White Pass Standard Gauge Conversion

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ABSTRACT

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The extension of the Alaska Railroad from Fairbanks, Alaska, to Whitehorse, Yukon, Canada, has been proposed through Alaska House Bill 241. At Whitehorse, the proposed railroad would join the existing White Pass and Yukon Route Railroad allowing for a tidewater connection at Skagway, Alaska. However, White Pass track gauge is non-standard and an overhaul of the entire railroad infrastructure would be necessary to accommodate the proposed rail link. This project considers the process and feasibility of this conversion.

Keywords: White Pass Railroad
Alaska Railroad
Gauge Conversion
Trans-Canada
Extension

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Introduction

This paper provides an engineering outline and discussion of the process and feasibility of converting the White Pass and Yukon Route Railroad from narrow gauge (36 in) to standard gauge (56 ½ in). This subject matter represents a sub-portion of the proposed systemwide expansion of the Alaska Railroad to connect Alaska with British Columbia and the contiguous United States. Especially, this paper augments Alaska House Bill 241, which proposes extension of the Alaska Railroad from Fairbanks, Alaska, to Whitehorse, Yukon, Canada.

This paper addresses only pertinent issues necessary for the operation of standard gauge equipment along the White Pass. Efficiency issues, such as line-changes, lessening of grade, curve compensation and realignment, and clearances are not addressed unless they pose an impasse to standard gauge operations.

The author has extensive institutional knowledge of the White Pass having spent many summers working a variety of positions including: track surveyor, bridge inspector, assistant project engineer, conductor, locomotive engineer, and work train conductor-foreman.

The conversion of the White Pass Railroad is a process expected to take two years. Since the actual start date of construction is not known, a generic timetable is employed using simply Year-One for the first year of construction and Year-Two for the second.

Many construction phases of the project will occur simultaneously along different portions of the railroad. A full timeline is provided in Appendix A and portions are used throughout the text for clarification.

White Pass and Yukon Route Railroad's primary means of revenue is summer passenger trains. White Pass caters to the tourist industry, specifically the thousands of passengers brought in daily by cruise ships. Railroad construction and maintenance of any type cannot interfere with the normal passenger operations and this poses a unique design challenge: rebuild an entire railroad without disrupting service. The seasonality of the White Pass Railroad does not favor the standardization process as the track work must be accomplished during the spring, summer, and early fall. Only the conversion of the rolling stock can take place during the winter months.

While the conversion from narrow gauge to standard gauge was relatively common prior to WWII, there have not been any since. Few similarities would exist between previous conversions and a modern conversion because previous conversions relied heavily on manpower and the proposed project will depend largely on modern machinery and equipment.

Such an undertaking would truly be an amazing feat and highly suitable for a railroad already designated an "International Historic Civil Engineering Landmark."

1.0 Project History

Alaska and Northern Canada are North America's last untapped storehouse of natural resources. The chief impediment to their development is the lack of transportation, namely railroads. The idea of a trans-Canada railroad from Alaska to the contiguous United States has existed for decades, beginning with President Woodrow Wilson's construction of the Alaska Railroad (completed in 1923). A railroad to the Northern interior was explored further just prior to the advent of World War II. A 1942 Army Corps of Engineers survey (War Department, 1942) explored a route as a complement to the Alaska Highway but public interest and national defense necessity eventually declined. In the 1970's, the State of Alaska passed legislation allowing funding for extensive research into the economic benefits, feasibility, and potential routes. Combined with recent, substantial efforts from Alaska, Northern Canada and the Yukon, with strong political support within Alaska (James Joint House Report, 2001), the prospect of a Yukon-Alaska railroad is growing (Murkowski, 1999).

A route beginning near Fairbanks, Alaska (DOTPF, 1979/82), passing through Whitehorse, YT, and finally meeting mainline North American Railroads in British Columbia is an idea that will provide system linkage and additional transportation options to a variety of resources (Alaska Geologic Survey, 2001).

One sub-portion of this rail system is the tidewater connection to Skagway, Alaska. The existing White Pass and Yukon Route Railroad (White Pass) extends from the

northernmost point of the Lynn Canal in Southeast Alaska and crosses the Alaska-British Columbia border at White Pass Summit and terminates, after 110 miles, in Whitehorse. This connection would serve first as a supply route for construction of the trans-Canada Railroad and would continue to serve as tidewater access for both freight and passengers. In addition, a trans-Canada railroad would be a benefit to construction of a gas pipeline (James, 2002). A 1977 State of Alaska Department of Commerce and Economic Development report expected Skagway and the White Pass Railroad link with the Yukon-Alaska system to transport petroleum products, containers, exported transcontinental freight, mining products, grain, coal, and pulp (Alaska Department of Commerce and Development, 1977). Given today's intense tourism market and White Pass's marked history and development within the tourism industry, such a network connection would certainly include the extensive transportation of passengers. The White Pass connection would give the Yukon-Alaska line an outlet to the Inside Passage including a protected seaway to Prince Rupert, Vancouver, and Seattle. Most importantly, a standard gauge White Pass Railroad would provide a direct tidewater link for the export of Yukon minerals. The development of mineral resources in the Yukon led to two White Pass engineering studies, which assessed the extension of White Pass north of Whitehorse (Yukon Railway Feasibility, 1969)(Yukon Railway Study, 1975).

However, White Pass was designed and built to narrow gauge specifications and is not compatible with standard gauge railroad networks. Conversion to standard gauge is necessary for White Pass to become an efficient, viable, and integral portion of the Yukon-Alaska railroad. Failure to convert would force the majority of interior-bound

freight via Skagway to be offloaded from barges onto trucks and then re-transferred to rail at Whitehorse. Sea-bound freight through Skagway would be taken off a train at Whitehorse, loaded onto trucks, and then re-transferred to barge or ship in Skagway. The system is significantly more efficient and effective if freight were left onboard rail cars and rolled directly on and off barges with immediate access to a rail network without the need for excess handling. It was the high costs of narrow gauge operation and the transfers of freight to narrow gauge cars that led to the shutdown of the White Pass as a freight-hauling railroad on 8 October 1982[1].

2.0 History of the White Pass and Yukon Route Railroad

The White Pass was built at the turn of the 20th century in response to the transportation demands of the Klondike gold rush. With its main terminal at tidewater in Skagway Alaska, the White Pass runs 110 miles passing through Alaska (20 miles), British Columbia (33 miles), and Yukon (57 miles) with a northernmost terminus at Whitehorse. Built to narrow gauge specifications with a rail gauge of 3 ft, the White Pass is unique in that its standards and conventions greatly exceed and surpass commonplace narrow gauge roadbed conditions[2].

[1] Interestingly enough, there is a strong argument to be made for the conversion of the White Pass with its current summer-only tourist operation due to the age factor, inefficiency, unreliability and maintenance of narrow gauge locomotive.

[2] As a matter of fact, two standard gauge steam rotaries were the very first new equipment purchased in 1900 for the fledgling railroad. White Pass has operated with standard gauge tank cars, cabooses, and standard gauge maintenance of way equipment.

Following the decline of the gold rush, White Pass remained in operation as a primary freight and passenger route into the interior of the Yukon and outlying regions gaining the title "Gateway to the Klondike." With the outbreak of WWII, White Pass was leased and operated by the United States Army and proved to be a valuable supply route during the construction of the Alaska-Canada Highway. With the rapid development of mineral ore in the Yukon and British Columbia during the 1960's and 1970's, White Pass boomed as a freight railroad hauling supplies north to Whitehorse and bringing large shipments of mineral ore south to Skagway to be loaded onto ships.

White Pass suspended operations in 1982 with the closing of crucial ore mines and the opening of a parallel highway. In 1988, White Pass reopened as strictly a tourist railroad catering to the cruise ship tourism industry. In its first year as a seasonal, passenger railroad, White Pass transported 38,000 passengers. In 2001, White Pass transported over 300,000 passengers. Currently, White Pass operates heavy passenger operations over only 40 miles of its 110 miles of mainline between Skagway and Bennett Station. The 27 miles between Bennett and Carcross has received recent, substantial overhaul but as of yet is unused. This Lake Bennett section is ready for immediate conversion to standard gauge. The unused 40-mile portion between Carcross and Whitehorse (actually Utah Yard at MP 106) is still intact and receives only minimal preservation maintenance. In 1990, White Pass was designated a Historic International Civil Engineering Landmark.

3.0 STANDARDIZATION OUTLINE

The standardization process is expected to take two years.

3.1 Current Track Maintenance

White Pass has done and is continuing to perform maintenance and construction at a level that meets both their current operating requirements while simultaneously benefiting the future standardization process. Such principles include the installation of heavy rail, 8 ft ties, greater clearances and track spacing, new passenger car trucks, switches, increased bridge and dock load ratings, and high specification ballast. These not only lend themselves to safe, reliable passenger operations but also greatly enhance the efficiency with which standardization can take place. However, such practices are not consistent throughout the entire length of railroad. Table 1 outlines milepost parameters, their level and quality of the track structure, and the corresponding maintenance effort.

Table 1: Track suitability for Standardization

Mainline Section		Standard Gauge Preparedness	Maintenance Regime
MP 0 –20	Skagway to White Pass	Ready for immediate conversion	Heavy, regular maintenance
MP 20 – 27	White Pass to Fraser	Ready for immediate conversion	Regular maintenance
MP 27 – 40	Fraser to Bennett	Ready for immediate conversion	Light maintenance
MP 40 – 67	Bennett to Carcross	Ready for immediate conversion	All new, recent construction/rebuild
MP 67 – 110	Carcross to Whitehorse	Still intact as a narrow gauge railroad but has received little maintenance since 1982; will require all new ties and rail.	

White Pass has spent millions of dollars upgrading the 27 miles of track between Bennett Station and Carcross with new ties, ballast, and extensive bank widening.

White Pass is unique and sets a precedent in dealing with five governments: Alaska, British Columbia, Yukon, the United States, and Canada. As a result of this combination, White Pass is often forced to comply with the most stringent of regulations throughout its length.

3.2 Traffic Interruption

The process of standardization must not interfere with normal passenger operations. Currently, the majority of revenue generated by White Pass is through tourist trains and to limit, restrict, or prevent their smooth operation for the purpose of standardization would be irrational and unnecessary. Much of the railroad is unused therefore a substantial amount of work can proceed without fear of traffic disruption during the summer tourist season. As tourism wanes in the fall of the year and passenger traffic eventually subsides, track-widening crews can proceed through the passenger corridor.

3.3 Affect on Tourism

It is important to address the affect of conversion on White Pass's tourist excursion business. White Pass is a vital and profitable Alaska tourist business much of which is attributed to its narrow gauge essence and mystic. The White Pass railroad is totally

dependent upon its five month long summer tourist excursion business and should the tourist market weaken or even disappear, White Pass would founder. Conversion would provide new, freight revenue and a diversification to the railroad business that spreads the revenue risk to a second source of income.

Since 1988, passengers have been riding over what is essentially standard gauge track with its 8 foot ties, heavy rail, heavy switches, and wide clearances. The passengers never see the track so they don't notice the width of the rails. All the historical sites along the White Pass railroad remain the same. All the scenic locations and the dramatic railroad trestle into the tunnel, high cliffs and curved bridges in horseshoe curves will not change. There is absolutely no risk to this consideration of the "Scenic Railway of the World."

When converted, White Pass would continue to use its small passenger cars on standard gauge running gear in the same manner as current operations. The only difference being that larger standard gauge locomotives as opposed to narrow gauge locomotives are pulling the excursions. The safety of the wider, and hence more stable, standard gauge track is of real value in reducing the risk of passenger train operations and in itself a very strong argument to convert to standard gauge.

The passenger cars, as opposed to track gauge, provide the greatest aura of times past: the small open vestibules open to the sounds and smell of a railroad; the ornate woodworking and cast-iron stoves; the brass fixtures and uniformed conductor all impart the feeling and

enjoyment that White Pass customer service prides itself on. The marketing effort of White Pass can emphasize that the railroad *track* has been converted for the passengers' convenience, comfort, and safety but passengers are still riding in narrow gauge equipment over the same journey, enjoying the same experience.

3.4 Construction Outline

The standardization process would be done in several phases, all of which would be completed in two years. A condensed timeline is presented with Figure 1. A full project timeline is provided in Appendix A. First would be the construction of a rail-barge loading facility providing the direct interchange of standard gauge cars and locomotives to the White Pass from supply points in the U.S., Canada, and west coast. Next, the upgrading and reinforcement of bridges to a level suitable for standard gauge traffic would be necessary. The third phase would be right-of-way stabilization between Carcross and Whitehorse. This phase would be accomplished during Year-One with a dedicated work train transporting fill material. Simultaneously, work would begin on gauge widening between Carcross and Bennett. As passenger operations in the fall of Year-One subside, gauge widening from Bennett to Skagway would commence. During the winter of Year-One and early spring of Year-Two, passenger equipment conversion to standard gauge would take place with work being completed prior to Year-Two's operating season. The final portion of rail, the mothballed section from Carcross to Whitehorse, would be converted during Year-Two. This northernmost division of track is the most decrepit and in need of rehabilitation beyond simple gauge widening as the

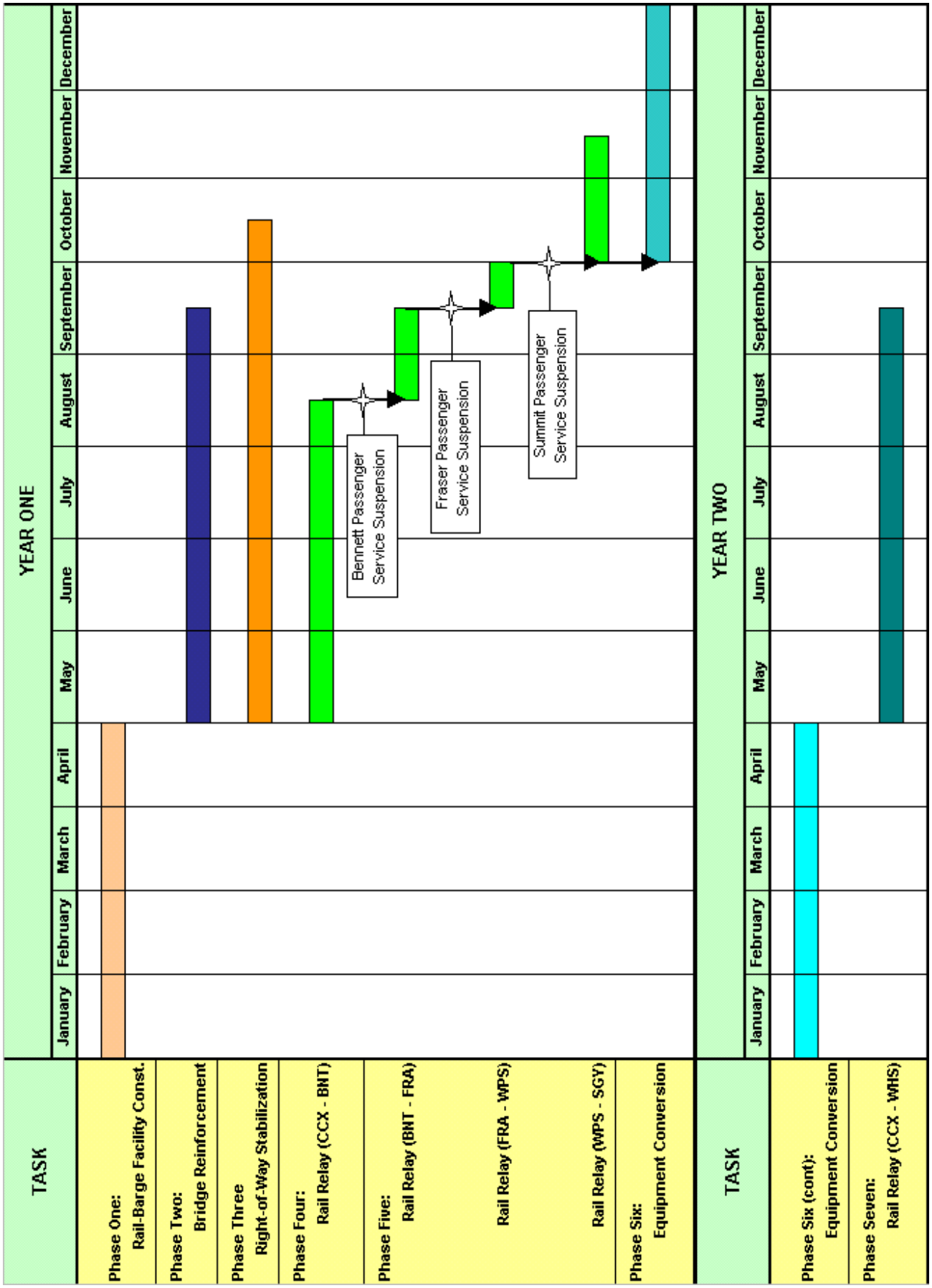

Figure 1. Construction Timeline

right-of-way itself is dilapidated; ties are decayed and will not hold gauge or support rail loads. Appendix A provides a full project time line.

4.0 STANDARDIZATION DETAIL

4.1 Phase 1: Rail-Barge Ramp Development

Beginning January of Year-One, construction of a rail-barge loading marine facility of standard gauge rail capacity would commence in Skagway Harbor. This would allow for construction material to be loaded by the manufacturer in the contiguous United States or Canada, and shipped directly to Skagway via barge. Such direct shipping ability would significantly lessen shipping cost and provide an immediate resource of construction materials and supplies via barge with cargo already on freight cars. This facility will also be the leading end of what is to become Skagway's rail/barge connection and new freight revenue. This would be the first White Pass freight revenue since October 1982.

The Skagway southern railroad yard, near the boat harbor, may be easily adapted to accommodate both standard gauge and narrow gauge equipment. While summer operations are ongoing, supplies necessary for standard gauge conversion can be staged and stockpiled, without hindering seasonal, tourist operations.

Construction of the loading facility would be completed prior to the arrival of the cruise ship season in early May of Year-One (Figure 1). Wintertime port construction is

common in Skagway. The majority of the existing facilities were constructed during the dead of winter as the summer cruise ship season allows little opportunity for summer construction.

Several docks exist in Skagway (Figure 2) and all have been designed or adapted to accommodate passenger traffic. However, two are immediately suitable for rail-barge ramp construction.

Figure 2. Skagway Port Facility

The first, identified as 'the Railroad Dock,' is located on the east side of the harbor. This deep-water dock was designed and built for standard gauge rail capacity and features standard gauge track via a third rail through much of its length. No additional railroad grade crossings would be required and the additional rail traffic accessing the pier would pose no significant threat increase to pedestrian traffic.

The second suitable pier, identified as 'the Ore Dock,' is located on the west side of the harbor, nearest Skagway River. A ramp, built and operated by Alaska Marine Line (AML) has just been constructed; however extensive upgrading would be required to

accommodate rail traffic. Track geometry[3] in the confined quarters of this area of the waterfront would also pose a design problem. Freight access may require additional grade crossings through the heart of Skagway's busy tourism district and the increase in rail activity accessing this portion of the harbor would pose an increased threat to the safety of pedestrian and vehicular traffic.

Skagway experiences tidal fluctuations of 25 ft. The appropriate ramp design would take advantage of the tide and allow for four loading/offloading opportunity windows per day at the 16 ft tide stage.

The City of Skagway exists in a confined valley with little room for expansion east or west. Waterfront land, leased by the White Pass from the City of Skagway, has been subdivided and the remaining available portions are not adequate for staging of railroad freight. However, land is available north of the White Pass railroad maintenance facility. The most efficient means of marshalling barge borne freight would be to remove the laden equipment from the barge and directly stage it north of Skagway along railroad milepost three (MP 3). Such an operation would limit public exposure to train operations within the tourism district and remove rail traffic congestion and subsequent interference with passenger operations. Another added benefit to a MP 3 yard would be the removal of noise from within the city. Night operations could commence with little noise disturbance to citizens.

[3] Unfortunately, recent land leases have essentially removed use of the Ore Dock Facility as a marine rail barge facility despite its prime location for such operations.

4.2 Phase Two: Bridges, Tunnels, and Clearances

White Pass has 23 bridges over its entire route, fourteen of which are maintained within the Alaska Subdivision (MP 0.0 – MP 20.4). To handle the increase in axle load of standard gauge railroad equipment, many of these bridges require upgrading. The simplest and most efficient means of upgrading is through the installation of intermediate pony trusses. This is, essentially, the construction of additional bents at the bridge mid-spans. This is not an uncommon practice among railroads[4]. Several wooden bridges within the last ten years have been rebuilt as steel structures and meet standard gauge capacity requirements. Two bridges designated as 15-A and 18-A would require extensive upgrading[5].

Within the British Columbia sub-division (MP 20 – MP 53), three bridges are maintained. Two have been recently rebuilt to sufficient standard gauge capacity and the third is due for reconstruction by 2003. All three will be of steel construction.

The Yukon Subdivision (MP 53 – MP 110) has six bridges, three of which will require extensive rehabilitation however; the bridges are short and shallow. The three remaining bridges have been extensively renewed by White Pass and are suitable for standard gauge operation.

[4] This is a common, well known railroad practice.
[5] Based on railroad assessment by engineering consulting firm, Peratrovich, Nottingham, and Drage.

Wherever appropriate, culverts will replace bridges. All culverts within the active passenger corridor are aluminum. Some wood box culverts are in place throughout the mothballed portion of line but will be replaced with aluminum culverts. This program is underway and is nearly complete with the exception of the segment between Carcross and Whitehorse.

A single crew of eight to ten people will spend the greater portion of Year-One, beginning May 1, constructing bents and upgrading bridges. The majority of their work can be done without impeding summer rail traffic; during critical construction periods where traffic must be limited, work will be performed in the evenings and nights where no disruption to passenger operations exists.

Two tunnels exist along the entire route. The only original tunnel is located at MP 16 with a length of 300 ft. Minimal clearance issues need be addressed as the current dimensions allow for normal standard gauge equipment. The second tunnel, built in 1969 at MP 18, is 600 ft long and built to American Railway Engineering Association standards (AREA). Dimensions are sufficient for standard gauge traffic save for the portals. The concrete portal entries need to be widened as they currently constrict the interior dimensions of the tunnel.

No additional right-of-way widening is necessary. Throughout the last ten years, the White Pass maintenance program has emphasized removing close clearances. Widening

cuts, deepening shoulders, and removing rocky outcrops have been a priority for maintenance operations. Such activity lends itself to standard gauge conversion.

Historically, White Pass has moved a variety of oversized dimension freight including heavy mining equipment, mobile homes, construction housing, and a variety of other irregular dimensioned cargo. In a proof of concept test in 1980, White Pass hauled three 80-ft lengths of 60-in diameter pipe (for Foothills Pipeline) stacked in a pyramid on a 65-ft long flatcar.

4.3 Phase Three: Right-of-Way Stabilization

The first of May is the traditional start-up time for railroad heavy maintenance operations. Usually, snow and ice have receded to a point where the staging of resources is possible and the threat of cold temperatures and storms no longer exists.

Beginning May first of Year-One, a detachment of equipment will begin right-of-way stabilization between Carcross (MP 65.7) and Utah Yard (MP 106.0). This section of track is unique, as little maintenance operations have taken place over this northernmost portion since 1982; only minor, preservation maintenance, i.e. beaver dam removal, brush cutting, etc. One locomotive, eight side dump cars, and supporting heavy equipment will spend six months restoring right-of-way shoulders, replacing decrepit wooden box culverts with aluminum culverts, widening cuts, and generally preparing the physical right-of-way for heavier operations. It is expected that over 200,000 yards of material

will be removed or distributed with a dedicated work train. Much, if not all, of the soil and rock material required for this portion of construction, is available from natural sources within designated railroad land rights. Much of the subsurface through this area is a mixture of sand and silt. During original construction and early maintenance, unclean sand was the chosen ballast. Following the advent of heavier freight trains in the 1960's and 1970's, cleaned ballast was used for maintenance and construction however small portions of track still exist with sand as the primary sub-grade.

No railroad operations are underway over this portion of track and construction crews can operate unimpeded. As stabilization takes place over this northernmost section, work will be commencing on southern rail portions. The work train and equipment will essentially be isolated and unable to proceed south of Carcross. This poses no hindrance to construction or safety. Access roads off the Klondike Highway are numerous and construction resources of people and equipment are available from nearby Whitehorse and the surrounding area.

Rail, ties, and accompanying hardware through much of this section of railroad are inadequate for standard gauge traffic and all new, heavy hardware will be required. Ties, track, ballast, and hardware will be addressed in Year-Two, as all of Year-One will be required for embankment improvement.

4.4 Phase Four: Gauge Widening Part I: Carcross, YT to Bennett, B.C.

The Carcross Section (MP 40 – MP 67) is a currently unused portion of railroad. The track closely follows the shore of Lake Bennett passing over light grades and through a mixture of fine soil terrain nearer Carcross with rock becoming the dominant feature nearer Bennett. Heavy track maintenance has been performed over this section since 1996. White Pass hopes to add passenger service over this rail portion but has yet to establish a viable market. Recent work has included shore stabilization, installation of long ties, extensive surfacing, and ballasting. Although the rail through much of this section is new, 100 lb/yd, several miles of 72 lb/yd rail still exists and remains heavily worn, yet still in condition to allow for straightforward gauge widening.

All of the gauge conversion work will be supported with standard gauge hy-rail track equipment and off-the shelf standard gauge production track machinery. Two crews will be required and both may work without concern of rail traffic. After a brief learning curve, the process of standard gauging should become efficient and mechanized. This work will closely resemble the process of a rail relay. Two men will precede crew one removing spikes and anchors on the westward rail; maintaining the east rail in place serving as the gauge rail. The crew will proceed with a hydraulic gauging machine moving the unspiked rail 10.25 in. and gauge spiking[6].

[6] Track gauge must be increased from 36 in to 56.5 in. The process outlined moves each rail equidistant. Therefore, each rail must be moved a distance equal to (56.5 in – 36 in) / 2 = 10.25 in.

Crew two, in the same fashion, will move the east rail 10.25 in. and gauge spike. Then, the bulk of the crew, using standard gauge production rail laying equipment, will complete all of the spiking, anchoring, leveling, and lining of the completed standard gauge track.

To maintain the momentum of the primary construction crews, their focus will be strictly on the gauging of open mainline. They will not address areas of discontinuity, i.e., grade crossings, turnouts, and yards. A follow up crew working behind the primary construction crew will address these more technical, tedious, and potentially time consuming tasks.

From Skagway to Bennett, the existing track material is suitable for standard gauge. Rail weight through critical portions is 115 lb/yd, far surpassing narrow gauge requirements and suitable for standard gauge. Non-critical portions of rail are either 85 lb/yd or 100 lb/yd. Both are adequate for standard gauge and may be upgraded at a later date. All ties along active mainline portions of the White Pass are eight foot ties and suitable for standard gauge track.

4.5 Phase Five: Gauge Widening Part II: Bennett, B.C. to Skagway, AK

Upon reaching Bennett, MP 40, gauging crews will be entering the active passenger operation corridor. Construction should be timed so that the day of standardization completion between Carcross and Bennett occurs simultaneously with the suspension of

Bennett passenger service. This date marks the end of passenger operations between Bennett and Fraser. Historically, service to Bennett is suspended around early to mid-August. In the waning days of 'Bennett Service,' passenger numbers are low and early suspension of service would be of no serious consequence should it be necessary. Alternative arrangements could be made to the few displaced passengers.

From Bennett, construction will continue south toward Fraser in the same manner as previously outlined. Again, crews must time their arrival into Fraser with the suspension of Fraser Passenger Service. The Fraser Train serves a popular link between Interior Alaska land tour packages and embarking/disembarking cruise ship passengers. This service should not be interrupted and generally concludes in early to mid-September.

Suspension of all passenger trains occurs in late September. At this point, construction crews have unrestricted access to the busiest portion of railroad mainline. Crews can continue their gauging; however, construction will need to be completed in November when winter and freezing temperatures arrive.

In Skagway yard, a small, skilled crew of eight to ten people will spend the majority of the summer converting switches, road crossings, and in some cases laying short lengths of three-rail track in support of the total standard gauge conversion program. At the end of summer of Year-One, the essential portions of the Skagway yard will be ready to accommodate standard gauge rolling stock.

4.6 Phase Six: Equipment Standardization

Following the conclusion of passenger service, the Skagway maintenance facility can become totally dedicated to equipment standardization.

Nearly all of White Pass's equipment in service is historical passenger equipment. The passenger equipment fleet has been completely transitioned to a uniform, steel design truck, which can be easily converted to standard gauge dimensions. Other work and freight equipment is non-essential and can be easily replaced with more efficient leased or purchased standard gauge equipment brought in by barge.

White Pass locomotives are wholly obsolete and their conversion to standard gauge would counter conventional logic. One modern, standard gauge locomotive could easily replace four existing White Pass units, which can be either purchased or leased, leasing being cheaper than current White Pass locomotive maintenance costs.

A stockpile of standard gauge components can be on hand early and an assembly line operation can be established. A passenger car would enter on narrow gauge tracks and emerge on standard gauge tracks. The standardization process would be straightforward: the car enters, is jacked up, narrow gauge trucks and brake rigging removed, standard gauge trucks and rigging installed. This is not dissimilar to operations in Europe where trains are re-gauged as they progress across the multi-gauged continent. A single file line would stretch through the yard leaving all other yard tracks empty for crews to re-gauge.

A temporary track may even be constructed into and away from the roundhouse to alleviate any potential constraints on construction crews working in the yard.

4.7 Phase Seven: Gauge Widening Part III: Carcross to Whitehorse

The existing narrow gauge track between Carcross (MP 67) and Utah Yard (MP 106) would be converted during the spring and summer of Year-Two.

Carcross can be established as a temporary terminal in the spring of Year-Two lasting only until the railroad is entirely converted to standard gauge from Carcross to Utah Yard. New freight revenue in the form of bulk materials, construction machinery and other freight, in car load lots, can be delivered over the new standard gauge line from Skagway to Carcross. This temporary measure would only last until Labor Day of Year-Two, when the entire railroad would offer full service between Skagway and Utah yard.

All new track material necessary for the conversion of this track section can be brought on standard gauge cars by barge from the supplier to eliminate unnecessary double handling of materials. From these cars, crews can place the material in the track using modern standard gauge production track machinery. The laying of new rail will occur simultaneously with new tie insertions at the rate of about three miles per week. This segment of the White Pass conversion of narrow to standard gauge will require intense management planning and organization. It will provide the most striking metamorphosis

of the railroad from that of an abandoned, overgrown section of 20-year-old narrow gauge track to that of a standard gauge line capable of handling 100-ton cars at 40 MPH.

First, a crew working forward (north) and without relying on equipment support and materials coming from behind will begin at Carcross and work north toward Utah yard widening gauge. Their methods will be the same as described earlier. This crew will leave behind a standard gauge railroad temporarily spiked down on the existing, narrow gauge ties[7]. This crew will depend upon narrow gauge track cars and support from the Klondike Highway to ensure their continuous, northward progress so as not to impede the advancement of the standard gauge crew (Crew Two) working from behind.

Crew two will be moving north behind crew one laying new 115# rail and inserting new ties. Crew two will use work trains loaded with new ties, new rails, tie plates, etc. to carefully inch along the old narrow gauge track dumping first ties and then new rails onto the track shoulder. This work would take place at night. The new ties, new rail, tie plates, spikes, bolts, anchors and angle bars would arrive in Carcross on the same railcars they left on from the lumber mills and steel mills having come over the new barge ramp in Skagway. The cars would be shoved out of Carcross using a light standard gauge locomotive. The stage areas would move north from Carcross to other work sites spaced about every 10 miles. Sidings already exist at Lorne, Mile 79, and at Cowley, Mile 95. A new siding would be constructed at Robinson, Mile 89.

[7] There is just enough length to narrow gauge ties to allow the standard gauge rails to be spiked down. There may be sections where new gauge ties (spaced every fifth tie) would be required if existing sections are too decayed. This situation is adequate for a short period of time to allow the passage of slow moving work trains delivering standard gauge ties and rails.

Each day a specialized rail relay crew would first lay in the new 78-foot lengths of 115# rail, spiking only enough to hold gauge and support maintenance of way machines. Then, following right behind, a fully equipped tie insertion crew would insert all the new ties, place all the tie plates, anchors and finish all the spiking to complete the track. Both crews would work in daylight and advance at the rate of about three miles per week. Both crews would have supplies, materials and equipment support coming from behind them over the new standard gauge railroad. Once the new track is built, the speed over this portion of the railroad would easily be 40 MPH.

An ancillary work train, hauling ballast or pit run gravel, would support a track surfacing crew following the advancing standard gauge conversion crews.

The entire program to convert the track between Carcross and Utah Yard would be finished by Labor Day.

Once the track was converted all the way into Utah yard, the rail relay crew would move back to MP 57 to relay the old 72 lb/yd rail with 100 lb/yd rail salvaged from between MP 94 and MP 104. This work would be completed before the winter's freeze of Year Two.

For the first time in White Pass's history this rail relay crew will work under standard gauge traffic as the new White Pass enters its first winter in its new year-round operation

as a full service freight and passenger railroad once again taking its place as the "Gateway to the Yukon".

5.0 COST ANALYSIS

Table 2 provides a cost assessment for each phase of construction. Resource costs are based upon generally accepted, average unit prices. The marine facility cost is based upon projects of similar scope and size. Bridge upgrade cost is based upon railroad maintenance and construction data. Man-hours are expected progression rates based on proven construction techniques and processes.

Table 2

COST ASSESSMENT

PHASE : Description		Item	cost	quantity	total	Phase sub-total
Phase 1	**Rail/Barge Facility**	Facility Construction			1,000,000.00	1,000,000.00
Phase 2	**Bridge Upgrading**	8 Person crew working 12 hours per day, 5 days per week for four months	60 $/Man-hr	8000 Man-hrs	480,000.00	
		Bridge Materials			500,000.00	
		Reconstruction of Bridges 15A, 18A, 67A			1,100,000.00	2,080,000.00
Phase 3	**Stabilization of track from Carcross to Whitehorse**	One, dedicated work train with supporting heavy equipment			500,000.00	500,000.00
Phase 4	**Track Conversion Carcross to Bennett**	30 Person Crew; Gauging CCX - BNT; Working 10 hr days five days per week	60 $ /Man-hr	21000 Man-hrs	1,260,000.00	1,260,000.00
Phase 5	**Track Conversion Bennett to Skagway**	30 Person Crew; Gauging BNT - SGY; Working 12 hr days six days per week	60 $/Man-hr	22000 Man-hrs	1,320,000.00	
		8 Person Crew; SGY Yard Prep; working 8 hr days five days per week	60 $/Man-hr	5000 Man-hrs	300,000.00	1,620,000.00
Phase 6	**Equipment Conversion**	Material Cost	18 000 $/Car	60 Cars	1,080,000.00	
		Facilities Cost (fuel, electricity)	32 000 $/Mo	6 Mo	192,000.00	
		Labor; 10-person crew, all winter	60 $/Man-Hr	9600 Man-hrs	576,000.00	1,848,000.00

Phase 7	**Track Conversion Carcross to Whitehorse**	Ties; 3000 ties per mile for 40 miles	30 $/tie	120000 ties	3,600,000.00	
		Track hardware; rail, spikes, plates, bolts, joints for 40 miles	300 000 $/mi	40 miles	12,000,000.00	
		30 person crew	60 $/Man-Hr	45000 Man-hrs	2,700,000.00	
						18,300,000.00

TOTAL PROJECT COST	**$26,608,000**

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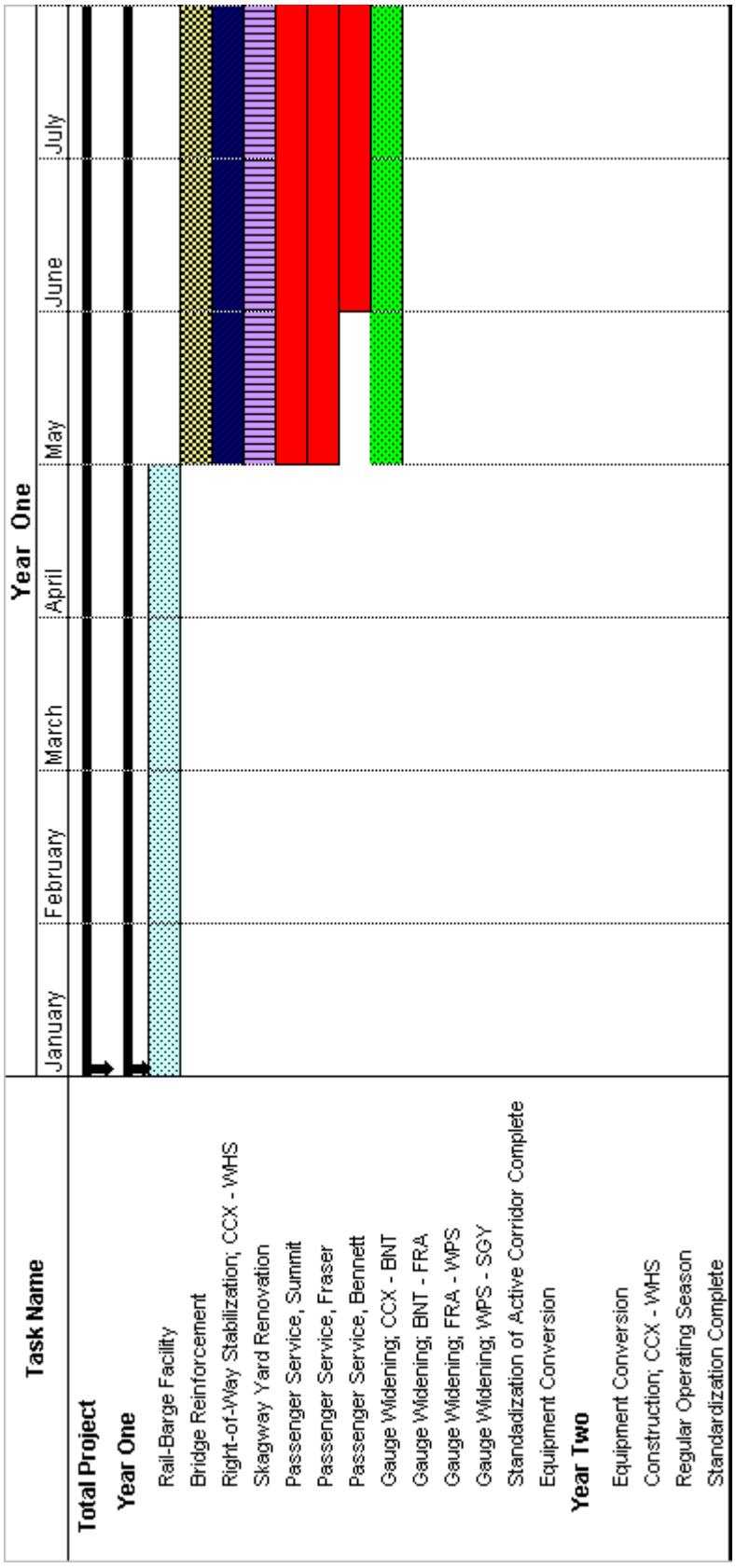
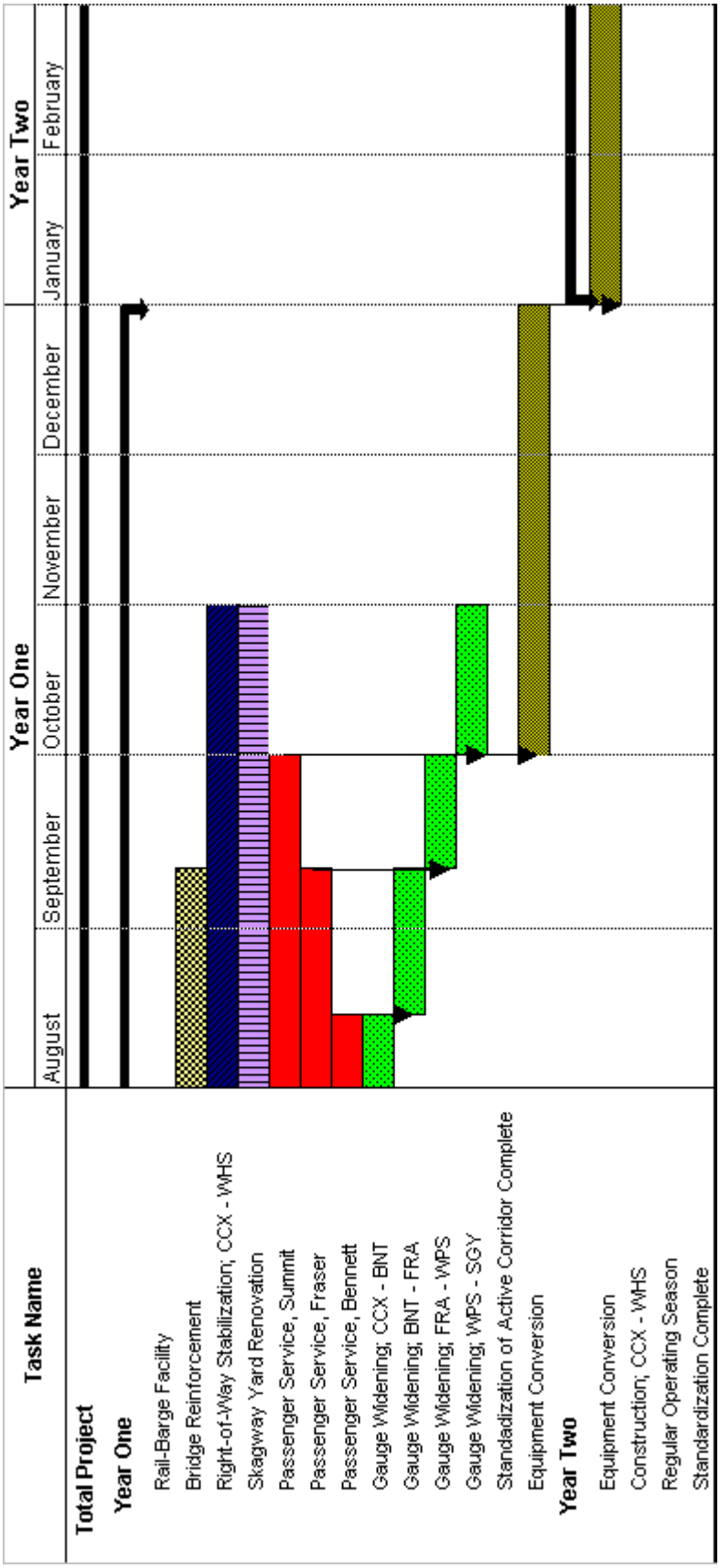
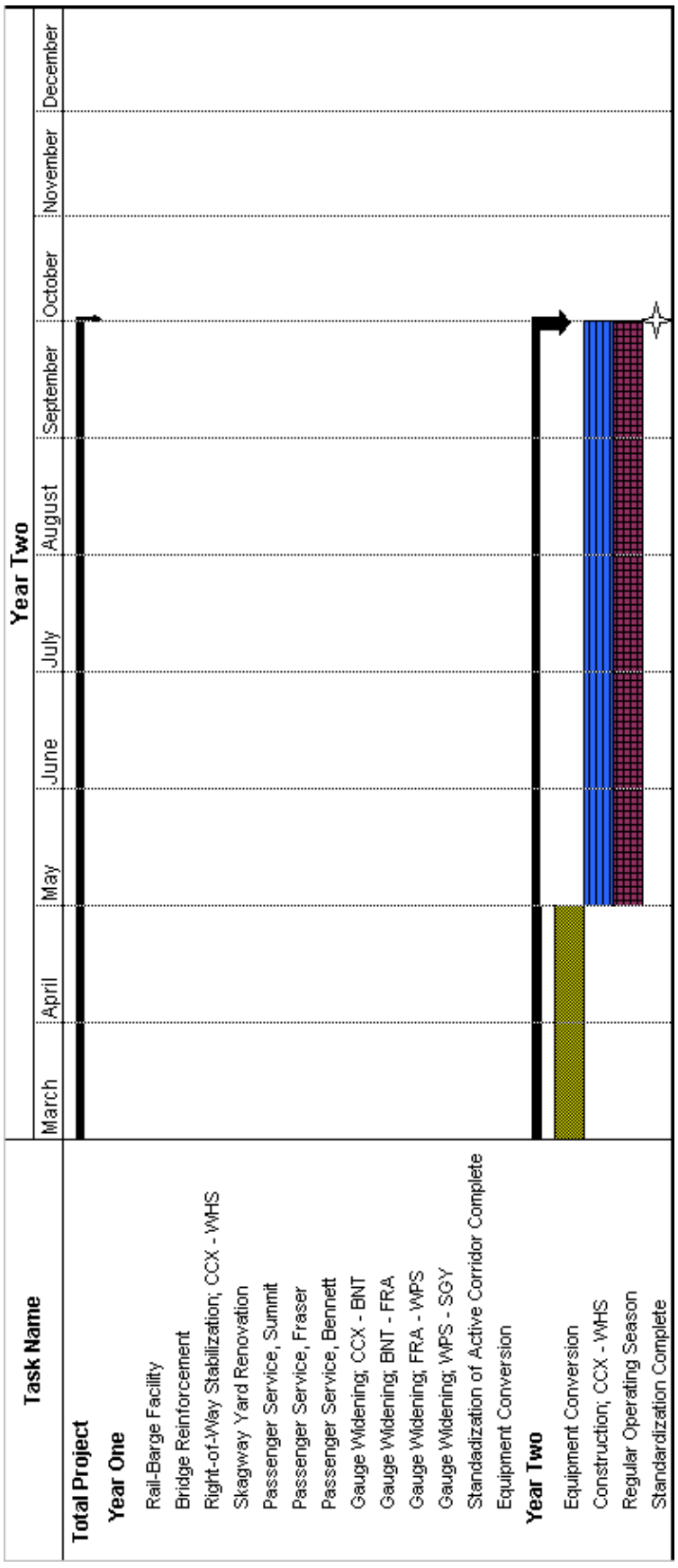
7.0 APPENDIX

Appendix A

Construction Timeline


Task Name
Year One
January
February
March
April
May
June
July
Total Project
Year One
Rail-Barge Facility
Bridge Reinforcement
Right-of-Way Stabilization; CCX - WHS
Skagway Yard Renovation
Passenger Service, Summit
Passenger Service, Fraser
Passenger Service, Bennett
Gauge Widening; CCX - BNT
Gauge Widening; BNT - FRA
Gauge Widening; FRA - WPS
Gauge Widening; WPS - SGY
Standadization of Active Corridor Complete
Equipment Conversion
Year Two
Equipment Conversion
Construction; CCX - WHS
Regular Operating Season
Standardization Complete


Task Name
Year One
August
September
October
November
December
Year Two
January
February
Total Project
Year One
Rail-Barge Facility
Bridge Reinforcement
Right-of-Way Stabilization; CCX - WHS
Skagway Yard Renovation
Passenger Service, Summit
Passenger Service, Fraser
Passenger Service, Bennett
Gauge Widening; CCX - BNT
Gauge Widening; BNT - FRA
Gauge Widening; FRA - WPS
Gauge Widening; WPS - SGY
Standadization of Active Corridor Complete
Equipment Conversion
Year Two
Equipment Conversion
Construction; CCX - WHS
Regular Operating Season
Standardization Complete


Task Name
Year Two
March
April
May
June
July
August
September
October
November
December
Total Project
Year One
Rail-Barge Facility
Bridge Reinforcement
Right-of-Way Stabilization; CCX - WHS
Skagway Yard Renovation
Passenger Service, Summit
Passenger Service, Fraser
Passenger Service, Bennett
Gauge Widening; CCX - BNT
Gauge Widening; BNT - FRA
Gauge Widening; FRA - WPS
Gauge Widening; WPS - SGY
Standadization of Active Corridor Complete
Equipment Conversion
Year Two
Equipment Conversion
Construction; CCX - WHS
Regular Operating Season
Standardization Complete

Appendix B

Construction Progression Through Corridor

Schematic outlining the active corridor and construction progression along the the railroad mainline.