Benefit-Cost Analysis
Technical Documentation

Transfer Span & Berthing Facility Replacement

Alaska Railroad Corporation

Whittier Terminal Master Plan

Whittier, Alaska
August 29, 2025

Contents

List of Tables

List of Figures

Executive Summary

Located in a fjord at the head of the Passage Canal in Prince William Sound, the Port of Whittier is a key connection point for freight transported to and from Alaska and is accessible and ice free year-round. Moreover, it is the only port in Alaska that has rail barge operations, which process railcars transported by barge. As such, it is Alaska Railroad Corporation's (ARRC's) point of connection to the rail systems of the contiguous United States and a key route for transporting containerized, bulk, and breakbulk commodities in and out of Alaska.

Due to the age and condition of the infrastructure required to maintain the rail barge operations at the Port of Whittier, there is an increasing probability that Whittier will lose the ability to accommodate rail barges as the infrastructure approaches the end of its useful life. The loss of this capacity at Whittier Terminal would result in operational and supply chain disruptions for freight movements between the contiguous United States and Alaska. Given the lack of rail barge services at alternate Alaskan ports and the infrastructure capacity required to accommodate certain commodities, the only alternative freight transportation mode is to truck many of the commodities currently barged from the contiguous United States. For instance, the Port of Alaska in Anchorage is a major alternative Alaskan port that could accommodate select commodities. However, it lacks the necessary available capacity to receive and store the majority of the potentially impacted bulk liquids, which are currently transported through the Whittier Terminal in railcars. As such, if the Port were to lose its rail barge services, the majority of the bulk liquids would have no alternatives to transportation other than via truck.

The Transfer Span & Berthing Facility Replacement Project (Project) was identified as a priority project to ensure reliable ongoing rail barge service at the Port of Whittier, avoiding the scenario in which supply chains are impacted due to a loss of service. The Project will replace the existing transfer span and reconstruct the berthing facility for barges transporting railcars and containers to the Port.

A Benefit-Cost Analysis (BCA) for the Project was conducted in conformance with federal guidance regarding evaluation methods and monetization values recommended by the U.S. Department of Transportation (U.S. DOT) in its May 2025 *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*.

Table ES - 1 summarizes the changes expected from the Project (and the associated benefits).

Table ES - 1: Summary of Infrastructure Improvements and Associated Benefits, 2023 Dollars

Current Status (Base Case) & Problems to be Addressed	Changes to Baseline (Alternative Case)	Type of Impact	Economic Benefit	Impacted Population	Summary of Results (Discounted Value)
The No-Build scenario is defined as the case in which the project does not proceed. As such, Whittier Terminal's rail barge infrastructure continues to deteriorate, leading to a loss of freight rail and barge service through the Port of Whittier. If Whittier Terminal loses the ability to accommodate rail barge service, volumes could be diverted to alternative ports, by barge or freight ship, or be transported from the contiguous United States via the Alaska-Canadian (ALCAN) Highway. Such diversions are expected to translate into an increased likelihood of transportation-related accidents, as well as an increase in emissions, pavement damage, and freight transportation costs.	The Build scenario is defined as the case in which the project proceeds as planned. In the Build scenario, the reconstruction of the rail barge facility mitigates the risk of lost service, allowing for bulk/interchange railcars and container volumes to continue to be barged from Seattle to Whittier before continuing by rail to Anchorage or Fairbanks. In this scenario, the additional barge and truck miles required to transport goods are not incurred, reducing safety costs, emissions, operating costs, and pavement damage. These benefits are partially offset by the emissions and potential accidents incurred by the additional rail trip between Whittier and Anchorage. The ongoing maintenance expenses required to sustain operations on the deteriorated wharf transfer span and berthing facility are also reduced relative to the No-Build scenario due to the reconstruction of the transfer span and berthing facility.	Reduced accidents due to avoided diversions to truck	Avoided Transportation Safety Costs	Shippers and road users	**$158.5 M**
		Reduced operating costs due to avoided diversions to other modes	Avoided Freight Transportation Costs	Shippers	**$242.0 M**
		Reduced emissions due to the avoided diversions to truck	Reduced Emissions	Local residents, environment	**$84.9 M**
		Reduced pavement damage due to avoided truck trips	Avoided Pavement Damage	Asset owners	**$21.2 M**
		Reduced O&M due to replacement of deteriorated assets	O&M Cost Savings	Asset owners	**N/A**
		Importing non-containerized goods and rolling stock	Connection to North American Rail Network	Local residents, shippers	**N/A**
		Improved reliability due to replacement of deteriorated assets	Service Reliability	Local residents, shippers	**N/A**
		Reduced operating costs due to year-round cargo service and continued rail connection	Supply Chain Efficiency	Local residents, shippers	**N/A**
		Reduced safety hazards due to avoided barge maintenance and safety improvements	Improved Worksite Safety	Workers, asset owners	**N/A**

The period of analysis used in the estimation of benefits and costs is 24 years including 20 years of benefits, with the Project expected to be completed by 2028 and benefits starting to accrue in 2029. The project cost is estimated at $30.3 million, in 2023 dollars. The capital expenditure for the Project by component are presented in **Table ES - 2**, while the total monetized benefits from the Project are presented in **Table ES - 3**.

Table ES - 2: Capital Expenditure by Component, 2023 Dollars

Component	Cost	Share of Costs
Replace Existing Transfer Span In-Place	**$15.6 M**	**51.6%**
Demolish Existing Span and Substructure	$1.0 M	3.2%
Barge Transfer Span	$8.2 M	27.1%
Transfer Span Approach	$0.3 M	1.0%
Electrical and Mechanical	$0.5 M	1.6%
Track Tie In	$0.1 M	0.3%
Temporary Structures	$1.0 M	3.2%
Engineering and Design	$0.6 M	1.8%
Construction Management	$0.8 M	2.6%
Contingency	$3.3 M	11.0%
Reconstruct Barge Berthing Facilities	**$14.6 M**	**48.4%**
Barge Sloughing Dolphin	$0.3 M	1.0%
Barge Berthing Dock	$8.8 M	29.2%
Barge Berthing Fenders	$0.9 M	2.9%
Engineering and Design	$0.5 M	1.7%
Construction Management	$0.7 M	2.3%
Contingency	$3.0 M	9.9%
Grand Total	**$30.3 M**	

Table ES - 3: Summary of Benefits, 2023 Dollars

Benefit	Undiscounted	Discounted
Avoided Transportation Safety Costs	$450.3 M	$158.5 M
Avoided Freight Transportation Costs	$687.7 M	$242.0 M
Reduced Emissions	$241.3 M	$84.9 M
Avoided Pavement Damage	$60.3 M	$21.2 M
Total	**$1,439.7 M**	**$506.7 M**

Based on the results of the BCA (**Table ES - 4**), the Project is expected to generate $506.7 million in discounted benefits, while costing $22.5 million (discounted) based on a 7.0 percent real discount rate for all impacts. This translates to a net present value (NPV) of $484.2 million and a benefit-cost ratio (BCR) of 22.6. The strong positive results reflect the importance of the rail barge services and limited freight transportation options for select commodities destined for Alaska. Additional detailed breakdowns of the analysis, including the various assumptions and methodologies, are presented in the remainder of this document.

Table ES - 4: Overall Results of the Benefit-Cost Analysis, 2023 Dollars

Key Financial Metrics	Undiscounted	Discounted
Total Benefits	$1,439.7 M	$506.7 M
Total Costs	$30.3 M	$22.5 M
Net Present Value (NPV)	$1,409.4 M	$484.2 M
Benefit-Cost Ratio (BCR)	47.6	22.6
Internal Rate of Return (IRR)	86.5%	

In addition to the monetized benefits summarized in **Table ES - 3**, the Project would also generate additional benefits that are difficult to quantify. A brief description of these benefits is provided below.

Connection to North American Rail Network

The Whittier Terminal's rail barge services are unique and the only rail barge operation in Alaska, making it a vital component of Alaska's transportation network. The service is critical for the rail connection from Alaska to the greater North American Rail Network and is a key mode for bringing non-containerized goods to Alaska. Without the rail connection between the Whittier Terminal and the greater North American Rail Network, transportation of non-containerized freight would be substantially less efficient and more costly due to the limited capabilities and infrastructure at alternative Alaskan ports. For instance, the Port of Alaska in Anchorage lacks the necessary capacity to receive and store the majority of the potentially impacted liquid bulk commodities. Additionally, ARRC also leverages the Whittier Terminal's rail barge operation and its connection to the North American Rail Network to receive new rolling stock, critical to both their freight and passenger rail operations in Alaska. Without the connection to the North American Rail Network, ARRC would have to seek alternative transportation methods that are more costly and less efficient.

Service Reliability

The transfer span and barge berthing facility at the Port of Whitter are necessary to support continued railcar barge operations, including transferring railcars and containers between the barge and the Alaskan rail network. Replacing this infrastructure ensures the long-term reliability of the service, avoiding disruptions, including impacts from infrastructure maintenance.

Supply Chain Efficiency

The continued operation of the Whittier rail barge will support competition in Alaska's freight transportation by maintaining an alternative cost-effective freight transportation option to trucking from the contiguous United States and avoiding additional handling costs for transporting bulk freight. Additionally, the lower relative operating cost of transporting goods via rail barge operations provides a cost-effective shipping option for shippers in Alaska.

Improved Workplace Safety

The improved infrastructure will reduce safety risks for workers, vessels, and cargo handling operations as the reconstruction of the barge berth and transfer span will avoid repair and maintenance operations that can increase hazards faced at Whittier Terminal. Furthermore, the improved infrastructure will offer greater resiliency to tsunami and earthquake risks and avoid unintended environmental impacts (i.e., spills or failures due to deteriorated infrastructure). Reconstruction of the transfer span and berthing facility will eliminate the possibility of a structural failure of the infrastructure and the associated loss of cargo and risks to worker safety.

Reduced Operations and Maintenance Expenses

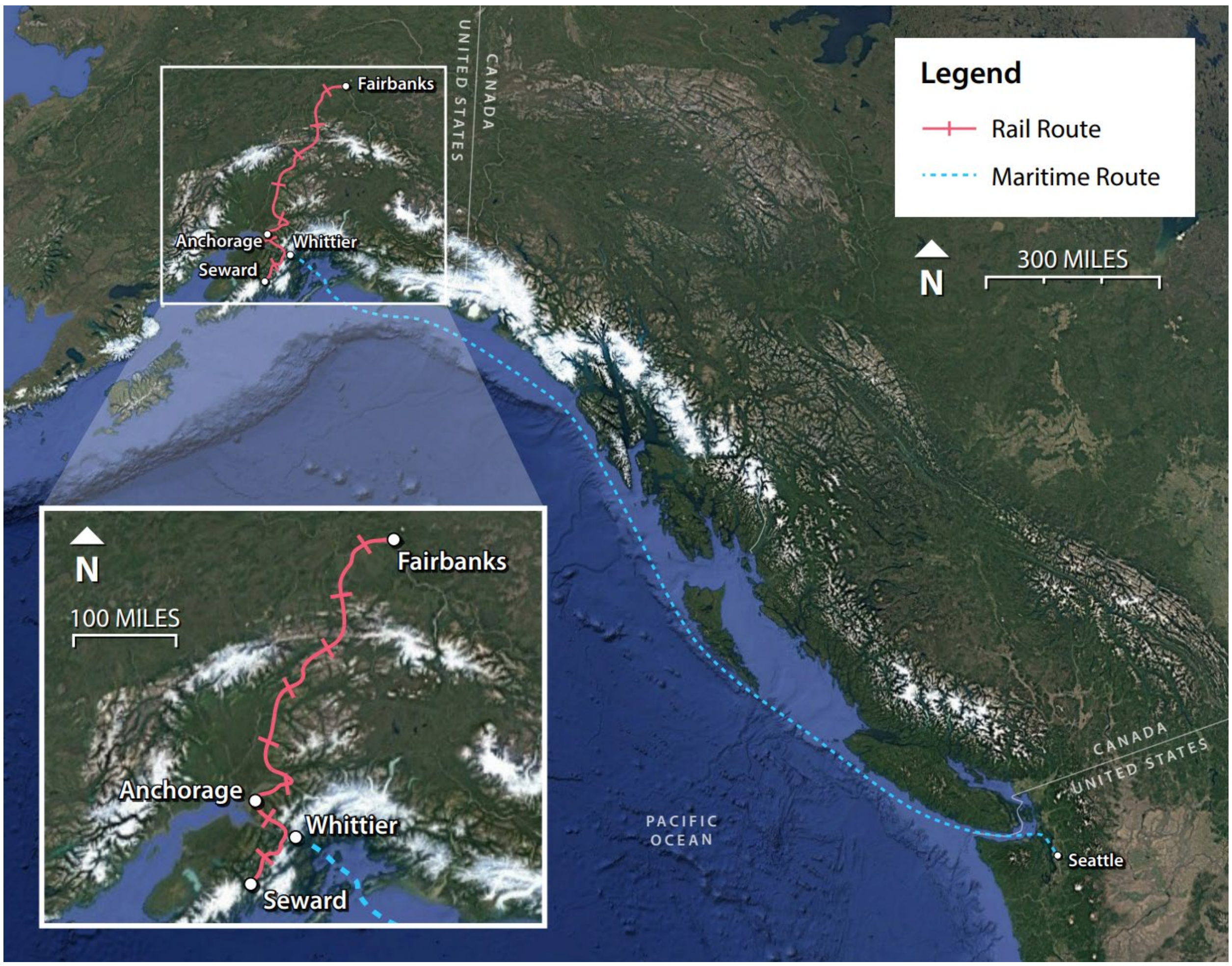
The existing deteriorated structures at Whittier Terminal require significant maintenance to remain operational. The Project will reduce O&M expenditures at Whittier Terminal by reducing the necessary maintenance compared to existing assets. However, to present a BCA based on the improved transportation safety and economic efficiencies associated with the avoided modal diversions that would result from the Project, the reduction in O&M expenses were not quantified in the analysis.

1 Introduction

Located in a fjord at the head of the Passage Canal in Prince William Sound, the Port of Whittier is a key connection point for freight transported to and from Alaska and is accessible year-round. Moreover, it is the only port in Alaska that has rail barge operations, which process railcars transported by barge. It is Alaska Railroad Corporation's (ARRC's) point of connection to the rail systems of the contiguous United States and a key route for transporting containerized, bulk, and breakbulk commodities in and out of Alaska.

A visual depiction of the diversion assumptions considered in the No-Build scenario is presented in **Figure 1**, with the maritime portion of the trip highlighted in blue, and the rail connections to destinations in Alaska presented in red.

Figure 1: Maritime and Rail Routes



Due to the age and condition of the infrastructure required to maintain the rail barge operations at the Port of Whittier, there is an increasing probability that Whittier will lose the ability to accommodate rail barges as the infrastructure approaches the end of its useful life. The loss of this capacity at Whittier Terminal would result in operational and supply chain disruptions for freight movements between the contiguous United States and Alaska. Given the lack of rail barge services at alternate ports, as well as the lack of capacity required to containerize or process all of the potentially impacted liquid bulk volumes, most of the bulk cargo would be diverted to trucks in the event of a loss of capacity to accommodate rail barges at Whittier Terminal. Diversions to alternate ports would occur for containerized goods, bulk cargo such as equipment, and bulk goods that can be containerized for transport.

The Transfer Span & Berthing Facility Reconstruction Project (Project) was identified as a priority project to ensure reliable ongoing rail barge service at the Port of Whittier, avoiding the scenario in which supply chains are impacted due to a loss of service The Project will replace the existing transfer span and reconstruct the berthing facility for barges transporting railcars and containers to the Port. The remainder of the document provides detailed technical information on the economic analyses conducted for the Project and is structured as follows:

- **Section 2, Methodological Framework**: Introduces the conceptual framework used in the Benefit-Cost Analysis (BCA).
- **Section 3, Overview**: Provides a description of the existing conditions and proposed alternatives, summary of cost estimates, and a description of the types of impacts the Project is expected to generate.
- **Section 4, General Assumptions**: Discusses the general assumption used in the estimation of the Project's costs and benefits.
- **Section 5, Demand Projections**: Provides estimates of freight volumes and demand related measures.
- **Section 6, Methodologies, Data, and Assumptions:** Details the specific data elements and assumptions used to address the goals of the Project.
- **Section 7, Summary of Findings and Benefit-Cost Outcomes:** Presents estimates of the net present value (NPV) its benefit-cost ratio (BCR), and other evaluation metrics.
- **Section 8, Benefit-Cost Analysis Sensitivity**: Summarizes the outcome of the sensitivity analysis that evaluates the difference assumptions made in the analysis, and the impact that the variability of those assumptions may have on the overall results.

2 Methodological Framework

The BCA conducted for this Project includes monetized benefits and costs measured using U.S. Department of Transportation (U.S. DOT) guidance, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, as well as the quantitative and qualitative merits of the Project.[1] A BCA provides estimates of the benefits that are expected to accrue over a specified period and compares them to the anticipated costs. Costs include both the resources required to develop the infrastructure and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected impacts of the Project valued in monetary terms.

While a BCA is just one of many tools that can be used in making decisions about infrastructure investments, U.S. DOT believes that it provides a useful benchmark from which to evaluate and compare potential transportation investments.

The specific methodology employed for this application was developed using the BCA guidance developed by U.S. DOT. In particular, the methodology involves:

- Establishing existing and future conditions under the Base Case (No-Build) and Alternative Case (Build) scenarios;
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using U.S. DOT guidance for the valuation of safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the U.S. DOT (7.0 percent); and
- Conducting a sensitivity analysis to assess the impacts of changes in key assumptions.

[1] *U.S. DOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, May 2025*

3 Overview

3.1 No-Build Scenario

The No-Build scenario is defined as the case in which the project does not proceed. As such, Whittier Terminal's rail barge infrastructure continues to deteriorate, leading to a loss of freight rail and barge service through the Port of Whittier.[2]

If Whittier Terminal loses the ability to accommodate rail barge service, volumes could be diverted to alternative ports, by barge or freight ship, or be transported from the contiguous United States via the Alaska-Canadian (ALCAN) Highway. Such diversions are expected to translate into an increased likelihood of transportation-related accidents, as well as an increase in emissions, pavement damage, and freight transportation costs.

For containerized volumes, it is assumed that if Whittier Terminal cannot accommodate rail barge operations, containers would be diverted to the Port of Alaska, in Anchorage, by either barge or freight ship. Volumes are generally destined for either Anchorage or Fairbanks, hence analysis leverages Anchorage as the common end point in Alaska for containerized goods. This was assumed as volumes destined for Fairbanks currently pass through Anchorage to reach their destination and are assumed to follow the same path from Anchorage to Fairbanks if container volumes are diverted from the Whittier Terminal to Port of Alaska. Therefore, the Anchorage-Fairbanks leg of the trip for containerized goods would not be impacted by the Project.

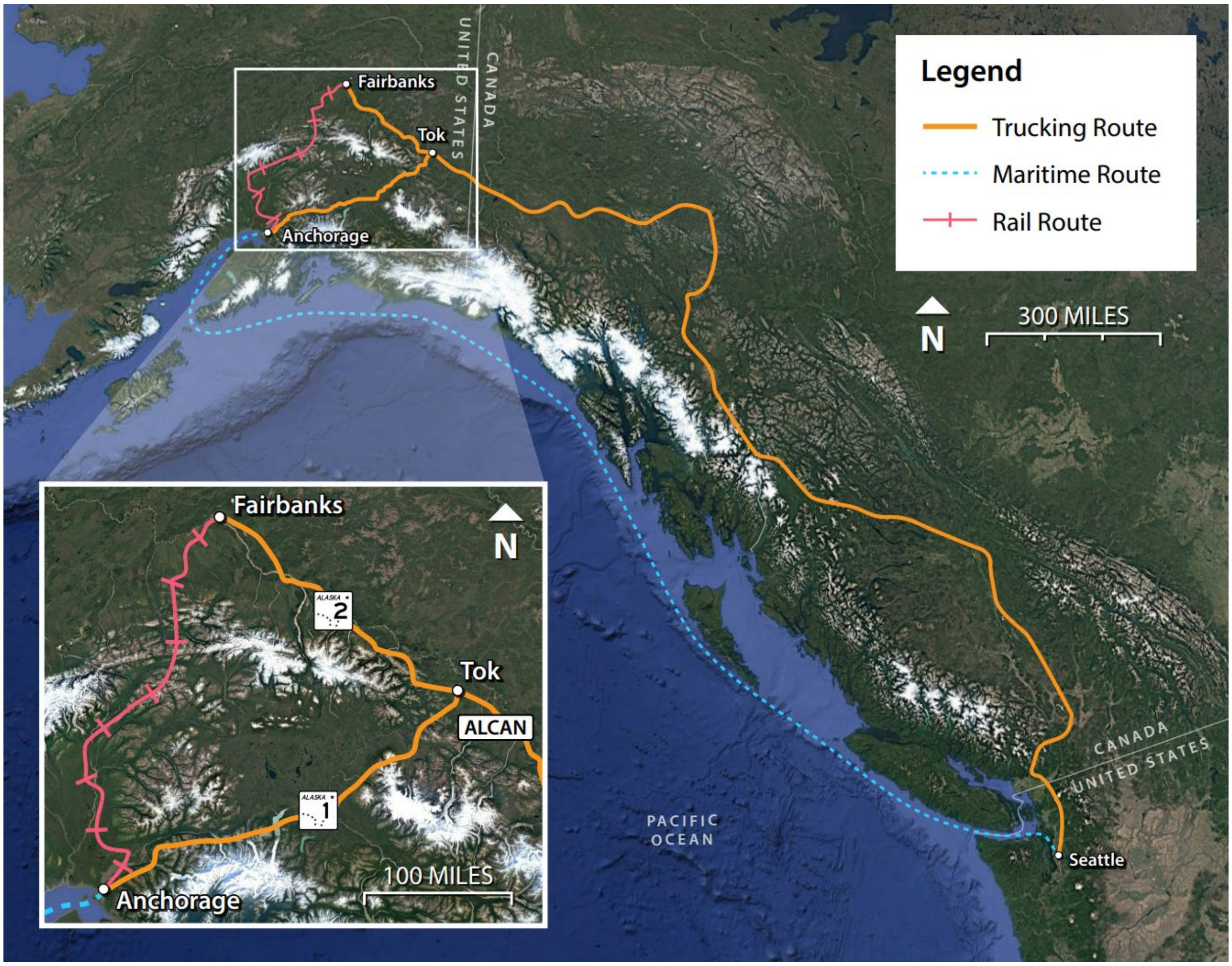
For bulk and breakbulk volumes, the analysis assumes that if Whittier Terminal is unable to accommodate rail barge operations, volumes would be either diverted to the Port of Alaska or trucked from the contiguous United States. While trucking from the contiguous United States to Alaska is notably far, this is considered due to infrastructure limitations at alternative Alaskan ports and the lack of direct rail connection from the contiguous United States to Alaska. In particular, bulk liquids encompass a large portion of the bulk and breakbulk volumes transported to Alaska from the contiguous United States, and key alternative Alaskan ports, such as the Port of Alaska in Anchorage, do not have the necessary capacity to receive and store the majority of the impacted bulk liquids. Moreover, as there is limited ability to source and obtain the ISO containers to transport bulk liquids to Alaska via containers, the only alternative is to truck the goods from the contiguous United States via the ALCAN Highway to Tok before reaching their destination of either Anchorage or Fairbanks. Meanwhile, other bulk / breakbulk commodities, such as equipment and containerized bulk liquids, could be received at the Port of Alaska in Anchorage via barge or ship. It is assumed that some of these volumes will be railed to Fairbanks while the remainder are destined for Anchorage.

A visual depiction of the diversion assumptions considered in the No-Build scenario is presented in **Figure 2**, with the trucking path highlighted in orange, while the maritime route diverted to the Port of Alaska is presented in blue.

---

[2] It should be noted that if the infrastructure for rail operations were to fail, an expedited reconstruction or replacement may occur. However, the analysis considers modal diversion and associated impacts to remain consistent with U.S. DOT guidance which states that "baselines should not assume that the same (or similar) proposed improvement would be implemented later."

Figure 2: Diversions in No-Build Scenario



3.2 Build Scenario

The Build scenario is defined as the case in which the project proceeds as planned. In the Build scenario, the reconstruction of the rail barge facility mitigates the risk of lost service, allowing for bulk/interchange railcars and container volumes to continue to be barged from Seattle to Whittier before continuing by rail to Anchorage or Fairbanks.

In this scenario, the additional barge and truck miles required to transport goods are not incurred, reducing safety costs, emissions, operating costs, and pavement damage. These benefits are partially offset by the emissions and potential accidents incurred by the additional rail trip between Whittier and Anchorage. The ongoing maintenance expenses required to sustain operations on the deteriorated transfer span and berthing facility are also reduced relative to the No-Build scenario due to the reconstruction of the transfer span and berthing facility.

3.3 Project Cost and Schedule

The capital costs are expected to begin in 2025 and will continue through completion in 2028, with pre-construction activities occurring from 2025 through 2027 and construction occurring from 2027 through 2028. The annual expenditures are summarized in **Table 1**, while capital costs are broken down by component in **Table 2**. Overall, the Project is expected to cost $30.3 million in 2023 dollars across four years of design and construction.

Table 1: Expenditure Profile, 2023 Dollars

Project Cost	2025	2026	2027	2028	Total
Planning & Engineering	$0.5 M	$0.5 M	$0.5 M	$0.0 M	$1.5 M
Construction	$0.0 M	$0.0 M	$14.4 M	$14.4 M	$28.8 M
Total Cost	**$0.5 M**	**$0.5 M**	**$14.9 M**	**$14.4 M**	**$30.3 M**

Table 2: Capital Cost by Component, 2023 Dollars

Component	Cost	Share of Costs
Replace Existing Transfer Span In-Place	**$15.6 M**	**51.6%**
Demolish Existing Span and Substructure	$1.0 M	3.2%
Barge Transfer Span	$8.2 M	27.1%
Transfer Span Approach	$0.3 M	1.0%
Electrical and Mechanical	$0.5 M	1.6%
Track Tie In	$0.1 M	0.3%
Temporary Structures	$1.0 M	3.2%
Engineering and Design	$0.6 M	1.8%
Construction Management	$0.8 M	2.6%
Contingency	$3.3 M	11.0%
Reconstruct Barge Berthing Facilities	**$14.6 M**	**48.4%**
Barge Sloughing Dolphin	$0.3 M	1.0%
Barge Berthing Dock	$8.8 M	29.2%
Barge Berthing Fenders	$0.9 M	2.9%
Engineering and Design	$0.5 M	1.7%
Construction Management	$0.7 M	2.3%
Contingency	$3.0 M	9.9%
Grand Total	**$30.3 M**	

4 General Assumptions

The BCA measures benefits against costs throughout a period of analysis, beginning at the start of construction and including 20 full years of operations.

The monetized benefits and costs are estimated in 2023 dollars, with future dollars discounted in compliance with U.S. DOT guidance.[3]

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2023 dollars;
- The period of analysis begins in 2025 and ends in 2048; it includes project development and construction years (2025–2028) and 20 full years of operations (2029–2048); and
- A constant 7.0 percent real discount rate all impacts is assumed throughout the period of analysis.

4.1 Useful Life of Existing Port Infrastructure

As the Port of Whittier's existing transfer span and berthing facility are near the end of their respective useful lives, there is limited ability to ensure the continued utility of the existing infrastructure. The analysis assumes the infrastructure currently has a 5.0 percent probability of failure, with service completely ending as the infrastructure approaches the end of its useful life in 2035. For years in between, the analysis assumes a linear increase in the probability of a permanent cessation of freight operations due to the age and condition of the infrastructure. The probabilities were incorporated within the BCA to adjust the potential impact of permanent supply chain disruptions described in the No-Build scenario.

The assumptions regarding the probability of the assets at Whittier Terminal deteriorating beyond the ability to accommodate rail barges are outlined in **Table 3**.

Table 3: Useful Life of Port Infrastructure Assumptions

Parameter	Unit	Value	Source
Last Year of Useful Life	year	2035	ARRC Estimate
Number of Useful Life Years Remaining	years	10	Calculated based on current year and the last year useful life.
Current Year (2025) Probability of Rail Barge Service Ending	%	5.0%	ARRC Estimate
Annual Incremental Increase in the Probability of Rail Barge Service Ending	%	9.5%	Calculated based on current probability and last year of useful life.

[3] *Ibid*.

5 Demand Projections

Accurate demand projections are important to ensure reasonable BCA output and results. The magnitudes of the long-term benefits accruing over the study period are a function of the freight volumes transported to the Port of Whittier via barge that would be impacted by a cessation of freight rail operations at Whittier due to the deterioration of the existing rail barge infrastructure.

5.1 Methodology

ARRC provided historical tonnage and railcar volumes for bulk and COFC cargo through the Whittier Terminal. Current volumes were forecasted to grow at the historic compound average growth rate of cargo volumes from 2004 to 2024. For ease of analysis, the final destinations considered in the demand projections were assumed to be Anchorage and Fairbanks. The ton-miles, vehicle-miles, and number of trips for each mode (rail, barge, truck) were calculated based on the assumptions regarding route characteristics and anticipated diversions under the Build and No-Build scenarios.

The BCA also considers capacity constraints of the Port of Whittier's rail barge operations based on existing infrastructure. This is determined based on the maximum number of barge trips the existing infrastructure could process per week and the maximum capacity for railcars and containers per barge. This provided an estimate of the maximum weekly volume of railcars and containers that could be processed at the Port of Whittier, which was then converted to a tonnage capacity based on the average tons per railcar and average tons per Twenty-Foot Equivalent Units (TEUs).

5.2 Assumptions

The assumptions used in the estimation of demand and the capacity of the Port are provided in **Table 4**.

Table 4: Assumptions Used in the Estimation of Demand and Port Capacity

Parameter	Unit	Value	Source
Northbound Bulk Railcar Volume (2024)	railcars/year	3,051	Data provided by ARRC
Northbound Bulk Railcar Tonnage (2024)	tons/year	252,121	
COFC Railcars (2023)	railcars/year	8,600	
COFC Tonnage (2023)	tons/year	315,094	
Freight Growth Rate	%	5.8%	CAGR based on inbound freight volumes at Whittier from 2004 - 2023.
Maximum Railcars per Barge	railcars/barge	42	Data provided by ARRC
Maximum TEUs per Barge	TEUs/barge	264	Data provided from AML
Maximum Barge Trips per Week	barges/week	2.5	Data provided by ARRC
Share of Interchange Volume Destined for Fairbanks	%	75.0%	

Due to the lack of infrastructure within Alaska, alternative ports, such as the Port of Alaska in Anchorage, do not have the necessary capacity to handle certain volumes. In particular, while the Port of Alaska does have the ability to receive and store bulk liquids, it is unlikely that they would have sufficient available capacity to accommodate the volume of impacted bulk liquid transported to the Port of Whittier, which reflects a large share of the commodities transported via the railcar barge service. Additionally, while the bulk liquids could be containerized in ISO containers and be processed at the Port of Alaska, it would be difficult to source the necessary ISO container volumes due to the sheer volume of bulk liquids impacted. As such, the only alternative is to truck the bulk liquids from the contiguous United States if the Port of Whittier's rail barge operations were to cease. Meanwhile, other bulk / breakbulk commodities, such as equipment or containerized bulk goods, could be diverted to the Port of Alaska. These infrastructure and supply chain constraints were considered when determining the diversion assumptions. The assumptions used regarding the diversion of bulk and containerized goods to alternate modes or routes to transport goods from Seattle to Anchorage in the absence of rail barge service at Whittier Terminal are outlined in **Table 5**.

Table 5: Diversion Assumptions

	Containerized	Bulk/Breakbulk
Diverted to Anchorage	100%	25%
Diverted to Truck (via ALCAN)	0%	75%

5.3 Demand Projections

The resulting projections for selected years are presented in **Table 6**.

Table 6: Demand Projections

Parameter	Unit	2025	2030	2035	2040	2045
Constrained Interchange Volumes	tons/year	266,744	353,609	374,781	374,781	374,781
Constrained COFC Volumes	tons/year	352,705	467,563	495,558	495,558	495,558
Total Constrained Volumes	tons/year	619,449	821,172	870,339	870,339	870,339

6 Methodologies, Data, and Assumptions

This section describes the measurement approach used for each benefit or impact category assessed in the BCA and provides an overview of the associated methodology, assumptions, and estimates.

6.1 Improved Safety

6.1.1 Methodology

The Project is expected to mitigate permanent supply chain disruptions which would result in volumes destined for Alaska via the Port of Whittier to seek an alternative Alaskan port facility or would be trucked from the contiguous United States via the ALCAN Highway (as an alternative port facility is unable to receive all the impacted volumes). A change in the supply chains is expected to have some level of impact on freight transportation safety.

The improved safety from avoiding supply chain disruptions was estimated based on the avoided fatalities and injuries between the No-Build and Build scenarios, monetized based on the factors from the U.S DOT BCA Guidance. For safety impacts related to barges and trucks, the analysis estimates the accidents by severity based on the ton-miles and the fatality and injury rates per billion ton-miles by mode in both the No-Build and Build scenarios. Meanwhile, for safety impacts related to rail, the analysis estimates the accidents by severity based on the train-miles and fatality and injury rates per million train-miles in both the No-Build and Build scenarios.

6.1.2 Assumptions

Table 7 presents the assumptions used in the estimation of transportation safety impacts.

Table 7: Assumptions used in the Estimation of Safety Impacts

Parameter	Unit	Value	Source
Fatalities - Freight Rail	fatalities/million train-miles	0.717	Based on the 10-year accident/incident overview data for Alaska Railroad (2015–2024). Data obtained from the FRA.
Injuries - Freight Rail	injuries/million train-miles	42.61	
Fatalities - Truck	fatalities/billion ton-mile	2.22	Texas A&M Transportation Institute. A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001–2019. January 2022.
Injuries - Truck	injuries/billion ton-mile	55.17	
Fatalities - Barge	fatalities/billion ton-mile	0.037	Based on total freight vessel fatalities and total ton-miles by water transportation, 2002–2022, as reported in Bureau of Transportation Statistics National Transportation Statistics.
Injuries - Barge	injuries/billion ton-mile	0.317	Based on total freight vessel injuries and total ton-miles by water transportation, 2002–2022, as reported in Bureau of Transportation Statistics National Transportation Statistics.
Cost of Injury (Unknown Severity)	2023$/injury	$229,800	U.S. Department of Transportation (U.S. DOT) , Benefit-Cost Analysis Guidance for Discretionary Grant Programs, November 2024.
Cost of Fatality	2023$/fatality	$13,200,000	

6.1.3 Benefit Estimates

Table 8 highlights the improved safety benefits. The estimated present value of the discounted benefits over the projected 20-year benefit period is $158.5 million.

Table 8: Estimates of the Safety Impacts

	Value Over Analysis Period	
	Undiscounted	Discounted
Avoided Transportation Safety Costs	**$450.3 M**	**$158.5 M**

6.2 Avoided Freight Transportation Costs

6.2.1 Methodology

A key consequence of the cessation of the Port of Whittier's rail barge service is that existing volumes, both railcars and containers, would be required to be diverted to an alternative port facility or be trucked from the contiguous United States via the ALCAN Highway. As such, it would be expected that, generally, the diversion would result in additional freight transportation costs that could otherwise be avoided. However, for containers, it is likely that diverting to an alternative port will likely be relatively competitive with the existing barge service. Thus, it is assumed that there would be negligible impacts on transportation costs for containerized cargo.

For bulk railcars, the analysis focuses on railcar volumes the addition cost to truck bulk goods via the ALCAN Highway relative to barging the commodities in railcars. The impacts of the modal diversions on freight transportation costs are included in the BCA as the loss of rail barge service constrains users to truck liquid bulk to Alaska from the contiguous United States. This was estimated based on the relative costs to transport goods by mode and the volumes diverted to trucks.

As the Port of Whittier has the only railcar barge operation in Alaska, freight volumes would require additional transload moves if they were diverted to an alternative port. However, these additional transload costs were excluded from the analysis to provide a conservative estimate of the freight transportation cost benefits.

6.2.2 Assumptions

Table 9 presents the assumptions used in the estimation of the avoided freight transportation costs.

Table 9: Assumptions used in the Estimation of Avoided Freight Transportation Costs

Parameter	Unit	Value	Source
Average Railcar Costs (Barge)	2023$/railcar	$13,181	Data provided by ARRC. Averages based on total cargo and average tariff rates. Does not include fuel cost surcharge. Values adjusted to 2023 dollars.
Average Railcar Costs (Rail) - Whittier to Anchorage	2023$/railcar	$1,465	
Average Equivalent Trucking Costs (Bulk)	2023$/truck	$7,421	Data provided by ARRC. Averages based on total cargo and average tariff rates. Does not include fuel cost surcharge. Value estimated based on an average of $7,400 dollars per truckload and approximately 4 trucks per railcar. Values adjusted to 2023 dollars.

6.2.3 Benefit Estimates

Table 10 highlights the avoided freight transportation costs. The estimated present value of the discounted benefits over the projected 20-year benefit period is $242.0 million.

Table 10: Estimates of the Avoided Freight Transportation Costs

	Value Over Analysis Period	
	Undiscounted	Discounted
Avoided Freight Transportation Costs	**$687.7 M**	**$242.0 M**

6.3 Avoided Emissions

6.3.1 Methodology

By mitigating against any permanent supply chain disruptions for volumes destined for Alaska via the Port of Whittier, the Project would also reduce emissions from transporting freight via truck. This benefit is estimated based on the change in emissions calculated based on the ton-miles transported by mode and the respective emission factors for select pollutants (i.e., NO_X and $PM_{2.5}$) under the No-Build and Build scenario. This is then monetized using the social costs by pollutant on a per metric-ton basis from as per U.S. DOT BCA Guidance.[4]

6.3.2 Assumptions

Table 11 summarizes the assumptions used in the estimation of avoided emissions.

Table 11: Assumptions used in the Estimation of Safety Impacts

a	Unit	Value	Source
Rail Emissions Factor			
NO_X	g/ton-mile	0.22	Texas A&M Transportation Institute. A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001–2019. January 2022.
$PM_{2.5}$	g/ton-mile	0.0049	
Barge Emissions Factor			
NO_X	g/ton-mile	0.15	Texas A&M Transportation Institute. A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001–2019. January 2022.
$PM_{2.5}$	g/ton-mile	0.0037	
Social Cost of Emissions			
NO_X Damage Cost	2023$/metric ton	$18,800 - $20,900	US Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, May 2025. Values increase over time. A table of annual values is available in the accompanying model and U.S. DOT guidance cited above.
$PM_{2.5}$ Damage Cost	2023$/metric ton	$912,200 - $1,004,100	

[4] CO_2 emissions were not monetized as there are not monetization factors within the latest U.S. DOT BCA Guidance.

6.3.3 Benefit Estimates

Table 12 highlights the monetized avoided emission benefits, while **Table 13** presents the metric tons of avoided emissions. The estimated present value of the discounted benefits over the projected 20-year benefit period is $84.9 million.

Table 12: Estimates of the Avoided Emissions Benefit

	Value Over Analysis Period	
	Undiscounted	**Discounted**
Reduced Emissions	**$241.3 M**	**$84.9 M**

Table 13: Estimates of the Avoided Emissions (Metric Tons)

	Total	Average Annual
Avoided NO_X Emissions	3,676	189
Avoided $PM_{2.5}$ Emissions	164	8.44

6.4 Avoided Pavement Damage

6.4.1 Methodology

Avoiding modal diversion to trucks that would result from the cessation of the rail barge operations at the Port of Whittier reduces the total pavement damage caused by trucks relative to the No-Build scenario. The cost of avoided pavement damage is based on the vehicle-miles traveled by trucks under the Build and No-Build scenarios and a per-mile pavement damage cost factor. The benefit of avoided pavement damage attributable to the Project is the incremental difference between pavement damage costs incurred under the Build and No-Build scenarios.

6.4.2 Assumptions

Table 14 presents the assumptions used in the estimation of the avoided pavement damage costs.

Table 14: Assumptions used in the Estimation of Avoided Pavement Damage Costs

Parameter	Unit	Value	Source
Pavement Damage Cost	2023$/vehicle-mile	$0.06	Assuming 60 kip 5-axle Comb/Rural Interstate. Data based on Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, May 2000. Inflated to 2023$

6.4.3 Benefit Estimates

Table 15 highlights the avoided pavement damage costs. The estimated present value of the discounted benefits over the projected 20-year benefit period is $21.2 million.

Table 15: Estimates of the Avoided Pavement Damage Costs

	Value Over Analysis Period	
	Undiscounted	**Discounted**
Avoided Pavement Damage	**$60.3 M**	**$21.2 M**

6.5 Non-Monetized Benefits

6.5.1 Connection to North American Rail Network

The Whittier Terminal's rail barge services are unique and the only rail barge operation in Alaska, making it a vital component of Alaska's transportation network. The service is critical for the rail connection from Alaska to the greater North American Rail Network and is a key mode for bringing non-containerized goods to Alaska. Without the rail connection between the Whittier Terminal and the greater North American Rail Network, transportation of non-containerized freight would be substantially less efficient and more costly due to the limited capabilities and infrastructure at alternative Alaskan ports. For instance, the Port of Alaska in Anchorage lacks the necessary capacity to receive and store the majority of the potentially impacted liquid bulk commodities. Additionally, ARRC also leverages the Whittier Terminal's rail barge operation and its connection to the North American Rail Network to receive new rolling stock, critical to both their freight and passenger rail operations in Alaska. Without the connection to the North American Rail Network, ARRC would have to seek alternative transportation methods that are more costly and less efficient.

6.5.2 Service Reliability

The transfer span and barge berthing facility at the Port of Whitter are necessary to support continued railcar barge operations, including transferring railcars and containers between the barge and the Alaskan rail network. Replacing this infrastructure ensures the long-term reliability of the service, avoiding disruptions, including impacts from infrastructure maintenance.

6.5.3 Supply Chain Efficiency

The continued operation of the Whittier rail barge will support competition in Alaska's freight transportation by maintaining an alternative cost-effective freight transportation option to trucking from the contiguous United States and avoiding additional handling costs for transporting bulk freight. Additionally, the lower relative operating cost of transporting goods via rail barge operations provides a cost-effective shipping option for shippers in Alaska.

6.5.4 Improved Workplace Safety

The improved infrastructure will reduce safety risks for workers, vessels, and cargo handling operations as the reconstruction of the barge berth and transfer span will avoid repair and maintenance operations that can increase hazards faced at Whittier Terminal. Furthermore, the improved infrastructure will offer greater resiliency to tsunami and earthquake risks and avoid unintended environmental impacts (i.e., spills or failures due to deteriorated infrastructure). Reconstruction of the transfer span and berthing facility will eliminate the possibility of a structural failure of the infrastructure and the associated loss of cargo and risks to worker safety.

6.5.5 Reduced Operations and Maintenance Expenses

The existing deteriorated structures at Whittier Terminal require significant maintenance to remain operational. The Project will reduce O&M expenditures at Whittier Terminal by reducing the necessary maintenance compared to existing assets. However, to present a BCA based on the improved transportation safety and economic efficiencies associated with the avoided modal diversions that would result from the Project, the reduction in O&M expenses were not quantified in the analysis.

7 Summary of Findings and Benefit-Cost Outcomes

Table 16 and **Table 17** summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the Project (24 years). As previously indicated, the Project is expected to be completed in 2028, and benefits accrue during the following completion of the Project, starting in 2029 and lasting through 2048.

Table 16: Summary of Benefits, 2023 Dollars

Benefit	Undiscounted	Discounted
Avoided Transportation Safety Costs	$450.3 M	$158.5 M
Avoided Freight Transportation Costs	$687.7 M	$242.0 M
Reduced Emissions	$241.3 M	$84.9 M
Avoided Pavement Damage	$60.3 M	$21.2 M
Total	**$1,439.7 M**	**$506.7 M**

Table 17: Overall Results of the Benefit-Cost Analysis, 2023 Dollars

Key Financial Metrics	Undiscounted	Discounted
Total Benefits	$1,439.7 M	$506.7 M
Total Costs	$30.3 M	$22.5 M
Net Present Value (NPV)	$1,409.4 M	$484.2 M
Benefit-Cost Ratio (BCR)	47.6	22.6
Internal Rate of Return (IRR)	86.5%	

Considering all monetized benefits and costs, the estimated internal rate of return of the Project is 86.5 percent. With a 7.0 percent real discount rate for all impacts, the $22.5 million investment would result in $506.7 million in total benefits, which translates to an NPV of $484.2 million and a BCR of approximately 22.6. The strong positive results reflect the importance of the rail barge services in bringing freight to Alaska. In particular, select commodities, such as bulk liquids, are primarily transported to Alaska through the rail barge services, with the only alternative option being trucking given the volume destined for Alaska and the lack of infrastructure at alternative Alaskan ports to receive bulk liquids.

8 Benefit-Cost Analysis Sensitivity

The BCA outcomes presented in the previous sections rely on many assumptions and long-term projections, all of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the “critical variables.”

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables—how much the results would vary with reasonable departures from the “preferred” or most likely value for the variable; and
- Assess the robustness of the BCA and evaluate whether the conclusions reached under the “preferred” set of input values are significantly altered by reasonable departures from those values.

The sensitivity analysis, presented in **Table 18**, considers a change in the capital costs, extending the useful life of existing infrastructure, as well as the exclusion of freight transportation cost savings.

Table 18: Sensitivity Analysis Results

Original NPV	Original BCR	Parameter	Change in Parameter	New NPV (Discounted)	Change in NPV	New BCR
$484.2 M	**22.6**	Capital Costs	50% Increase	$473.0 M	-2.3%	15.0
			50% Decrease	$495.4 M	2.3%	45.1
		Useful Life of Assets	Extend to 2045	$327.3 M	-32.4%	15.6
		Bulk / Breakbulk Diversion Assumptions	Assume 75% are diverted to Port of Alaska and 25% of impacted volumes are trucked from mainland U.S.	$210.5 M	-56.5%	10.4
		Freight Transportation Cost Savings	50% Reduction	$363.2 M	-25.0%	17.2
			Exclude Freight Transportation Costs	$242.2 M	-50.0%	11.8

Based on the results of the analysis, a 50 percent change in the capital cost results in a 2.3 percent change in the NPV, with a BCR ranging from 15.0 to 45.1.

One of the key assumptions and drivers of the results is the useful life of existing infrastructure assets. Assuming the asset could be used for an additional 10 years (extending the useful life to 2045) results in an NPV of $327.3 million, or a 32.4 percent decrease from the baseline results.

Another key assumption and driver of the results is the diversion assumptions related to the bulk / breakbulk commodities. In particular, the analysis assumes that due the insufficient capacity for bulk liquids at the Port of Alaska, a larger portion of the bulk / breakbulk goods would need to be trucked from the contiguous United States. One sensitivity scenario considered if diversion shares were inversed. That is, assuming a larger share is diverted to the Port of Alaska and a smaller share would need to be trucked from the contiguous United States. The results of that scenario indicates that inversing the diversion assumptions results in a 56.5 percent reduction in the NPV, but still translates to a strong outcome with an NPV of $210.5 million and a BCR of 10.4.

Finally, excluding the freight transportation cost benefits reduces the NPV by 50.0 percent, translating to a NPV of $242.2 million and a BCR of 11.8.

Overall, each of the scenarios considered in the sensitivity analysis results in a BCR well above 1.0 as the baseline benefits of the Project far exceed its capital costs.