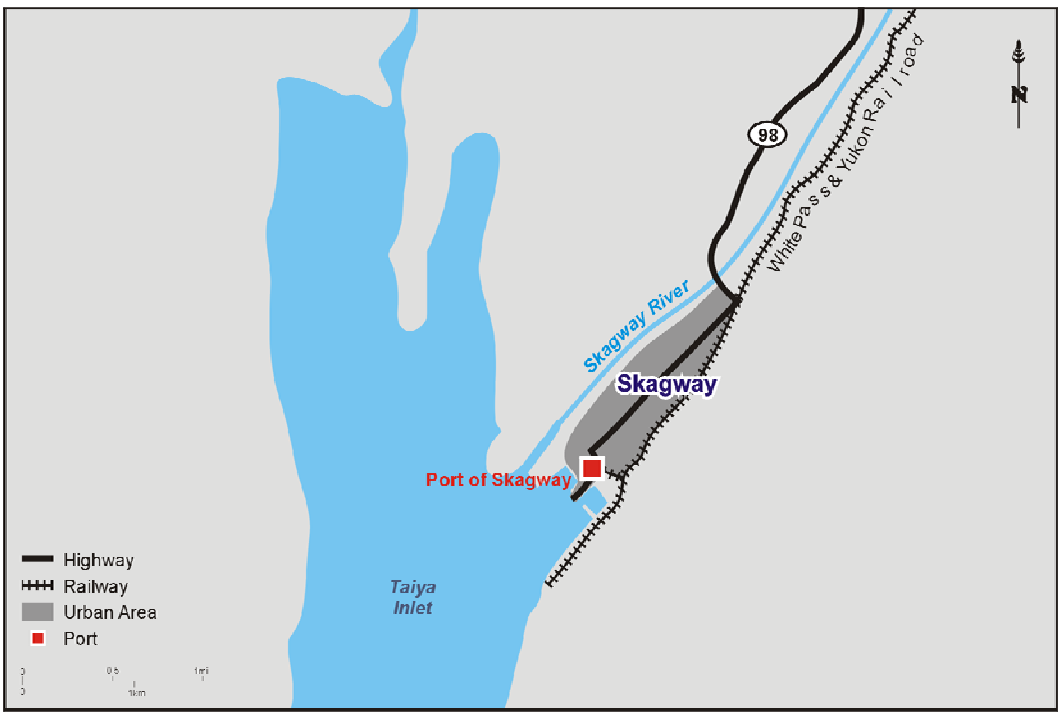


Figure 3.3 – Skagway Port Area

3.1.3 Life-Cycle Port Facility Capital Costs

In Work Package B2g, expansion of the Port of Skagway was considered to be limited by the lack of available land area and berthing expansion potential plus conflicts with the existing passenger cruise vessel traffic. Therefore, the non-Crest traffic level of approximately 3-5 million tons assumed in all scenarios analyzed may not be attainable through this port. If the lower traffic volume described above in 3.1.2 was used instead, initial capital costs were estimated in the Yukon Ports Access Strategy Report (Draft) to range between U$ 64-136 million. When sustaining capital costs are added, the total life-cycle costs are estimated to be in the magnitude of $U 100-200 million.

3.1.4 Capital Cost Summary

Analysis of Scenario 1 included the following estimated undiscounted life-cycle capital in the magnitude of $U 11.8 billion. As traffic volumes are not equivalent to other scenarios, direct comparison of the following number is not possible.

3.2 Scenario 2 - Port-Mackenzie - Anchorage via Beaver Creek with Crest Iron Ore

In Scenario 2, the ALCAN Rail Link mainline would be developed via Beaver Creek and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route envisioned, this connection could be omitted. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage. Development of a short spur to Port Mackenzie would be required to access Port Mackenzie.

At Port Mackenzie a port facility would be developed to handle approximately 28M tons of projected Crest Iron Ore and 3-5 million tons of bulk non-Crest traffic (mineral concentrates and coal). Short-lived pipe traffic in years 3-4 would be unloaded at existing facilities in the Port of Anchorage. The major network components of Scenario 2 are presented below in **Figure 3.4**.

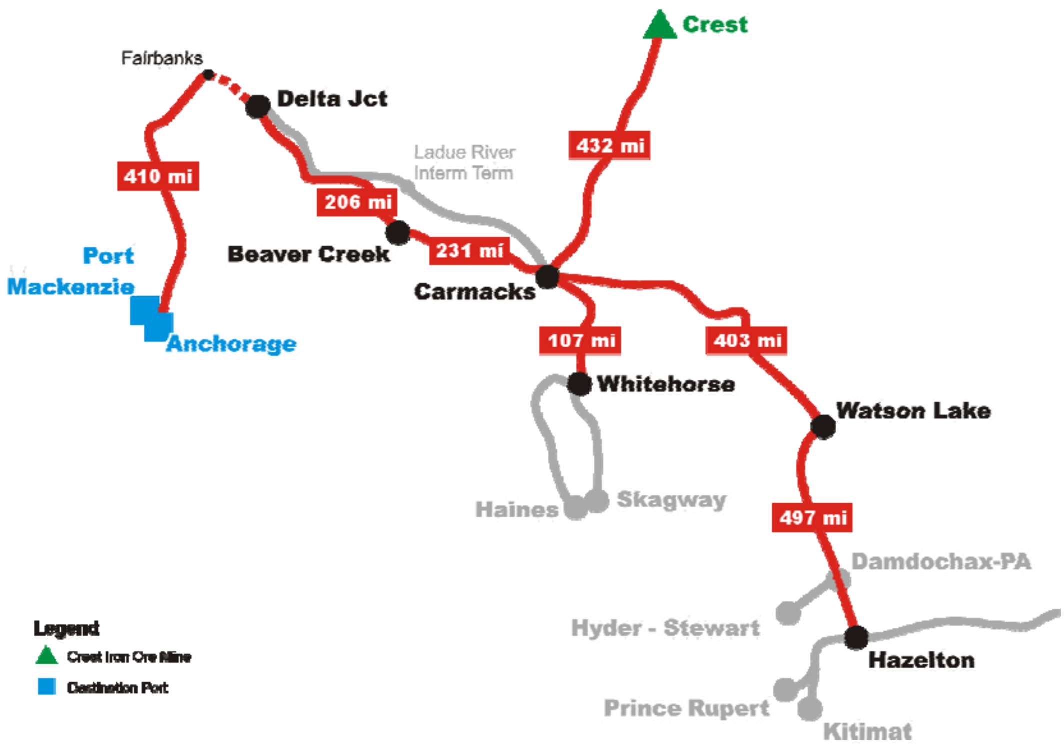


Figure 3.4 - Scenario 2 (Port Mackenzie via Beaver Creek) Network Components

3.2.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs, including initial and sustaining capital, have been estimated for each segment of the Scenario 2 rail network and are presented below in **Table 3.3**. Total track capital costs for Scenario 2 are estimated at U$17.7 billion.

Table 3.3 - Life- Cycle Track Capital Costs by Segment (Port Mackenzie via Beaver Creek – with Crest)

Port MacKenzie via Beaver Creek Track Capital Costs by Segment with Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,237	$8.5	24%	UMA
Watson Lake-Carmacks	403	$3,497	$8.7	20%	UMA
Carmacks-Beaver Creek	231	$3,282	$14.2	19%	UMA
Beaver Creek-Delta Jct	206	$1,466	$7.1	8%	UMA
Whitehorse-Carmacks	107	$547	$5.1	3%	UMA
Crest-Carmacks	432	$4,680	$10.8	26%	YES
Total	**1876**	**$17,711**	**$9.4**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 2 and are presented below in **Table 3.4**.

Table 3.4 - Total Life-Cycle Rail Capital Costs (Port Mackenzie via Beaver Creek – with Crest)

Port MacKenzie Via Beaver Creek Capital Costs with Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$15,483
Sustaining Track Capital Costs	$2,228
Total Capital Costs	**$17,711**

3.2.2 Port Facility Improvements

The Port of Anchorage and Port Mackenzie lie on opposite sides of Knik Arm at the north end of Cook Inlet (**Figure 3.5**). Based on traffic projections of 28 million tons of iron ore and 3-5 million tons of mineral concentrates and coal, it is anticipated that the use of both facilities would be likely. Therefore, for the purposes of this analysis, both facilities are collectively considered as a complementary port pair.

Port Mackenzie is situated on the north side of Knik Arm. Current facilities include a 20acre / 8ha pad, a single berth with a draft of 60ft / 20m and a maximum ship length of 1000ft / 300m plus a wood chip loader. Port Mackenzie enjoys extensive level back-up lands but these lands are situated on a bench approximately 100ft / 30m above the pad elevation. Currently a wood chip conveyor and road have been built between the two levels.

For purposes of the analysis it has been assumed that Port Mackenzie would be developed into a high volume dry bulk loading facility, primarily for iron ore, small volumes of coal and mineral concentrates. This would require significant upgrades and phased expansion to the current infrastructure, including:

- Berthing Structures
- Site Preparation and Utilities
- Bulk Storage Yard

- Rail Trackage and Dumper Facilities
- Stacker/Reclaimer Equipment
- Ship Loaders

In addition to the improvements listed above, several other key issues should be noted. First, Port Mackenzie does not currently have rail access; a proposed spur of the Alaska Railroad from Houston is currently under investigation. For the purposes of this analysis it is assumed that the rail spur would be developed by others. Second, ships accessing Knik Arm must pass over the Knik Shoal which currently has tidal draft restrictions. Ships accessing this future facility will be significantly larger, and with deeper draft, than the typical ships accessing Knik Arm today. Therefore, to facilitate 200,000 DWT plus ships, additional work may be required to facilitate passage over the shoal, or, with the associated operational impacts, tighter tidal windows may be possible.

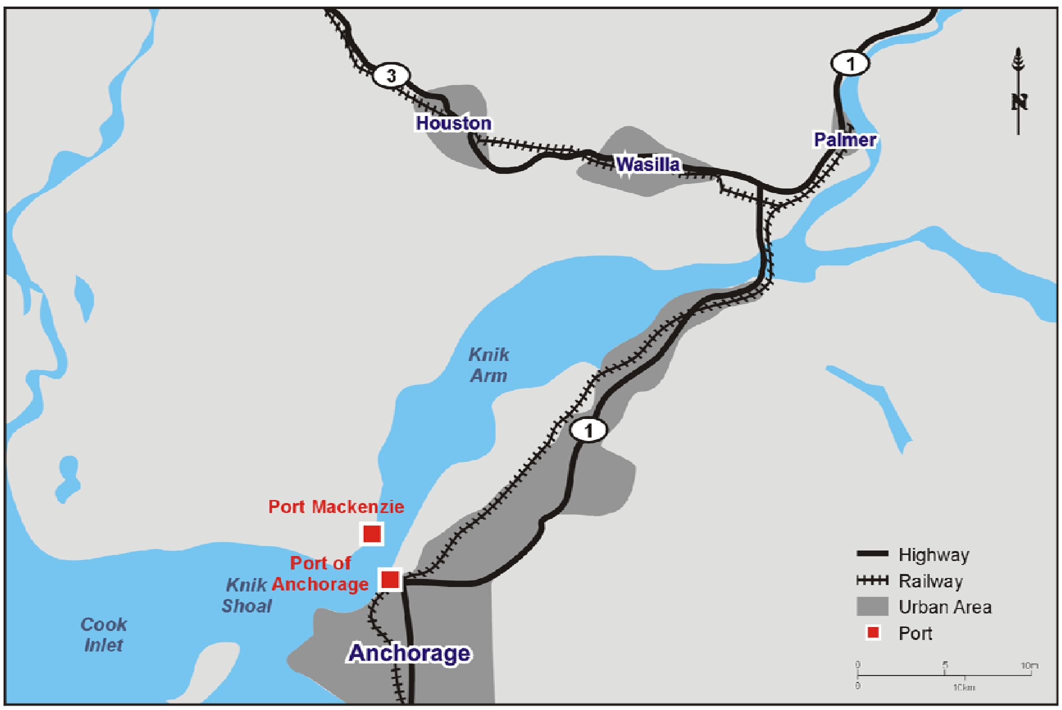


Figure 3.5 - The Port of Anchorage / Port Mackenzie (with Crest)

3.2.3 Life-Cycle Port Facility Capital Costs

As reported in Work Package B2f the Port of Anchorage has plans for a major expansion to its multi – purpose cargo handling facilities. For purposes of this study and the analysis of estimated costs, it is assumed that the forecast pipe traffic volumes would be routed through the Port of Anchorage and that the bulk products would move through the expanded terminal at Port Mackenzie. With the assumed connection of Port Mackenzie into the Alaska Railroad system, both ports will be rail served. Port Mackenzie, with its deep draft berth(s), large back up land area and comparatively rural location, is well suited to accommodate large volumes of bulk traffic.

The incremental capital to expand the Port of Anchorage is not considered in this analysis as these expenditures will be made in any event and the Port or its terminal operator will charge competitive throughput rates for handling general cargoes. Estimates of these rates are provided in Work Package B3d.

The major incremental capital costs of expanding the infrastructure at Port Mackenzie are required for study unit cost purposes as these expenditures would not occur without the forecast bulk traffic in this Scenario. The life – cycle capital costs of this expansion over the 50 year life – cycle dictated by the iron ore shipments is presented below. These costs comprise the initial capital and the sustaining capital outlays estimated for a three phase expansion initiative at Port Mackenzie. Phase 1 and 2 would accommodate iron ore and coal with the Phase 2 expansion when traffic exceeds 15 million tons per year. Phase 3 would accommodate mineral concentrates.

Table 3.5 – Life-Cycle Port Facility Capital Costs (Port Mackenzie via Beaver Creek – with Crest)

Port Mackenzie via Beaver Creek (with Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

Initial Capital	
Phase 1 Expansion (Iron Ore/Coal)	
Initial Capital	$420
Phase 2 Expansion (Iron Ore/Coal)	
Initial Capital	$330
Phase 3 Expansion (Minerals)	
Initial Capital	$225
Sustaining Capital	$684
Total Life - Cycle Capital	**$1,434**

3.2.4 Capital Cost Summary

Analysis of Scenario 2 included the following estimated undiscounted life-cycle capital costs at the level of U$ 19.0 billion.

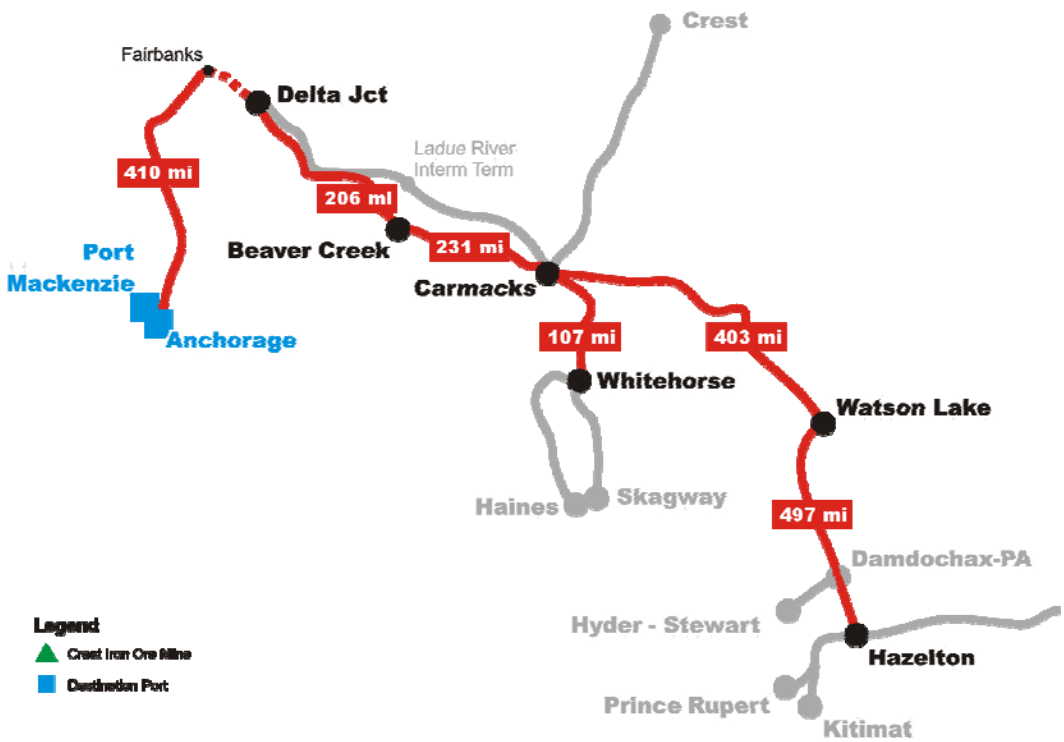
Table 3.6 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Beaver Creek – with Crest)

Port Mackenzie via Beaver Creek (with Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$17,711
Port Facility Improvements	$1,434
Total Improvements	**$19,145**

3.3 Scenario 2a - Port-Mackenzie - Anchorage via Beaver Creek without Crest Iron Ore

In Scenario 2a, the ALCAN Rail Link mainline would be developed via Beaver Creek and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. From Delta Junction west, rail traffic would use the existing Alaska Railroad network to connect to Anchorage where 3-5m tons of non-Crest traffic would be handled at the existing port sites at Anchorage and Port Mackenzie. The major network components of Scenario 2a are presented below in **Figure 3.6**.

Figure 3.6 - Scenario 2a (Port Mackenzie via Beaver Creek) Network Components



3.3.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 2a rail network and are presented below in **Table 3.7**. Total track capital costs for Scenario 2a are estimated at U$12.4 billion.

Table 3.7 - Life- Cycle Track Capital Costs by Segment (Port Mackenzie via Beaver Creek – without Crest)

Port MacKenzie via Beaver Creek Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,237	$8.5	34%	UMA
Watson Lake-Carmacks	403	$3,497	$8.7	28%	UMA
Carmacks-Beaver Creek	231	$2,828	$12.2	23%	UMA
Beaver Creek-Delta Jct	206	$1,264	$6.1	10%	UMA
Whitehorse-Carmacks	107	$547	$5.1	4%	UMA
Total	**1444**	**$12,373**	**$8.6**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 2a and are presented below in **Table 3.8**.

Table 3.8 - Total Life-Cycle Rail Capital Costs (Port Mackenzie via Beaver Creek – without Crest)

Port MacKenzie Via Beaver Creek Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$11,735
Sustaining Track Capital Costs	$638
Total Capital Costs	**$12,373**

3.3.2 Port Facility Improvements

In Scenario 2 the bulk products traffic (including Crest Iron Ore) is assumed to move through a large scale phased bulk handling terminal expansion at Port Mackenzie while the nearby Port of Anchorage accommodates pipe traffic in years 3-4. In this scenario the same rationale is applied except in this case the volume of bulk cargo shipments is greatly reduced with the elimination of the Crest Iron Ore traffic.

In this scenario the existing terminal at Port Mackenzie would still be improved but in a single phase expansion project. The configuration of the Port Mackenzie terminal to handle the bulk products (without iron ore) is described as follows:

- Strengthen the existing berthing structure
- Site preparation and utilities
- Bulk storage yard and shed
- Rail track and dumper facilities
- Stacker / reclaiming equipment
- Ship loader

This configuration will be suitable to handle the bulk product traffic forecast in this scenario, (coal and other mineral products).

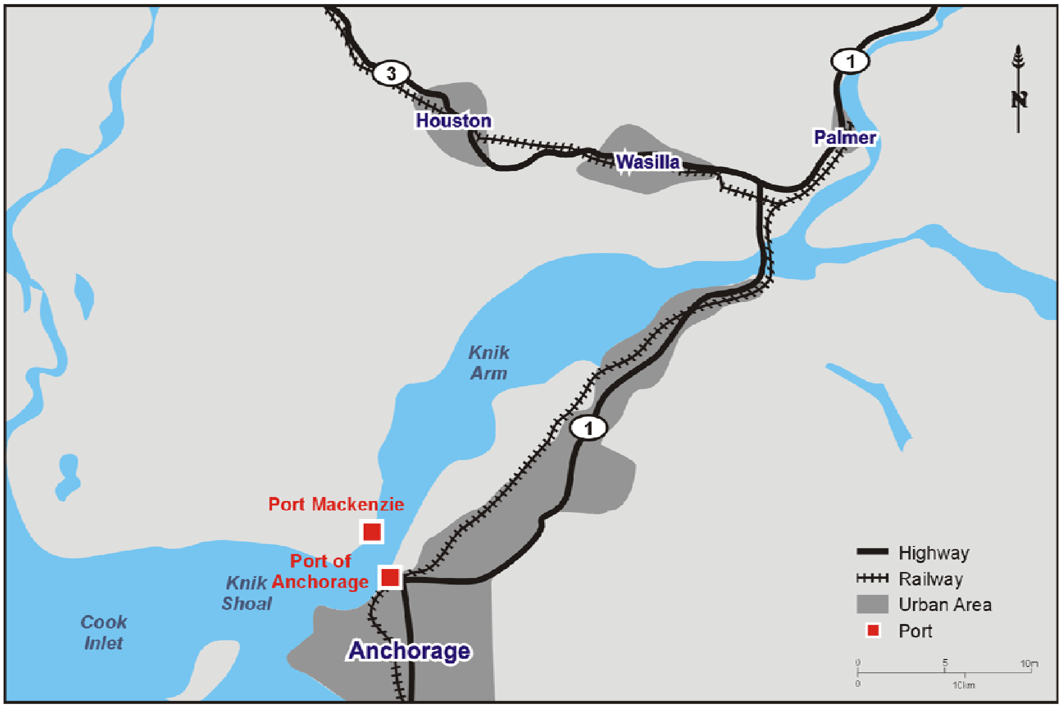


Figure 3.7 - The Port of Anchorage / Port Mackenzie (without Crest)

3.3.3 Life-Cycle Port Facility Capital Costs

In Scenario 2a, projected shipments through the Port of Anchorage is limited to pipe traffic early in the analysis period. With this assumption no capital costs are estimated for Anchorage on the premise that the Port is expanding in any event and will charge its tariff rate for the pipe traffic.

The initial and sustaining capital costs of expanding the bulk terminal at Port Mackenzie are provided in Table 3.9 below.

Table 3.9 – Life-Cycle Port Facility Capital Costs (Port Mackenzie via Beaver Creek – without Crest)

Port Mackenzie via Beaver Creek (no Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

Intial Capital	$235
Sustaining Capital	$108
Total Life - Cycle Capital	**$343**

3.3.4 Capital Cost Summary

Analysis of Scenario 2a included the following estimated undiscounted life-cycle capital costs.

Table 3.10 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Beaver Creek – without Crest)

Port Mackenzie via Beaver Creek (without Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$12,373
Port Facility Improvements	$343
Total Improvements	**$12,716**

3.4 Scenario 3 - Port-Mackenzie - Anchorage via Ladue River with Crest Iron Ore

In Scenario 3, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). As in Scenario 2, a spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. A second spur would head north from Carmacks to the Crest Iron Ore Mine. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage, development of a short spur to Port Mackenzie would be required.

At Port Mackenzie a port facility would be developed to handle approximately 28M tons of projected Crest Iron Ore and 3-5 million tons of bulk non-Crest traffic (mineral concentrates and coal). Short-lived pipe traffic in years 3-4 would be unloaded at existing facilities in the Port of Anchorage. The major network components of Scenario 3 are presented below in **Figure 3.8**.

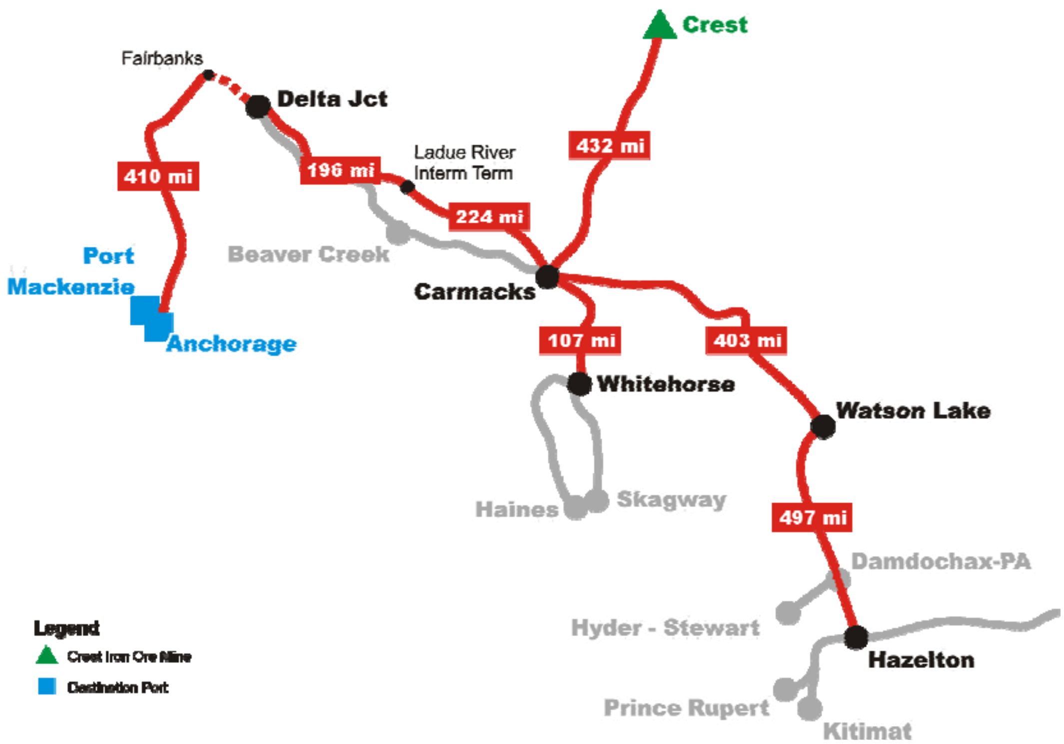


Figure 3.8 - Scenario 3 (Port Mackenzie via Ladue River) Network Components

3.4.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 3 rail network and are presented below in **Table 3.11**. Total track capital costs for Scenario 3 are estimated at U$17.0 billion.

Table 3.11 - Life- Cycle Track Capital Costs by Segment (Port Mackenzie via Ladue River – with Crest)

Port MacKenzie via Ladue River Track Capital Costs by Segment with Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,237	$8.5	24.9%	UMA
Watson Lake-Carmacks	403	$3,497	$8.7	20.6%	UMA
Carmacks-Interm Term	224	$2,663	$11.9	15.7%	UMA
Interm Term-Delta Jct	196	$1,388	$7.1	8.2%	UMA
Whitehorse-Carmacks	107	$547	$5.1	3.2%	UMA
Crest-Carmacks	432	$4,680	$10.8	27.5%	YES
Total	**1858**	**$17,012**	**$9.2**	**100.0%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 3 and are presented below in **Table 3.12**.

Table 3.12 - Total Life-Cycle Rail Capital Costs (Port Mackenzie via Ladue River – with Crest)

Port MacKenzie Via Ladue River Capital Costs with Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$14,554
Sustaining Track Capital Costs	$2,459
Total Capital Costs	**$17,012**

3.4.2 Port Facility Improvements

Port improvements would be as in Scenario 2.

3.4.3 Life-Cycle Port Facility Capital Costs

Port facility capital cost estimates would be as in Scenario 2

3.4.4 Capital Cost Summary

Analysis of Scenario 3 included the following estimated undiscounted life-cycle capital costs.

Table 3.13 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Ladue River – with Crest)

Port Mackenzie via Ladue River (with Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$17,012
Port Facility Improvements	$1,434
Total Improvements	**$18,447**

3.5 Scenario 3a - Port-Mackenzie - Anchorage via Ladue River without Crest Iron Ore

In Scenario 3a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). As in Scenario 3, a spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage, and Port Mackenzie via a currently undeveloped spur line. 3-5m tons of non-Crest traffic would be handled at the existing port sites in Anchorage and Port Mackenzie. The major network components of Scenario 3a are presented below in **Figure 3.9**.

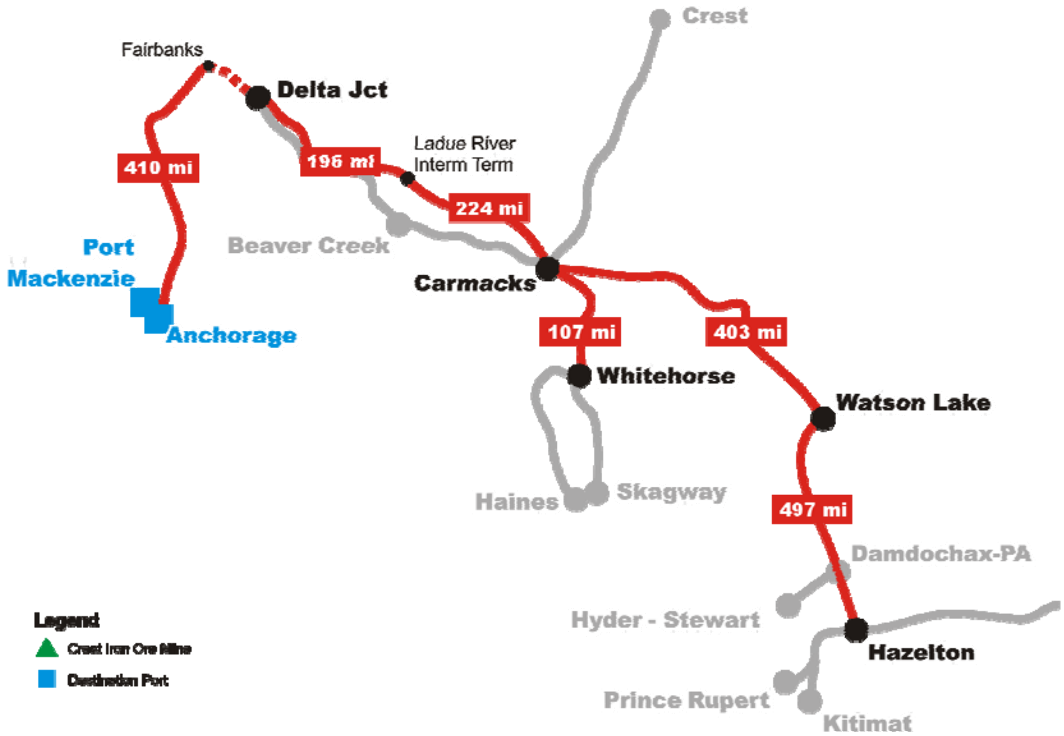


Figure 3.9 - Scenario 3a (Port Mackenzie via Ladue River) Network Components

3.5.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 3a rail network and are presented below in **Table 3.14**. Total track capital costs for Scenario 3a are estimated at U$11.5 billion.

Table 3.14 - Life- Cycle Track Capital Costs by Segment (Port Mackenzie via Ladue River – without Crest)

Port MacKenzie via Ladue River Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,237	$8.5	37%	UMA
Watson Lake-Carmacks	403	$3,497	$8.7	30%	UMA
Carmacks-Interm Term	224	$2,145	$9.6	19%	UMA
Interm Term-Delta Jct	196	$1,055	$5.4	9%	UMA
Whitehorse-Carmacks	107	$547	$5.1	5%	UMA
Total	**1426**	**$11,482**	**$8.1**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 3a and are presented below in **Table 3.15**.

Table 3.15 - Total Life-Cycle Rail Capital Costs (Port Mackenzie via Ladue River – without Crest)

Port MacKenzie Via Ladue River Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$10,806
Sustaining Track Capital Costs	$676
Total Capital Costs	**$11,482**

3.5.2 Port Facility Improvements

Port improvements would be as in Scenario 2a.

3.5.3 Life-Cycle Port Facility Capital Costs

Port facility capital cost estimates would be as in Scenario 2a.

3.5.4 Capital Cost Summary

Analysis of Scenario 3a included the following estimated undiscounted life-cycle capital costs.

Table 3.16 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Ladue River – without Crest)

Port Mackenzie via Ladue River (without Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$11,482
Port Facility Improvements	$343
Total Improvements	**$11,824**

3.6 Scenario 4 – Haines (with Crest Iron Ore)

In Scenario 4, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then on to Haines; no connection to the White Pass Railway route would be provided. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. At Haines port facilities would be developed to handle approximately 28m tons of projected Crest Iron Ore and 3-5m tons of mixed bulk non-Crest traffic. The major network components of Scenario 4 are presented below in **Figure 3.10**.

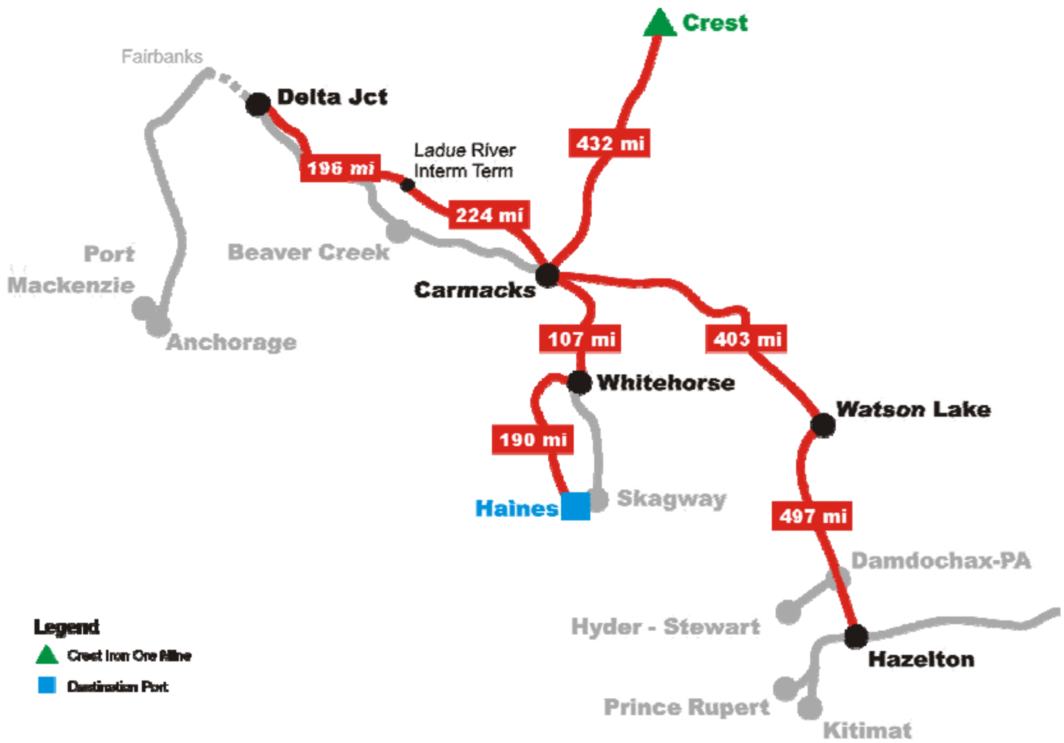


Figure 3.10 - Scenario 4 (Haines – with Crest) Network Components

3.6.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 4 rail network and are presented below in **Table 3.17**. Total track capital costs for Scenario 4 are estimated at U$18.6 billion.

Table 3.17 - Life- Cycle Track Capital Costs by Segment (Haines – with Crest)

Haines Track Capital Costs by Segment with Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,220	$8.5	23%	UMA
Watson Lake-Carmacks	403	$3,510	$8.7	19%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	11%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	6%	UMA
Whitehorse-Carmacks	107	$689	$6.5	4%	UMA
Crest-Carmacks	432	$4,680	$10.8	25%	YES
Haines-Whitehorse	190	$2,348	$12.4	13%	YES
Total	**2048**	**$18,628**	**$9.1**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 4 and are presented below in **Table 3.18**.

Table 3.18 - Total Life-Cycle Rail Capital Costs (Haines – with Crest)

Haines Capital Costs with Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$16,547
Sustaining Track Capital Costs	$2,081
Total Capital Costs	**$18,628**

3.6.2 Port Facility Improvements

To meet forecasted traffic of this multi-product analysis this study envisions the phased development of an outer port complex at Haines, at Tanani Point and within Lutak Inlet. Specifically this development calls for a two berth deep draft (60 ft / 20m) dry bulk products terminal at Tanani Point (iron ore) plus a single berth medium draft terminal to handle mineral concentrates traffic plus coal at the Chilkoot Lumber Site in Lutak Inlet, approximately 2mi / 3km to the north. The existing area of back-up lands at both sites is deemed insufficient for the proposed volumes of traffic, particularly when including iron ore traffic from the Crest. For the purposes for this analysis it is anticipated that additional back-up lands would be developed by cutting into the uplands to the west and filling the foreshore at significant cost.

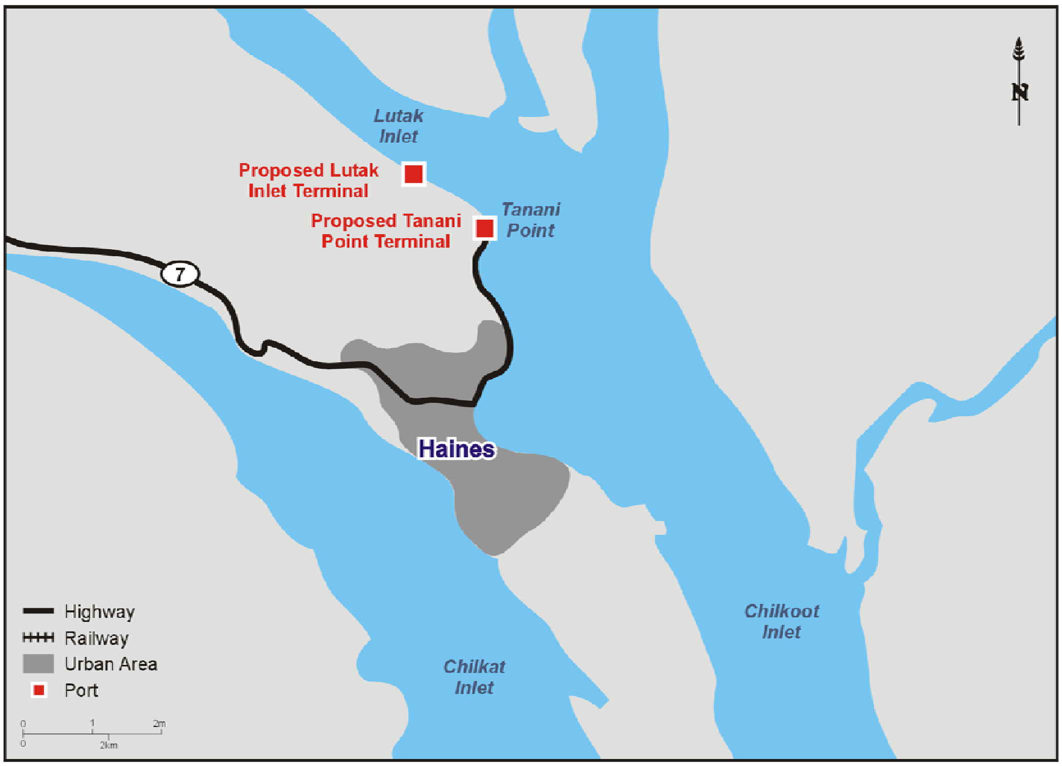


Figure 3.11 - The Port of Haines (with Crest)

3.6.3 Life-Cycle Port Facility Capital Costs

The estimated life cycle capital costs of port facility improvements at Haines are provided in Table 3.19 below. This comprises of the Tanani Point Bulk Terminal estimated to cost U$1,848 million (initial and sustaining capital) and the Lutak Inlet Multi Product terminal estimated to cost U$ 374 million (initial and sustaining capital). Similar to Port Mackenzie, Tanani would accommodate iron ore and coal in two phases. Phase 1 would handle up to 15 million tons of before the Phase 2 expansion; Lutak Inlet would be developed to accommodate mineral concentrates.

Table 3.19 – Life-Cycle Port Facility Capital Costs (Haines – with Crest)

Haines (with Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

Tanani Point Bulk Terminal	
Initial Capital	
Phase 1 Expansion	
Initial Capital	$610
Phase 2 Expansion	
Initial Capital	$510
Sustaining Capital	$728
Sub-Total Life - Cycle Capital	**$1,848**
Lutak Inlet Multi Product Terminal	
Initial Capital	
Initial Capital	$285
Sustaining Capital	$89
Sub-Total Life - Cycle Capital	**$374**
Total Life - Cycle Capital	**$2,222**

3.6.4 Capital Cost Summary

Analysis of Scenario 4 included the following estimated undiscounted life-cycle capital costs.

Table 3.20 – Total Estimated Undiscounted Life-Cycle Costs (Haines – with Crest)

Haines (with Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$18,628
Port Facility Improvements	$2,222
Total Improvements	**$20,850**

3.7 Scenario 4a – Haines (without Crest Iron Ore)

In Scenario 4a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then on to Haines; no connection to the White Pass Railway route would be provided. At Haines a port facility would be developed to handle approximately 3-5m tons of mixed non-Crest traffic. The major network components of Scenario 4a are presented below in **Figure 3.12**.

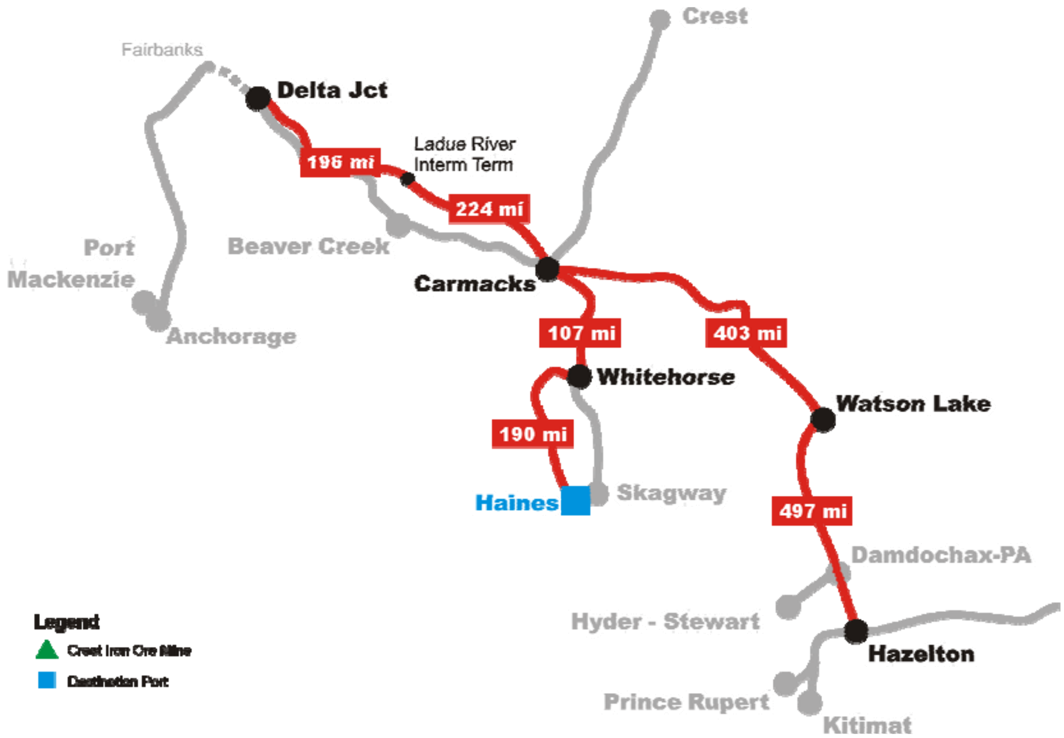


Figure 3.12 - Scenario 4a (Haines - without Crest) Network Components

3.7.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 4a rail network and are presented below in **Table 3.21**. Total track capital costs for Scenario 4a are estimated at U$13.5 billion.

Table 3.21 - Life- Cycle Track Capital Costs by Segment (Haines – without Crest)

Haines Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,220	$8.5	31%	UMA
Watson Lake-Carmacks	403	$3,510	$8.7	26%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	16%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	8%	UMA
Whitehorse-Carmacks	107	$553	$5.2	4%	UMA
Haines-Whitehorse	190	$2,015	$10.6	15%	YES
Total	**1616**	**$13,479**	**$8.3**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 4a and are presented below in **Table 3.22**.

Table 3.22 - Total Life-Cycle Rail Capital Costs (Haines – without Crest)

Haines Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$12,799
Sustaining Track Capital Costs	$680
Total Capital Costs	**$13,479**

3.7.2 Port Facility Improvements

To meet forecasted traffic of this multi-product analysis this study envisions the phased development of an outer port bulk complex at Haines in Lutak Inlet similar to facilities proposed in Scenario 4. Without the development of the Crest Iron Ore Mine, reduced volumes of dry bulk traffic would require only one Panamax sized berth at Tanani Point. The area of back-up lands at Tanani Point is deemed to be sufficient for the proposed volumes of bulk traffic.

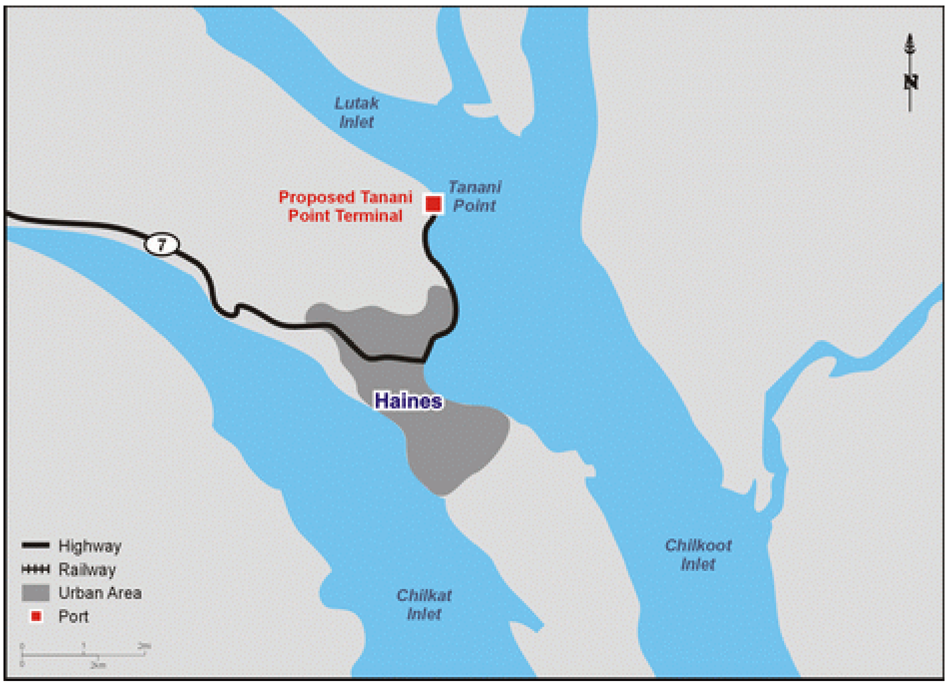


Figure 3.13 - The Port of Haines (without Crest)

3.7.3 Life-Cycle Port Facility Capital Costs

The estimated capital costs of the facilities in Lutak Inlet described above are presented in Table 3.23 below. The total life cycle capital cost for these facilities is estimated to be U$ 452 million (initial and sustaining capital).

Table 3.23 – Life-Cycle Port Facility Capital Costs (Haines – without Crest)

Haines (without Crest) Undiscounted Port Facility Capital Cost Estimate 2006 U$ millions	
Intial Capital	$335
Sustaining Capital	$117
Total Life - Cycle Capital	**$452**

3.7.4 Capital Cost Summary

Analysis of Scenario 4a included the following estimated undiscounted life-cycle capital costs.

Table 3.24 – Total Estimated Undiscounted Life-Cycle Costs (Haines – without Crest)

Haines (without Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$13,479
Port Facility Improvements	$452
Total Improvements	**$13,931**

3.8 Scenario 5 – Hyder-Stewart (without Crest Iron Ore)

In Scenario 5, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. One hundred miles north of Hazelton, at Damdochax-Pa, a spur would be developed, heading west, providing access to Hyder-Stewart. It is noted that access to Hyder-Stewart would require development of 145 miles of additional rail while being only approximately 120 miles shorter than access to the Port of Prince Rupert.

At Hyder-Stewart a port facility would be developed to handle approximately 3-5m tons of mixed bulk non-Crest traffic. The major network components of Scenario 5 are presented below in **Figure 3.14**.

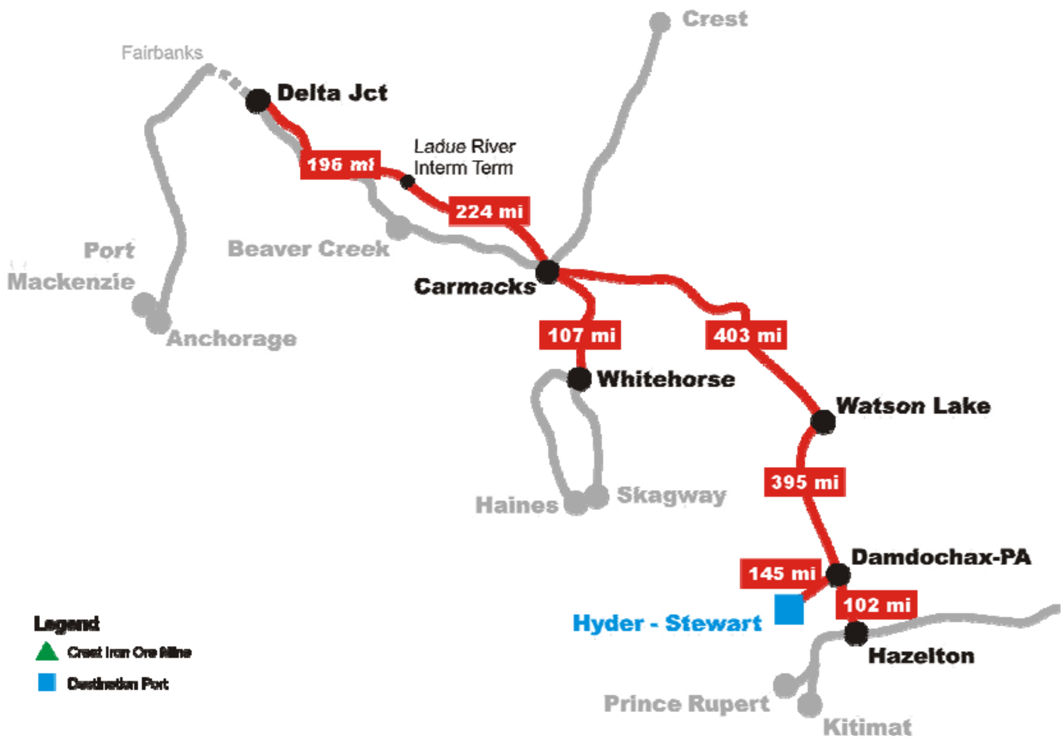


Figure 3.14 - Scenario 5 (Hyder-Stewart) Network Components

3.8.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 5 rail network and are presented below in **Table 3.25**. Total track capital costs for Scenario 5 are estimated at U$13.1 billion.

Table 3.25 - Life- Cycle Track Capital Costs by Segment (Hyder-Stewart – without Crest)

Hyder Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,203	$8.5	32%	UMA
Watson Lake-Carmacks	403	$3,516	$8.7	27%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	16%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	8%	UMA
Whitehorse-Carmacks	107	$547	$5.1	4%	UMA
Damdochax-PA-Hyder	145	$1,682	$11.6	13%	YES
Total	**1571**	**$13,130**	**$8.4**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 5 and are presented below in **Table 3.26**.

Table 3.26 - Total Life-Cycle Rail Capital Costs (Hyder-Stewart – without Crest)

Hyder Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$12,470
Sustaining Track Capital Costs	$660
Total Capital Costs	**$13,130**

3.8.2 Port Facility Improvements

To accommodate the forecast rail-served traffic demand forecast in this scenario it is envisioned that a deep sea multi-product bulk terminal would be developed at Hyder, AK. For the purposes of analysis, this scenario assigns all traffic through this terminal. However, efficiencies could be gained by using existing facilities such as the Arrow Barge Terminal at Stewart, B.C. to handle the pipe component of the traffic and Stewart Bulk Terminals to handle a portion of the other mineral concentrates.

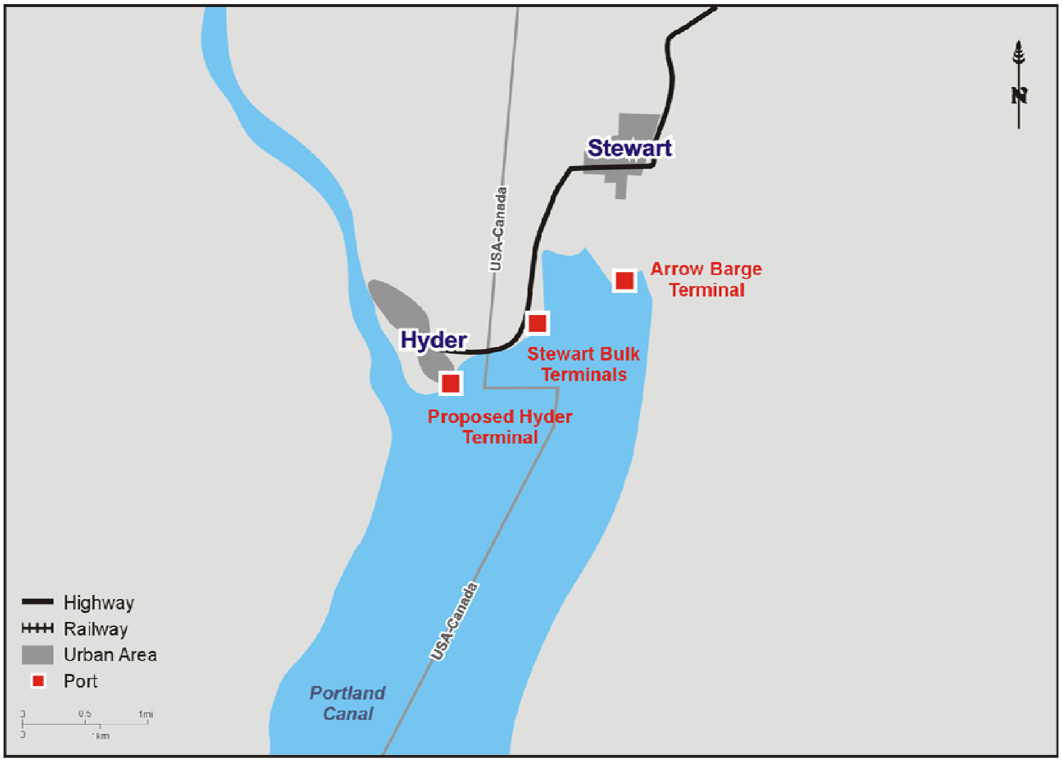


Figure 3.15 - The Hyder / Stewart Port Area (without Crest)

3.8.3 Life-Cycle Port Facility Capital Costs

The estimated capital costs of the facilities at the proposed Hyder Multi Product Bulk Terminal described above are presented in Table 3.27 below. The total life cycle capital cost for these facilities is estimated to be U$ 506 million (initial and sustaining capital).

Table 3.27 – Life-Cycle Port Facility Capital Costs (Hyder-Stewart – without Crest)

Hyder-Stewart (without Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

Intial Capital	$360
Sustaining Capital	$146
Total Life - Cycle Capital	**$506**

3.8.4 Capital Cost Summary

Analysis of Scenario 5 included the following estimated undiscounted life-cycle capital costs.

Table 3.28 – Total Estimated Undiscounted Life-Cycle Costs (Hyder-Stewart – without Crest)

Hyder-Stewart (without Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$13,130
Port Facility Improvements	$506
Total Improvements	**$13,636**

3.9 Scenario 6 – Prince Rupert with Crest Iron Ore

In Scenario 6, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. From the southern terminus of the ALCAN Rail Link at Hazelton rail traffic would make use of the existing CN Northern Mainline to connect to port facilities at Prince Rupert.

At Prince Rupert, approximately 28 million tons of Crest Iron Ore would be processed through an expanded Ridley Island Terminal. Non-Crest mixed traffic would be processed through a combination of expansion to the bulk terminal capacity at Ridley Island and the development of a new multi – purpose bulk terminal at South Kaien Island. In this scenario short-term pipe traffic would be routed through the under-utilized EuroCan Terminal at Kitimat.

The major network components of Scenario 6 are presented below in **Figure 3.16**.

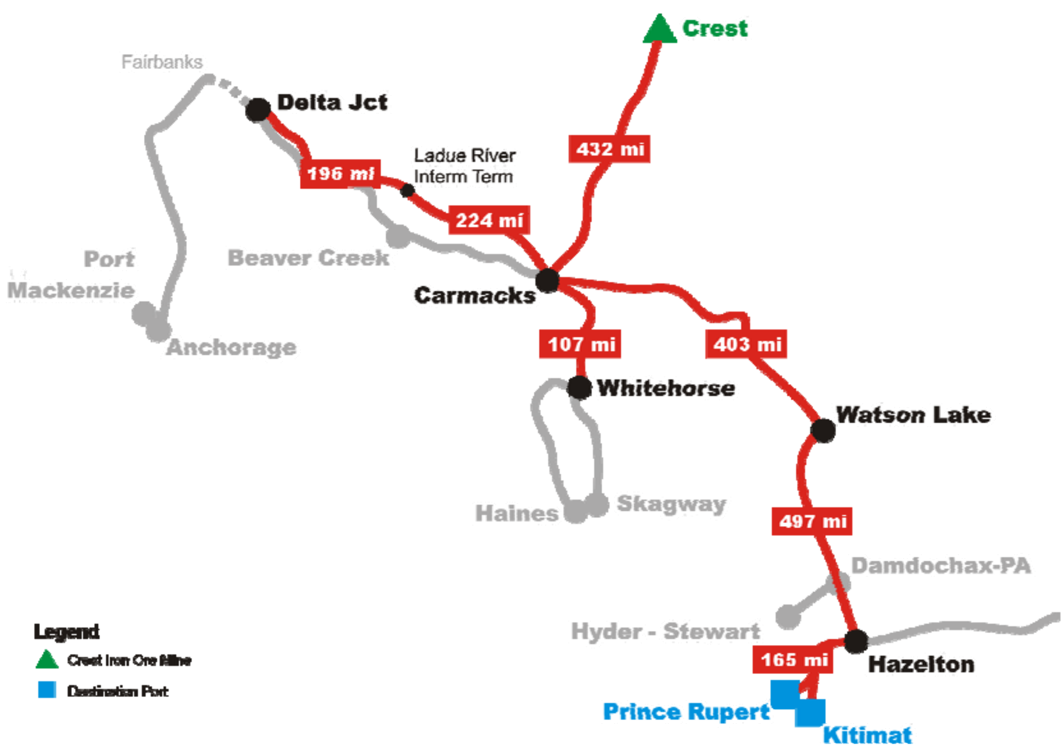


Figure 3.16 - Scenario 6 (Prince Rupert) Network Components

3.9.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 6 rail network and are presented below in **Table 3.29**. Total track capital costs for Scenario 6 are estimated at U$18.0 billion.

Table 3.29 - Life- Cycle Track Capital Costs by Segment (Prince Rupert – with Crest)

Prince Rupert Track Capital Costs by Segment with Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$5,300	$10.7	29%	UMA
Watson Lake-Carmacks	403	$4,337	$10.8	24%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	12%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	6%	UMA
Whitehorse-Carmacks	107	$547	$5.1	3%	UMA
Crest-Carmacks	432	$4,680	$10.8	26%	YES
Total	**1858**	**$18,047**	**$9.7**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 6 and are presented below in **Table 3.30**.

Table 3.30 - Total Life-Cycle Rail Capital Costs (Prince Rupert – with Crest)

Prince Rupert Capital Costs with Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$14,554
Sustaining Track Capital Costs	$3,493
Total Capital Costs	**$18,047**

3.9.2 Port Facility Improvements

Currently the Port of Prince Rupert includes Ridley Grain Terminal and the Ridley Terminals coal loading facilities both at Ridley Island and the Fairview Container Terminal (under construction) with Phase 1 capacity of 500,000 TEU in Prince Rupert harbour (**Figure 3.17**).

To facilitate additional dry bulk traffic this scenario envisions the expansion of Ridley Terminals from its existing capacity of 15 million tons to accommodate incremental coal and the development of an adjacent berth and back-up lands (storage, rail unloading) to handle Crest iron ore. Dependent on the volume of other (Northeast BC) coal shipments, an additional third berth could be required at Ridley Terminals. However for this analysis a two berth Ridley Terminals facility is assumed complete with the appropriate increases to its rail car unloading, bulk storage and ship loading facilities. Other mineral products could be accommodated at the nearby South Kaien terminal property owned by the Port of Prince Rupert.

Accommodation of mineral traffic through the Port of Prince Rupert is assumed to be handled through the construction of the proposed South Kaien Island multi product bulk terminal at the site adjacent to Ridley Island. Given the time required to develop this new capacity the pipe traffic in years three and four could be accommodated at the under-utilized EuroCan Terminal in Kitimat.

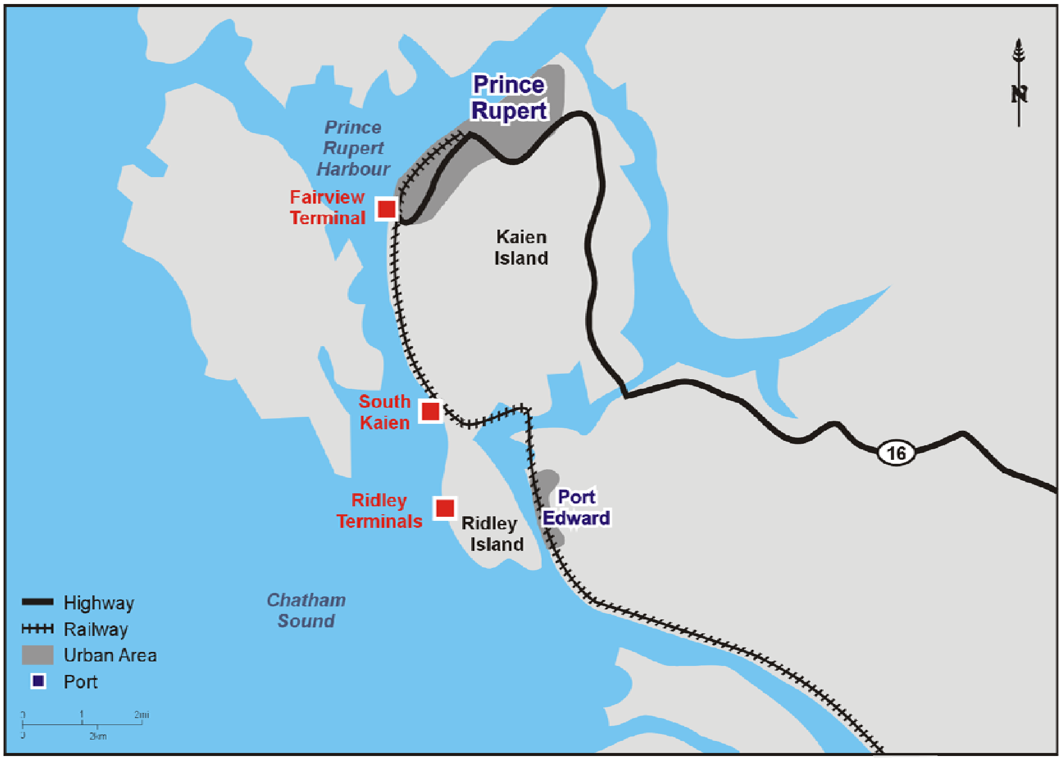


Figure 3.17 - The Port of Prince Rupert (with Crest)

3.9.3 Life-Cycle Port Facility Capital Costs

With the Crest Iron Ore traffic the capital improvements at Prince Rupert comprise of the refurbishment and expansion to Ridley Terminals (to handle iron ore and coal) and the development of the nearby South Kaien Terminal for the remainder of the bulk products. On this basis the life cycle capital costs of Port improvements at Prince Rupert are estimated to total U$ 1,687 million of which U$ 1,308 million is for the Ridley Terminals expansion and the remainder to construct the South Kaien Multi Product terminal. These estimated capital costs are set out in Table 3.31 below.

Table 3.31 – Life-Cycle Port Facility Capital Costs (Prince Rupert – with Crest)

Prince Rupert (with Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

Ridley Terminals	
Refurbishment	
Initial Capital	$280
Expansion	
Initial Capital	$470
Sustaining Capital	$558
Sub-Total Life - Cycle Capital	**$1,308**
South Kaien Multi Products Terminal	
Initial Capital	$290
Sustaining Capital	$90
Sub-Total Life - Cycle Capital	**$380**
Total Life - Cycle Capital	**$1,687**

3.9.4 Capital Cost Summary

Analysis of Scenario 6 included the following estimated undiscounted life-cycle capital costs.

Table 3.32 – Total Estimated Undiscounted Life-Cycle Costs (Prince Rupert – with Crest)

Prince Rupert (with Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$18,047
Port Facility Improvements	$1,687
Total Improvements	**$19,734**

3.10 Scenario 6a – Prince Rupert (without Crest Iron Ore)

In Scenario 6a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks was included to Whitehorse, if no direct connection to the existing White Pass Railway route is envisioned, this connection could be omitted. From the southern terminus of the ALCAN Rail Link at Hazelton rail traffic would make use of the existing CN Northern Mainline to connect to the existing port facilities at Prince Rupert and Kitimat. Approximately 3-5 million tons of non-Crest mixed traffic would be processed through a combination of the Ridley Island Terminal, a new terminal at South Kaien and Kitimat. The major network components of Scenario 6a are presented below in **Figure 3.18**.

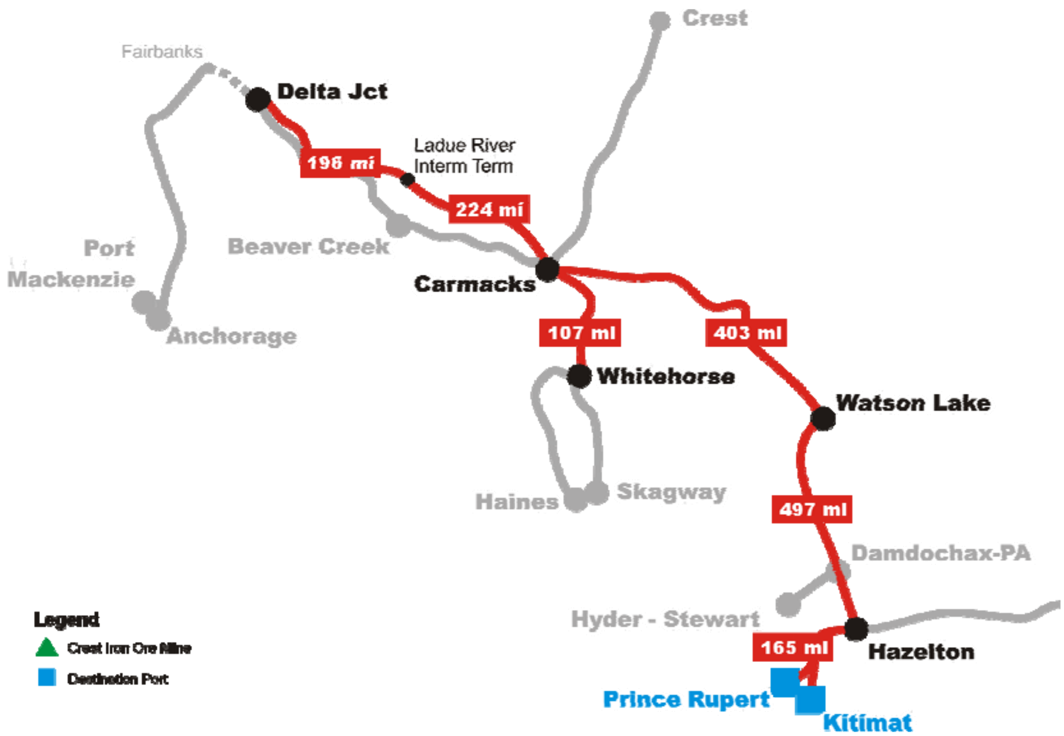


Figure 3.18 - Scenario 6a (Prince Rupert) Network Components

3.10.1 Life-Cycle Rail Network Capital Costs

Undiscounted track capital costs only, including initial and sustaining capital, have been estimated for each segment of the Scenario 6a rail network and are presented below in **Table 3.33**. Total track capital costs for Scenario 6a are estimated at U$11.5 billion.

Table 3.33 - Life- Cycle Track Capital Costs by Segment (Prince Rupert – without Crest)

Prince Rupert Track Capital Costs by Segment without Crest					
Segment	**Miles**	**Initial & Sustaining Capital Costs (in U$ millions)**	**Cost per Mile (in U$ millions)**	**Percentage of Total Track Cost**	**Source**
Hazelton-Watson Lake	497	$4,260	$8.6	37%	UMA
Watson Lake-Carmacks	403	$3,516	$8.7	31%	UMA
Carmacks-Interm Term	224	$2,134	$9.5	19%	UMA
Interm Term-Delta Jct	196	$1,048	$5.4	9%	UMA
Whitehorse-Carmacks	107	$547	$5.1	5%	UMA
Total	**1426**	**$11,504**	**$8.1**	**100%**	

Total undiscounted life cycle rail capital costs, initial and sustaining, have been estimated for Scenario 6a and are presented below in **Table 3.34**.

Table 3.34 - Total Life-Cycle Rail Capital Costs (Prince Rupert – without Crest)

Prince Rupert Capital Costs without Crest	
(in U$ millions 2006)	**Management Strategy**
	1 / 2 / 3
Initial Track Capital Costs	$10,806
Sustaining Track Capital Costs	$698
Total Capital Costs	**$11,504**

3.10.2 Port Facility Improvements

In this scenario without the Crest Iron Ore traffic the major refurbishment and expansion of Ridley Terminals would not be required. The modest volume of coal forecast from the Alaska – Canada Rail study region, (30 million tons over 22 years), could be accommodated at the existing single berth coal handling terminal. The focus of port facilities improvements in this case would be the development of the South Kaien terminal to serve the non Crest bulk products net of coal.

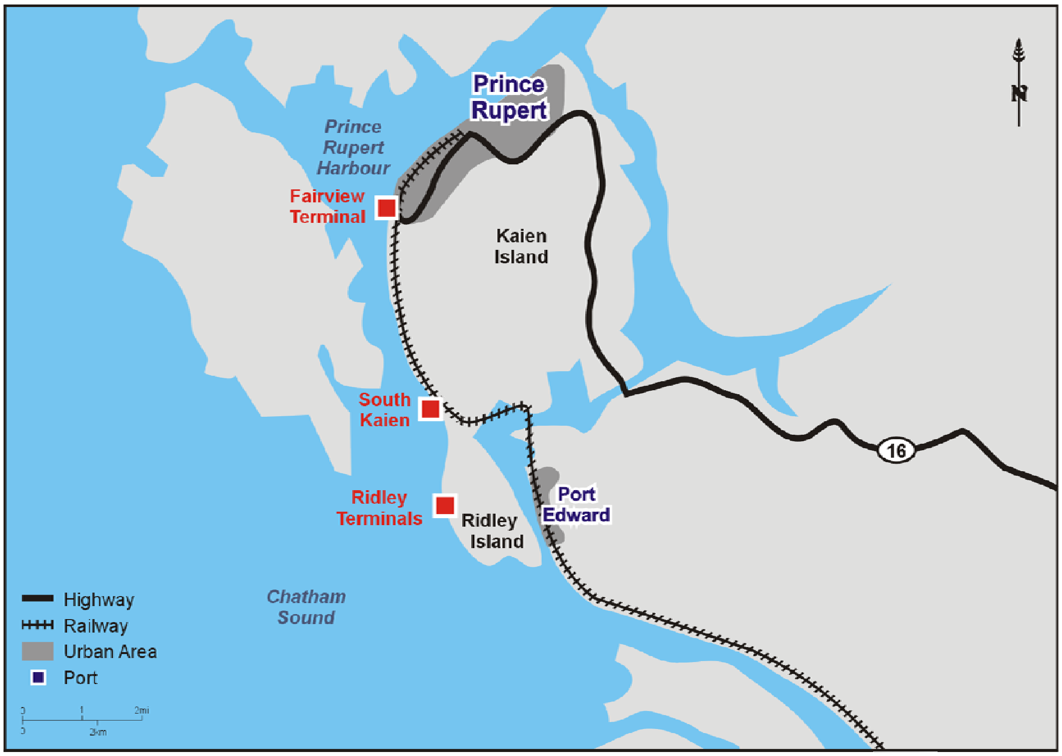


Figure 3.19 - The Port of Prince Rupert (without Crest)

3.10.3 Life-Cycle Port Facility Capital Costs

These capital costs in Table 3.35 below are the same as the South Kaien terminal estimate in Table 3.31 above.

Table 3.35 – Life-Cycle Port Facility Capital Costs (Prince Rupert – without Crest)

Prince Rupert (without Crest)
Undiscounted Port Facility Capital Cost Estimate
2006 U$ millions

South Kaien Multi Products Terminal	
Initial Capital	$290
Sustaining Capital	$90
Total Life - Cycle Capital	**$380**

3.10.4 Capital Cost Summary

Analysis of Scenario 6a included the following estimated undiscounted life-cycle capital costs.

Table 3.36 – Total Estimated Undiscounted Life-Cycle Costs (Prince Rupert – without Crest)

Prince Rupert (without Crest)	Estimated Undiscounted Life-Cycle Capital Costs Management Strategy 1 / 2 / 3 (U$ millions)
Rail Network Improvements	$11,504
Port Facility Improvements	$380
Total Improvements	**$11,884**

4.0 Summary

This report on Work Package B3(b) estimates in constant dollars the life – cycle capital costs of the selected options for multi – modal part integration to the main Alaska – Canada Rail Link system. At this stage of initial or pre-feasibility economic planning the scenarios reported herein are meant for mutually exclusive comparison and not for system network optimization.

Life cycle capital costs tabulated below encompass a set of port – route link options. The cost data includes the initial capital costs of rail line infrastructure and the sustaining capital costs over the 50 year life cycle. The estimated capital costs of port facility refurbishment, expansion and / or new development are set out in a separate column. These costs encompass the estimates of port facility infrastructure and the materials handling equipment needed to handle the forecast volumes of bulk product and pipe traffic.

Estimated Undiscounted Life-Cycle Capital Costs		Port Improvements (U$ millions)	Rail Improvements (U$ millions)	Total Improvements (U$ millions)
Scenario 1	Skagway (without Crest) *	$200	$11,600	$11,800
Scenario 2	**Port Mackenzie via Beaver Creek (with Crest)**	**$1,400**	**$17,700**	**$19,100**
Scenario 2a	Port Mackenzie via Beaver Creek (without Crest)	$300	$12,400	$12,700
Scenario 3	**Port Mackenzie via Ladue River (with Crest)**	**$1,400**	**$17,000**	**$18,400**
Scenario 3a	Port Mackenzie via Ladue River (without Crest)	$300	$11,500	$11,800
Scenario 4	**Haines (with Crest)**	**$2,200**	**$18,600**	**$20,900**
Scenario 4a	Haines (without Crest)	$500	$13,500	$13,900
Scenario 5	Hyder-Stewart (without Crest)	$500	$13,100	$13,600
Scenario 6	**Prince Rupert (with Crest)**	**$1,700**	**$18,000**	**$19,700**
Scenario 6a	Prince Rupert (without Crest)	$400	$11,500	$11,900

* Due to constrained port expansion capacity direct comparison not possible. High range reported.

From this summary level data the following observations are made:

- The capital costs of port improvements are small when compared with the costs of rail improvements to access these tidewater locations.
- Port improvement and rail improvement total life cycle capital costs are greatly impacted with the presence of the Crest Iron Ore traffic.
- Total rail and port capital costs with the Crest traffic range from twenty billion dollars for the Port Mackenzie route integration to some twenty two billion with the Prince Rupert integration option and approach twenty two and a half billion dollars with the Haines route option.
- In the scenarios without the high volume Crest traffic the same general rail – port route access pattern is observed but the total life – cycle costs range over a much lower level from over thirteen million dollars up to nearly fifteen billion dollars.

It is noted that the comparative information estimated in this work package and summarized herein presents only one (important) part of the transportation economic cost picture. The operating expenses that accompany each of these options need to be considered and added to the capital estimates provided herein to obtain the basis to estimate the total unit cost of service for the selected rail-port scenarios. The companion report on work package B3(d) estimates the operating expenses associated with the same rail-port route options Then, in work package B3(f) the capital costs and the operating expenses are combined over the life cycle, discounted to a present value and divided by the present value of the traffic flows to derive estimates of the unit cost of service.

The following paragraphs summarize the port integration options considered above at a strategic level:

- Port Mackenzie and the Port of Anchorage offer a number of advantages due to the presence of existing infrastructure and access. Port Mackenzie has sufficient back-up land area, an existing deep sea berth with the potential to add a second and third berth position which could facilitate development of a high volume dry bulk terminal. The planned expansion of the Port of Anchorage would provide enough capacity to absorb the pipe traffic. Limitations for this rail-port route option include the draft restriction crossing Knik Shoal plus the long round-trip distance 2500 miles (4000 km) return from the Crest Iron Ore Mine in northeast Yukon to the export terminal location in south central Alaska.
- Haines and its outer port area at Tanani Point and within Lutak Inlet have two potential sites for terminal development, albeit at comparatively high terminal capital cost. Haines is closer to the Crest Iron Ore Mine 1500 miles (2400 km) return than other port route options with the exception of Skagway. The abandoned industrial facilities at Tanani Point and in Lutak Inlet could be redeveloped and expanded to facilitate both a multi product terminal and a high volume dry bulk product terminal. However, the scale of facilities needed to serve the projected traffic will challenge the available back-up lands necessitating potentially costly site reclamation.
- Skagway was reported herein for rail route costs but not for large scale port expansion. Limitations due lack of port – related industrial land, conflicts with passenger cruise business, the environmental impacts of port construction in an urban setting close to the mouth of a river limit the future capacity potential of Skagway. In addition to not being able to service Crest Iron Ore it is likely that Skagway would not be able to facilitate 3-5 million tons of non-Crest traffic. If Skagway is to expand its role as an industrial port, it would be likely in a limited number of bulk cargoes that have limited impacts on adjacent port uses.
- Hyder – Stewart port route development was considered as a port pair. At Hyder a site is proposed for development is located at the mouth of a sensitive river. While this site could potentially handle the non Crest traffic it is not considered suitable for large volume iron ore storage and handling. The small scale facilities in the Port of Stewart could play a supporting role in handling some of the outbound mineral resource products. The capital cost of rail infrastructure into Hyder – Stewart would also present a challenge to realization of this port – rail integration route considering the low traffic volumes and proximity to the established Port of Prince Rupert.
- Prince Rupert is the Gateway port to central and northern British Columbia and the adjacent western Canadian provinces. Its port facilities can be integrated into the Alaska Canada system by connecting to the CN Rail northern mainline. Similar to Port Mackenzie – Anchorage this route integration does require comparatively long hauls. On balance however, Prince Rupert is a comparatively low risk port integration option offering sheltered deep water at its inner and outer harbour berthing locations and a well developed array of port infrastructure.