Oregon International Port of Coos Bay

Proposed Section 204(f)/408
Channel Modification Project

Appendix C

Economics

May 2024

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1 Overview

The Oregon International Port of Coos Bay (OIPCB) proposes to build a fully intermodal (ship and rail) container terminal on OIPCB property along the federal channel at Coos Bay. Improvements to the federal channel would be required to allow the containership design vessel (1,201-foot length overall, 168-foot beam, and 45-foot operating draft) access to the proposed terminal. The OIPCB proposes a project to deepen and widen a portion of the existing Federal navigation project at the Port of Coos Bay, Oregon from the ocean to River Mile (RM) 8.2. This is a single-purpose project for deep draft navigation conducted by the Oregon International Port of Coos Bay under the authority granted by Section 204(f) of WRDA 1986 (as amended). This Economics Appendix to the Section 204(f)/408 Report presents the economic justification and supporting information for the proposed improvements to the federal navigation channel at Coos Bay in accordance with U. S. Army Corps of Engineers (USACE) guidance[1].

Project benefits are based on the Coos Bay rail intermodal container terminal increasing U. S. west coast (USWC) rail intermodal container handling capacity by two million twenty-foot equivalent units (TEUs). This substantial increase in USWC rail intermodal capacity will allow some projected container trade between land-locked inland states and Far East Asia to use Coos Bay as an alternative to sailing through the Panama Canal to U. S. east coast (USEC) ports and trucking containers between the USEC ports and inland state destinations. The cargo origins and destinations are unchanged by using the container terminal at Coos Bay, but transportation cost savings result from the reduction in ocean voyage costs and from the reduction in landside transportation costs due to the shift from truck to rail transport.

Figure 1 graphically depicts the generalized concept of project benefits. Under without-project conditions some cargo traded between Far East Asia (represented by Busan) and U. S. inland states uses the ports of Los Angeles and Long Beach and some cargo uses USEC ports represented by the Port of Savannah. Under with-project conditions some cargo uses Coos Bay as an alternative to the USEC and some cargo continues to use the ports of Los Angeles and Long Beach. For the cargo that would use Coos Bay as an alternative to the USEC, the ocean voyage is reduced by about 11 days and payment of Panama Canal fees are avoided.

[1] ER 1165-2-211 Operation and Maintenance of Improvements Carried Out by Non-Federal Interests to Authorized Harbor or Inland Harbor Projects, 04 February 2016

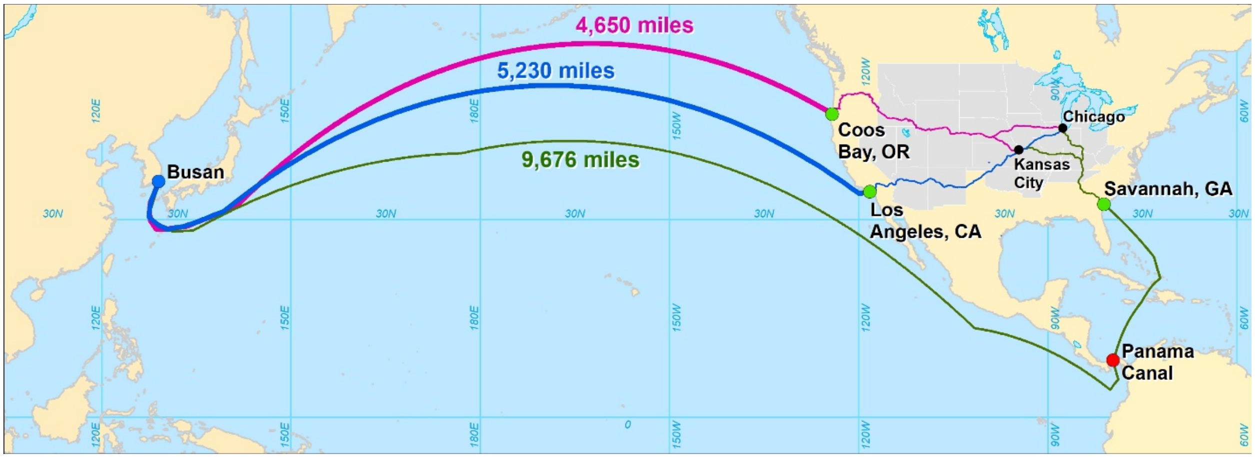

Figure 1
Alternative Routes

The USACE Planning Guidance Notebook (ER 1105-2-100) and the interim planning guidance ER 1105-2-103 confirm that the economic benefit of a navigation project is the reduction in the value of resources required to transport commodities. Both guidance documents identify categories of benefits that occur when the commodities have the same origin and destination under without and with-project conditions:

- More efficient use of existing vessels (reduced ocean voyage distance and reduced operating toll costs), and
- Shift in mode benefits (truck transport replaced by rail transport).

The benefits in both categories are calculated in a spreadsheet model. In both the without and with-project conditions, the same number of TEUs and the same vessel fleet are projected to transport cargo between the same origins and destinations (Far East Asia and U.S. inland states). The difference between the without and with-project conditions is the availability of Coos Bay as an alternative to USEC ports. The spreadsheet model calculates the hours of ocean transport to the USEC by vessel class under without-project conditions and the hours of ocean transport to Coos Bay under with-project conditions. These waterborne transportation cost savings are calculated as a component of project benefits.

In addition, passage through the Panama Canal is avoided for Far East Asia cargo that uses Coos Bay as an alternative to USEC ports. For this reason, transportation cost savings also includes the reduction in Panama Canal operating costs due to fewer vessels transiting the canal under with-project conditions.

The shift in mode benefits is based on the shift:

- from TEUs being transported by <u>truck</u> between USEC ports and U. S. inland states under without-project conditions, and
- to TEUs being transported by <u>rail</u> between Coos Bay and the U. S. inland states under with-project conditions.

Project benefit calculations rely heavily on information provided in USACE navigation channel improvement feasibility studies for harbors located along the USWC and USEC. USACE feasibility studies used in this analysis are:

- 2021 Port of Long Beach Feasibility Study (Los Angeles District, USACE)
- 2022 Tacoma Harbor Feasibility Study (Seattle District, USACE)
- 2018 Seattle Harbor Feasibility Study (Seattle District, USACE)
- 2022 Oakland Harbor Feasibility Study (San Francisco District, USACE)
- 2022 New York & New Jersey Harbor Feasibility Study (New York District, USACE)
- 2018 Norfolk Harbor Feasibility Study (Norfolk District, USACE)
- 2015 Charleston Harbor Feasibility Study (Charleston District, USACE)
- 2012 Savannah Harbor Feasibility Study (Savannah District, USACE)

Information provided in these USACE feasibility studies that support benefit calculations in this analysis include projected increases in future cargo tonnage, containership fleet composition, and vessel sailing draft distributions.

The USACE has forecasted trans-Pacific trade operations (cargo and fleet forecasts) in the feasibility studies cited above for each major USEC and USWC port. It is important to note that the feasibility studies and associated appendices are finalized, publicly available USACE reports recommending channel improvements that have been authorized for construction by Congress and in most cases have been constructed or are under construction. The trans-Pacific trade forecasts developed for this analysis are based on 2018 - 2022 reported cargo volumes and fleet operations projected into the future using a compilation of forecasts from the cited USACE feasibility studies. In addition, the USACE feasibility studies provided data that was used to inform the number of TEUs typically on board of each type of containership vessel size class, vessel operating draft distributions, and waterborne transit costs per hour for each containership vessel size class.

2 Commodity Forecasts

The commodity forecasts consist of a baseline developed from recent historical data, growth rates calculated from USACE feasibility studies, and projected import, export, and empty TEU estimates for five-year intervals from 2030 – 2050. The commodity forecasts display the potential market that would be available to a fully rail intermodal container terminal at Coos Bay, including cargo origin, destination, mode of transport, and routing. Multiple forecasts are developed to provide a national perspective on the projected amount of trade and the opportunities for transportation efficiencies that would be made available by the rail intermodal container terminal at Coos Bay.

Commodity (TEU) forecasts are developed for:

- Worldwide import and export containerized trade for the 25 inland states,
- Far East Asia import and export containerized trade for the 25 inland states,
- Far East Asia import and export containerized trade for the 15 inland states west of the Mississippi River,

- Import, export, and empty TEUs for the major USEC and USWC ports,
- Import, export, and empty TEUs for the Far East Asia - Panama Canal - USEC ports, and
- Rail intermodal transport of TEUs.

The 25 inland states (states without an ocean coastline – excluding Vermont) are depicted in orange in Figure 2. Origins and destinations within the 25 inland states are typically far enough away from coastal ports to make rail intermodal transport more economically efficient than trucking, if rail intermodal transport is available.

It is important to note that inland state containerized cargo that would have the highest likelihood of shifting from USEC ports to Coos Bay is the cargo that would accrue the largest transportation cost reduction. The cargo that would have the highest potential cost savings would have origins and destinations in inland states west of the Mississippi River that are farther from the USEC and closer to Coos Bay than states east of the Mississippi River.[2]

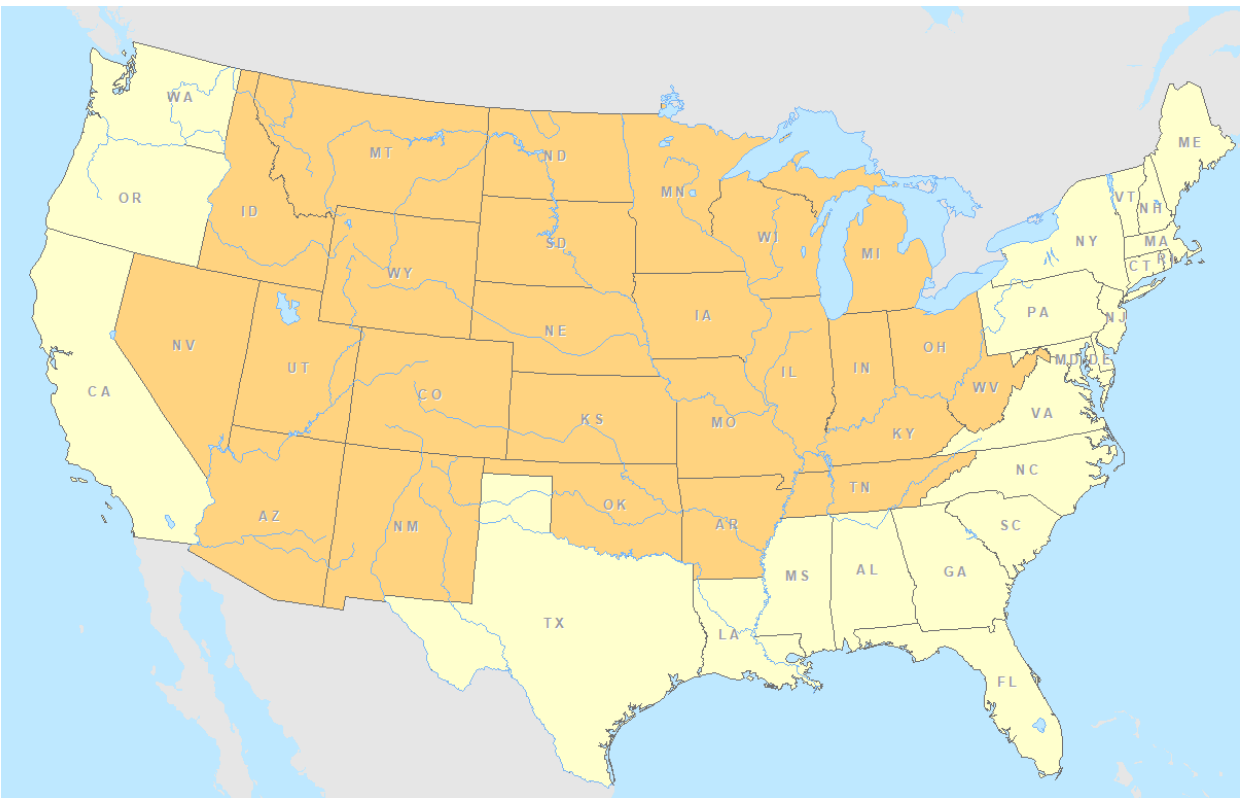

Figure 2
25 Inland States

2.1 Forecast Baseline

Historical data (2018 – 2022) from state level containerized commodity data obtained from the U. S. Census Bureau, Economic Indicators Division accessed at USA Trade Online was used to

[2] The 15 western inland states are Arizona, Colorado. Idaho, Iowa, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming

develop commodity forecast baseline estimates. The Census Bureau data provides state of origin and destination, foreign trade country for imports and exports, and containerized cargo weight. Each of the 25 inland states was identified in the Census Bureau data as the origin-state for exports and the destination-state for imports. Based on the 2018 – 2022 Bureau of Census data, the following countries account for 99.5% of Far East Asia containerized trade with the U. S.: Cambodia, China, Indonesia, Japan, Malaysia, Philippines, South Korea, Taiwan, Thailand, and Vietnam.

2.1.1 All Landside Transport Modes Baseline

Census Bureau data is presented in kilograms. To establish the number of TEUs these data represent, the analysis requires a conversion from kilograms to TEU. Tonnage to TEU conversion factors for worldwide trade were sourced from four USACE feasibility studies[3] that identified average cargo weights for loaded containers. Containerized cargo weights of 6.4 metric tons per TEU for imports and 9.3 metric tons per TEU for exports were used consistently for worldwide containerized cargo weights throughout this analysis.

Tonnage to TEU conversion factors specifically for Far East Asia cargo were sourced from the Port of Long Beach Deep Draft Navigation Feasibility Study[4] that identifies average weights for loaded containers on the Northeast Asia route that most closely matches the Far East Asia region identified in the Census Bureau data. Containerized cargo weights of 5.7 metric tons per TEU for imports and 9.7 metric tons per TEU for exports, as identified in the Port of Long Beach Deep Draft Navigation Feasibility Study (USACE, 2021), were used consistently for Far East Asia cargo throughout this analysis.

The number of empty containers for worldwide trade is calculated from values reported in the USACE feasibility studies.[5] Based on worldwide empty projections for 2025 from all USACE feasibility studies referenced for this analysis, import empty containers are 7.5% of loaded import containers and export empty containers are 68.9% of loaded export containers.

The number of empty containers for Far East Asia cargo is calculated from the Northeast Asia – USWC and Far East – Panama Canal – USEC routes, as reported in the USACE feasibility studies. Import empty containers are calculated as 8.0% of loaded import containers and export empty containers are calculated as 73.8% of loaded export containers as reported in the feasibility studies for 2025.

Based on the Census Bureau data, baseline estimates were developed for worldwide and Far East Asia containerized export and import Twenty-foot Equivalent Unit (TEU) totals for the 25 inland states and the 15 western inland states. The commodity forecast baselines are calculated as the 5-year (2018 – 2022) average number of TEUs per year. Table 1 presents the resultant commodity forecast baseline estimates for containerized cargo using all modes of landside transport (truck and rail). Table 1 is a summary table compiled from Appendix Tables A1 – A-3.

[3] Charleston, Savannah, Seattle, and Long Beach
[4] Port of Long Beach Deep Draft Navigation Feasibility Study (2021) Table 2-4
[5] Based on worldwide empty projections for 2025 from all USACE feasibility studies: Import empties 7.5% of loaded imports and Export empties 68.9% of loaded exports.

Table 1
Baseline Estimates for all Inland Transport Modes (TEUs)

Trade Origins & Destinations	Imports	Exports	Total
World – 25 Inland States	11,841,000	5,138,000	16,979,000
Far East Asia – 25 Inland States	4,169,000	3,227,000	**7,396,000**
Far East Asia – 15 Western Inland States	1,308,000	1,162,000	**2,470,000**

Note: Values in bold will be referenced in Table 11 at the end of this section.

2.1.2 Rail Intermodal Transport Baseline

The rail intermodal baseline is developed from 2018 – 2022 waybill data aggregated by Transearch, Inc. The data identifies the origin and destination points of the rail intermodal trip by city and state in the U.S. Cargo on rail movements from an origin within the 25 (or 15) inland states to a port city destination are identified as exports. Cargo on rail movements from a port city origin to a destination within the 25 (or 15) inland states are identified as imports. The waybill data reports tonnage, therefore the same TEU conversion factors used for the Census Bureau data was applied to the rail intermodal data. Empty rail intermodal TEU estimates are calculated in the same manner as empty TEU estimates for the Census data.

Census Bureau data indicate that during 2018 – 2022, Far East Asia containerized import tonnage to the 25 inland states averaged 31% of the worldwide containerized import tonnage to the 25 inland states. During that same time, containerized export tonnage to Far East Asia from the 25 inland states averaged 64% of the worldwide containerized export tonnage from the 25 inland states (Appendix Table A-4). These percentages were used to calculate the Far East Asia amount of rail intermodal imports and exports from the worldwide imports and exports reported in the Transearch waybill data. The rail intermodal baseline estimates presented in Table 2 are a summary of the baseline estimates developed as shown in Appendix Tables A5 – A8.

Table 2
Baseline Estimates for Rail Intermodal Transport (TEUs)

Trade Origins & Destinations	Imports	Exports	Total
World – 25 Inland States	2,807,000	1,889,000	**4,697,000**
Far East Asia – 25 Inland States	870,000	1,209,000	2,079,000
World – 15 Western Inland States	557,000	424,000	981,000
Far East Asia – 15 Western Inland states	173,000	271,000	444,000

Note: Bold value is referenced later in this section in Table 12.

Table 3 shows the comparison of baseline estimates for inland state containerized trade using all modes of inland transport (truck and rail) to containerized trade using rail intermodal. The comparisons in Table 3 indicate that containerized cargo making the long haul between USWC and USEC ports and inland states is largely transported by truck. The predominance of long-haul cargo transported by truck causes substantial transportation inefficiencies and is an indication of limited availability of rail intermodal capacity at USWC and USEC ports. The limited availability of rail intermodal capacity is exacerbated in the without-project future condition because projected increases in containerized foreign trade for the inland states will not be met with sufficient planned increases in USWC and USEC rail intermodal capacity (see Section 4: Without-Project Conditions).

Table 3
5-Year Average Baseline TEUs (2018 – 2022) for All Inland Transport Modes and Rail Intermodal Transport with Calculated Non-Rail Transport

	All Transport Modes	Rail Intermoda (Ship-Rail)	Non-Rail (Ship-Truck)
Worldwide Trade with 25 Inland States	16,979,000	**4,697,000**	12,282,000
	100%	28%	72%
Far East Asia Trade with 25 Inland States	7,396,400	2,079,000	5,317,000
	100%	28%	72%
Far East Asia Trade with 15 Western Inland States	2,470,000	444,000	2,026,000
	100%	18%	82%

Note: Non-Rail TEUs are calculated as the difference between All Transport Modes and Rail Intermodal; Bold value is referenced later in this section in Table 12.

2.2 Projected Future Growth

The objective of projecting future growth is to estimate the future number of TEUs for trade between Far East Asia and the 25 inland states and between Far East Asia and the 15 western inland states. Growth rates calculated from the eight USACE feasibility study commodity forecasts were used to project the future TEU estimates. Observed 2022 import and export loaded TEU data for each of the eight ports in the USACE feasibility studies was obtained through the Pacific Merchant Shipping Association (PMSA). The PMSA data for 2022, presented in Table 4, was used to validate the USACE projections for 2025. As described below, two adjustments to the USACE forecasts were required because the number of actual 2022 TEUs reported by PMSA was more than the 2025 USACE projection.

Table 4 presents import, export, and total loaded TEU observed 2022 data (PMSA 2023) and projections from USACE feasibility studies for USWC ports (Los Angeles, Long Beach, Oakland, Seattle, and Tacoma) and USEC ports (Savannah, Charleston, Norfolk, and New York). For USEC imports and total TEUs the 2022 observed data (PMSA 2023) are greater than the 2025 values projected by USACE (highlighted in bold in Table 4). Table 5 presents the incremental growth rates calculated from the forecasts presented in Table 4. The negative growth rates for 2025 USEC imports and total TEUs (highlighted in bold in Table 5) result from the observed 2022 number of TEUs being greater than the USACE 2025 projections.

Table 4
2022 Actual and USACE Forecasts: Loaded TEUs (thousands of TEUs)

	Actual	USACE Forecasts					
USWC	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Imports	11,354	14,529	18,065	21,891	25,752	28,854	32,390
Exports	3,712	4,770	5,991	7,303	8,657	9,500	10,582
Total USWC	15,066	19,299	24,056	29,194	34,409	38,354	42,972
USEC	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Imports	**10,786**	**7,949**	10,260	11,846	13,482	15,652	17,756
Exports	4,388	5,994	7,320	8,517	9,774	11,195	12,559
Total USEC	**15,174**	13,943	17,580	20,363	23,256	26,847	30,315

Note: 2022 actuals are port data for loaded TEUs reported by PMSA (PMSA 2023)

Table 5
USACE Loaded TEU Forecast: Incremental Growth Rates

USWC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Imports	8.6%	4.5%	3.9%	3.3%	2.3%	2.3%
Exports	8.7%	4.7%	4.0%	3.5%	1.9%	2.2%
Total USWC	8.6%	4.5%	3.9%	3.3%	2.2%	2.3%
USEC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Imports	**-9.7%**	5.2%	2.9%	2.6%	3.0%	2.6%
Exports	11.0%	4.1%	3.1%	2.8%	2.8%	2.3%
Total USEC	**-2.8%**	4.7%	3.0%	2.7%	2.9%	2.5%

Note: 2025 growth rate calculated as the 3-year increment (2022 – 2025) from observed port data (PMSA 2023); 2030 – 2050 5-year incremental growth rates calculated from aggregated USACE forecasts.

USEC port feasibility studies (Savannah, Charleston, Norfolk, and New York) are older than the USWC port feasibility studies and therefore need to be adjusted to account for the increase in trade between Far East Asia and the USEC via the Panama Canal USEC that was not projected in the older feasibility studies but has been observed today. In 2022, the PMSA data shows that there were 10,786,000 loaded TEUs imported to Savannah, Charleston, Norfolk, and New York (highlighted in bold in Table 4). The USACE forecast for 2025 projects 7,949,000 loaded TEUs (highlighted in bold in Table 4). The 2025 USEC import forecast needs to be adjusted to account for the actual increase in TEUs that was observed in 2022. This adjustment was made by using the USACE export growth rate for 2022 - 2025 (11%) to project import growth from 2022 to 2025 (Appendix Table 9). The remaining (2030 – 2050) import growth rates and all export growth rates (Table 5) are the same as the original growth rates calculated from the USACE forecasts.

Growth rates calculated from USACE commodity forecasts were also used to project the future number of TEUs for the Far East Asia-Panama Canal-USEC route. For this route, observed 2022 PMSA data for each USEC port was allocated to the Far East Asia-Panama Canal-USEC route based on the route-TEU distributions identified in the USACE feasibility studies for the USEC ports. The 2022 data presented in Table 6 is therefore an estimate based on observed data (PMSA 2023) and USACE feasibility study proportional route allocations (Appendix Table 10). Table 6 presents import, export, and total loaded TEUs estimated for 2022 and USACE projections for 2030 - 2050. For imports and total TEUs on the Far East Asia-Panama Canal-USEC route the 2022 estimates are greater than the 2025 values projected by USACE (highlighted in bold in Table 6). Table 7 presents the incremental growth rates calculated from the forecasts presented in Table 6. The negative growth rates for 2025 imports and total TEUs (highlighted in bold in Table 7) result from the estimated 2022 number of TEUs being greater than the USACE 2025 projections for the Far East Asia-Panama Canal-USEC route.

Table 6
Far East Asia-Panama Canal-USEC 2022 Actual and USACE Forecasts: Loaded TEUs (thousands of TEUs)

	Estimated	USACE Forecasts					
	2022	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Imports	**2,921**	2,178	2,977	3,438	3,909	4,651	5,385
Exports	1,069	1,490	1,795	2,087	2,389	2,719	3,041
Total	**3,990**	3,668	4,772	5,525	6,298	7,370	8,426

Note: 2025 growth rate calculated as the 3-year increment from the 2022 estimate. The 2022 estimate is based on 2022 actual data (PMSA 2023) allocated to the Far East Asia-Panama Canal-USEC route using USACE feasibility study proportional allocations.

Table 7
USACE Far East Asia-Panama Canal-USEC Loaded TEU Forecast: Incremental Growth Rates

	2025	2030	2035	2040	2045	2050
Import Rate	**-9.3%**	6.4%	2.9%	2.6%	3.5%	3.0%
Export Rate	11.7%	3.8%	3.1%	2.7%	2.6%	2.3%
Total Rate	**-2.8%**	5.8%	3.0%	2.6%	3.3%	2.8%

Note: 2025 growth rate calculated as the 3-year increment from observed 2022 data

The estimate based on PMSA data and USACE feasibility analyses shows that there were 2,921,000 loaded and empty TEUs imported from Far East Asia to the four USEC ports via the Panama Canal in 2022 (highlighted in bold in Table 6). The USACE forecast for 2025 for the same four USEC ports is 2,178,000 TEUs (highlighted in bold in Table 6). The 2025 USEC import forecast needs to be adjusted to account for the actual increase in TEUs that was observed in 2022. This adjustment to the Far East Asia – Panama Canal – USEC imports forecast was made by using the USEC export growth rate for this route during 2022- 2025 (11.7%) to project import growth from 2022 to 2025 (Appendix Table 11). The remaining (2030 – 2050) import growth rates and all export growth rates (Table 7) are the same as the original growth rates calculated from the USACE forecasts for this route.

The number of import and export empty TEUs was projected by USACE for each route and for each port. The percentage of empty TEUs was calculated from the original USACE forecasts as presented in the feasibility studies. Those percentages were used to calculate the number of empty TEUs in the updated forecasts (Appendix Tables 12 and 13).

The updated TEU forecasts developed for this analysis indicate substantial increases in TEUs projected for major USWC and USEC ports (Table 8) and for the Far East Asia-Panama Canal-USEC route (Table 9).

Table 8
Updated USWC and USEC Ports Total TEU Forecasts (thousands of TEUs)

USWC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	15,382	19,048	23,017	27,023	30,246	33,906
Export TEUs	9,091	11,460	14,031	16,656	18,200	20,302
Total TEUs	24,473	30,508	37,048	43,679	48,446	54,208
USEC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	16,291	20,990	24,216	27,539	31,916	36,160
Export TEUs	9,086	11,127	12,922	14,795	16,980	19,088
Total TEUs	25,377	32,117	37,138	42,334	48,896	55,248

Note: The 2025 growth rate used to increase from the baseline was adjusted as described in the previous paragraphs; Total TEUs includes loaded and empty TEUs.

Table 9
Far East Asia-Panama Canal-USEC Total (Loaded and Empty) TEU Forecast (thousands of TEUs)

	2025	2030	2035	2040	2045	2050
Import TEUs	4,342	5,934	6,854	7,792	9,269	10,729
Export TEUs	2,468	2,978	3,458	3,953	4,504	5,043
Total TEUs	6,810	8,912	10,312	11,745	13,773	15,772

Note: The 2025 growth rate used to increase from the baseline was adjusted as described in the previous paragraphs; Total TEUs includes loaded and empty TEUs.

Based on the adjusted USACE forecasts (Tables 8 & 9) and the detailed route specific forecasts[6] presented in the USACE feasibility studies, growth rates and projections for Far East Asia cargo and major USWC and USEC ports were developed (Table 10 and Appendix Tables 14 and 15).

Table 10
Far East Asia - USWC and USEC Ports Total TEU Forecasts (thousands of TEUs)

	2025	2030	2035	2040	2045	2050
Import TEUs	12,893	16,472	19,471	22,523	25,791	29,226
Export TEUs	7,125	8,798	10,504	12,272	13,659	15,297
Total TEUs	20,018	25,270	29,975	34,795	39,450	44,523
Growth Rates	**8.9%**	**4.8%**	**3.5%**	**3.0%**	**2.5%**	**2.4%**

Note: 2025 growth rate calculated as the 3-year increment from observed 2022 data; Total TEUs includes loaded and empty TEUs.

The projected growth rates calculated for Far East Asia cargo to the major USWC and USEC ports (presented in bold in Table 10) were used to project future containerized trade between Far East Asia and the 25 and 15 western inland states (Table 11). Projections of future worldwide trade with the 25 inland states are presented in Appendix Table 15.

[6] Unadjusted projections for the Northeast Asia-USWC route and the adjusted projections for the Far East Asia-Panama Canal-USEC route were summed to create projections for all Far East Asia cargo.

Table 11
Far East Asia – Inland States Baseline and (Loaded and Empty) TEU Forecasts (thousands of TEUs)

Baseline	2025	2030	2035	2040	2045	2050
Far East Asia – 25 Inland States						
7,396	9,533	12,006	14,245	16,549	18,768	21,178
Far East Asia – 15 Western Inland States						
2,470	3,179	3,998	4,744	5,512	6,246	7,045

Note: Baseline values previously presented in bold in Table 1

Table 3 presented the existing condition of insufficient rail intermodal capacity for existing containerized commodity traffic between the inland states and USWC and USEC ports. In the future, the existing predominance of long-haul trucking over rial intermodal is further exacerbated by projected growth in containerized commodity traffic between the inland states and USWC and USEC ports, as presented in Table 11.

Projected increases in rail intermodal capacity (Table 12) do not keep pace with projected increases in traffic between the inland states and USWC and USEC ports exhibited in Table 9. By 2030, rail intermodal projects at Ports of Long Beach and Los Angeles will increase USWC rail intermodal capacity by 1.8 million TEUs and an additional planned increase in rail intermodal capacity in 2040 (3.2 million TEUs) is projected for the Port of Long Beach Pier B. Based on recent historical distribution of intermodal resources towards the 25 inland states, as indicated in the Transearch data, 62.3% of this increase in intermodal capacity will be available to the 25 inland states (Appendix Table 16). Projections beyond 2040 are calculated using the annual growth rate exhibited by the increase from 2022 to 2040 (2.9%). The projected future increase in required long-haul trucking is presented in detail in Section 4: Without-project Conditions.

Table 12
USWC Ports Rail Intermodal Capacity Projections (thousands of TEUs)

Worldwide Trade – 25 Inland States						
Baseline	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
4,697	5,070	5,818	6,814	7,811	8,996	10,361

Note: Baseline previously presented in bold in Table 2

3 Fleet Forecast

Table 13 shows the USACE classification of containerships by size used in USACE Feasibility Studies and used throughout this analysis. Note that in USACE Feasibility Studies, the operating TEU capacity of a vessel is less than the nominal TEU capacity. USACE performs a load factor analysis to calculate operating TEU capacity based on historical data for factors such as average laden weight per TEU, container weight, vacant slot allotment, variable ballast, and other factors. Consistent with the practices shown in the USWC and USEC USACE Feasibility Studies cited, all calculations performed in this analysis assume that operational TEU capacity is 85% of nominal TEU capacity, consistent with USACE load factor analyses.

Table 13
USACE Containership Classification

Containership Size Class	Class Abbreviation	Maximum TEU Capacity	Average Operating Capacity
Sub-Panamax	SPX	2,800	2,380
Panamax	PX	5,100	4,335
Post-Panamax Generation 1	PPX1	6,700	5,695
Post-Panamax Generation 2	PPX2	8,600	7,310
Post-Panamax Generation 3	PPX3 (Neo-Panamax)	15,000	12,750
Post-Panamax Generation 4	PPX4	22,000	18,700

USACE vessel call forecasts by vessel class and by route group were compiled from each of the eight feasibility studies. The summation of projected vessel calls by vessel class presents a distribution of vessel calls by vessel class for each year. USACE forecasts of containership fleet composition by vessel size are presented in Table 14 for vessels from Far East Asia to US east coast ports via the Panama Canal, and in Table 15 for vessels from Far East Asia to US west coast ports.

Table 14
USACE Projected Vessel Fleet Composition
Far East Asia – Panama Canal - USEC
(number of vessel calls)

Vessel Class	2030	2035	2040	2045	2050
SPX	27	30	30	30	30
PX	219	237	275	316	261
PPX1	143	144	162	171	94
PPX2	248	257	273	327	396
PPX3	637	731	860	971	1,071
PPX4	60	76	93	103	114
Total	**1,334**	**1,475**	**1,693**	**1,918**	**1,966**

Table 15
USACE Projected Vessel Fleet Composition
Far East Asia – USWC

Vessel Class	2030	2035	2040	2045	2050
SPX	37	36	33	32	29
PX	250	192	132	76	17
PPX1	217	181	143	83	21
PPX2	497	475	456	389	322
PPX3	643	694	785	841	896
PPX4	150	265	306	422	536
Total	**1794**	**1843**	**1855**	**1843**	**1821**

4 Without-Project Conditions

Table 16 presents the Far East Asia projected trade with the 25 inland states and the projected USWC intermodal capacity available for that trade. As demonstrated by the difference between the TEU Forecast row and the Rail Intermodal Capacity row in Table 16, under without-project conditions there is insufficient rail-intermodal capacity to fully accommodate projected Far East Asia trade with the 25 inland states.

Table 16
USWC Ports Rail Intermodal Capacity Shortfall
(thousands of TEUs)

Far East Asia Trade – 25 Inland States						
	2025	**2030**	**2035**	**2040**	**2045**	**2050**
TEU Forecast	9,533	12,006	14,245	16,549	18,768	21,178
Rail Intermodal Capacity	5,083	5,856	6,886	7,917	9,152	10,581
Trucking Requirement	4,450	6,150	7,359	8,632	9,616	10,597

Note: Compiled from Tables 11 and 12

The eight major USWC and USEC ports are projected to have an average increase of 2.4 million TEUs each year throughout the forecast (Table 8) and nearly one million TEUs (976,100) of that annual increase is projected to be Far East Asia cargo (Table 10). In each year of the forecast, Far East Asia trade with the 25 inland states is projected to increase by an average of 460,000 TEUs (Table 11). In the without-project condition, the planned USWC port capacity or intermodal capacity projects are not large enough to stop the projected increase in the number of Far East Asia TEUs transiting the Panama Canal and being trucked to or from inland origins and destinations. Based on the projected growth in trade shown in this analysis, the trucking requirement for Far East Asia trade with the 25 inland states will more than double from 4.5 million TEUs in 2025 to 10.6 million TEUs in 2050. Most of the Far East Asia trade with the 25 inland states that will pass through the Panama Canal will continue to be trucked to and from inland points as it is currently done in the existing condition (Table 3).

5 With-Project Conditions

Under with-project conditions there will be a fully intermodal (ship-rail) container terminal at Coos Bay. The terminal will be designed for a capacity of 2 million TEUs per year. Ship simulation modeling by the Coos Bay Pilots indicates that containerships will only access and depart the container terminal at slack tide. The tides of Coos Bay are mixed semi-diurnal, meaning that Coos Bay experiences two daily highs and two daily lows of unequal duration and amplitude.

Typical navigation operations at Coos Bay would have containerships transiting the channel with favorable tides that occur twice per day. Given that weather constraints, such as high winds, rough seas, and fog periodically occur at Coos Bay, a reasonable, yet conservative estimate would be 330 transit-days per year for containerships. This estimate is conservative because most containerships calling at Coos Bay are projected not to require full channel depth (see Section 5.1 Containership Fleet) and therefore channel availability would be greater than it would be if more containerships required full channel depth. The channel is a one-way channel. For this analysis, the number of containership calls (after a ramp up period) is estimated at 330 per year. This estimate is developed only for the purpose of this economic evaluation and is not meant to be an indication of channel capacity at Coos Bay. Actual vessel operations at the container terminal may far exceed the conservative estimate used in this analysis.

Depending on vessel class and operating draft at Coos Bay, some vessels may be restricted to operating with tidal advantage to maintain appropriate under keel clearance (10% of the vessel's static draft). Tides are substantial at Coos Bay with Mean High Water seven feet above Mean Lower Low Water.

5.1 Coos Bay With-Project Containership Fleet

The with-project fleet projected to call at Coos Bay from 2030 to 2050 is based on the distribution of vessel classes shown in Table 15, with the exception that the containership fleet projected to call at Coos Bay does not include SPX and PPX4 vessels. SPX vessels are not included in the Coos Bay fleet forecast because they are a very small proportion, (<2%) of the USACE-forecasted fleet (Table 17). PPX4 vessels are not included in the Coos Bay fleet forecast because the design vessel (the vessel class for which the channel improvement is designed) is a PPX3 vessel, which has less length overall, less beam, and far less cargo capacity overall than PPX4 vessels (Table 13).

Table 17
Coos Bay Proportional Vessel Class Distribution
(proportion of vessel calls)

Vessel Class	2030	2035	2040	2045	2050
PX	8.0%	6.0%	5.0%	4.0%	2.0%
PPX1	8.0%	6.0%	5.0%	4.0%	2.0%
PPX2	20.0%	19.0%	18.0%	17.0%	16.0%
PPX3	64.0%	69.0%	72.0%	75.0%	80.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Containership vessel calls at Coos Bay are projected to ramp up from 150 per year in 2030 to 300 per year in 2035 and 330 calls per year in 2040 and thereafter (Table 18).

Table 18
Coos Bay Vessel Class Distribution
(number of vessel calls)

Vessel Class	2030	2035	2040	2045	2050
PX	12	18	17	13	7
PPX1	12	18	17	13	7
PPX2	30	57	59	56	53
PPX3	96	207	237	248	263
Total	**150**	**300**	**330**	**330**	**330**

Note: Sums may not add to total because of rounding

Containership vessel operating draft distributions are derived from the cumulative draft distributions presented in the Seattle Harbor feasibility study[7]. Vessel operating draft distributions are truncated at 45 feet because that is the maximum draft for containerships operating under with-project conditions. Table 19 presents the cumulative vessel draft distribution truncated at 45 feet and Table 20 presents the 2030 number of vessel calls by vessel class and operating draft based on the distribution presented in Table 19. Over time, the draft distribution (Table 19) remains constant but the shift to larger vessels exhibited in Tables 17 and 18 results in increases in the number of TEUs carried on vessels with deeper drafts and in the total number of TEUs overall (see section 5.2 Coos Bay With-Project TEUs).

[7] Seattle Economics Appendix Figures 4-4 through 4-7

Table 19
Cumulative Vessel Operating Draft Distribution

Draft	PX	PPX1	PPX2	PPX3
34	50%	20%	15%	10%
35	10%	5%	5%	5%
36	10%	10%	5%	5%
37	5%	10%	5%	10%
38	25%	5%	5%	10%
39		10%	15%	5%
40		10%	14%	10%
41		10%	11%	10%
42		5%	10%	10%
43		5%	5%	10%
44		5%	5%	5%
45		5%	5%	10%
Total	100%	100%	100%	100%

Table 20
2030 Vessel Operating Draft Distribution
(number of vessel calls)

Draft	PX	PPX1	PPX2	PPX3	Total
34	6	2	5	10	23
35	1	1	2	5	8
36	1	1	2	5	9
37	1	1	2	10	13
38	3	1	2	10	15
39	-	1	5	5	11
40	-	1	4	10	15
41	-	1	3	10	14
42	-	1	3	10	13
43	-	1	2	10	12
44	-	1	2	5	7
45	-	1	2	10	12
Total	**12**	**12**	**30**	**96**	**150**

5.2 Coos Bay With-Project TEUs

This analysis uses the assumption that one-third (33%) of the cargo on board the vessel is destined for Coos Bay, based on cargo share estimates developed by USACE for the Seattle Harbor (30%) and Tacoma Harbor (38%) Feasibility Studies (USACE 2018 and 2022, respectively). Coos Bay import TEUs were allocated to each vessel call based on vessel class, operating draft, and vessel immersion factor (metric tons per inch of draft). Table 21 presents the distribution of 2030 import TEUs by vessel class and operating draft. The Bureau of the Census data from 2018 – 2022 indicates that for trade between Far East Asia and the inland states export tonnage was 82% of import tonnage (Appendix Table X). This export to import factor was maintained throughout the analysis.

Table 21
2030 Import TEU Distribution (number of TEUs)

Draft	PX	PPX1	PPX2	PPX3	Total
34	4,131	1,619	4,014	13,038	22,802
35	910	458	1,500	7,170	10,038
36	994	1,024	1,662	7,820	11,500
37	539	1,131	1,824	16,942	20,436
38	2,904	619	1,986	18,243	23,752
39	-	1,346	6,445	9,772	17,563
40	-	1,453	6,470	20,845	28,768
41	-	1,560	5,440	22,147	29,147
42	-	834	5,270	23,448	29,551
43	-	887	2,797	24,749	28,433
44	-	941	2,959	13,025	16,925
45	-	995	3,121	27,352	31,468
Total	**9,478**	**12,868**	**43,488**	**204,550**	**270,384**

Under with-project conditions, the total number of Coos Bay TEUs is largely dependent on the number of vessel calls and the fleet mix. The number of Coos Bay TEUs increases from 2030 to 2050 (Table 22) because of the increase in the use of larger vessels (Table 17) and the increase in the number of vessel calls (Table 18). The number of empty TEUs is calculated using the same proportion of empties, based on the eight USACE feasibility studies (Appendix Tables 11 and 12), used to generate Table 8: Updated USWC and USEC Ports Total TEU Forecasts. Note that transportation cost savings are calculated for only loaded TEUs (see Section 6: Transportation Cost Savings).

Table 22
Coos Bay With-Project TEUs

	Imports		Exports		Total		
	Loaded	**Empty**	**Loaded**	**Empty**	**Loaded**	**Empty**	**Total**
2030	270,384	21,042	221,085	164,633	**491,469**	185,675	677,144
2035	557,207	41,861	455,611	342,640	**1,012,818**	384,501	1,397,319
2040	624,296	45,720	510,469	385,427	**1,134,765**	431,147	1,565,912
2045	633,806	46,154	518,245	387,722	**1,152,050**	433,877	1,585,927
2050	652,376	46,970	533,429	398,927	**1,185,804**	445,897	1,631,701

The with-project condition TEU forecast for Coos Bay is only a small percentage of the Far East Asia - inland states forecasts presented in Table 11. Under with-project conditions, the total 2030 TEU forecast for Coos Bay (677,144 TEUs) is 6% of the Far East Asia - 25 inland states forecast (12.0 million TEUs) and 17% of the Far East Asia - 15 western inland states forecast (4.0 million TEUs) for 2030. By 2050, the total TEU forecast for Coos Bay (1.6 million TEUs) is 8% of the Far East Asia - 25 inland states forecast (21.2 million TEUs) and 23% of the Far East Asia - 15 western inland states forecast (7.0 million TEUs).

All the with-project Coos Bay TEUs are rail intermodal that increase USWC rail intermodal capacity. Under with-project conditions, the Far East Asia – 25 inland states 2030 forecasted trucking requirement of 6.2 million TEUs (Table 16) would be reduced by 11% and the 2050 forecasted trucking requirement of 10.6 million TEUs would be reduced by 15%.

6 Transportation Cost Savings

In this analysis, transportation cost savings are calculated only for loaded TEUs. There are three components to transportation costs: vessel waterborne operating costs, Panama Canal fees (operations and maintenance component only), and landside transportation costs.

6.1 Waterborne Operating Costs

Vessel waterborne operating costs are based on 2013 USACE published vessel operating costs informally updated (reduced) to 2017 using anecdotal information. Vessel operating costs are calculated on a cost per TEU per 1,000 miles basis using the standard import and export TEU cargo weights for Far East Asia cargo (5.7 metric tons for imports and 9.7 metric tons for exports). Under this calculation method, costs per TEU decrease as more TEUs are loaded on the vessel. The cost per TEU on any vessel will be higher if the vessel is loaded to a draft of 35 feet than the cost per TEU when the vessel is loaded to a draft of 45 feet. Also for example, the cost per TEU on a PPX3 will be less than the cost per TEU on a PPX2, when both vessels are loaded to the same draft, because the PPX3 holds more TEUs than the PPX2 at the same draft.

Route distances are based on Busan as a representative Far East Asia port. Norfolk is used as a mid-range USEC port. The ocean voyage distances[8] are:

- Busan to Coos Bay: 4,650 nautical miles, and
- Busan to Norfolk via the Panama Canal: 9,894 nautical miles.

Vessel speed at sea is assumed constant at 19 knots. Vessel operating costs are calculated for the same fleet, vessel draft, and load distributions for the Busan to Norfolk route and for the Busan to Coos Bay route. Under without-project conditions, Far East Asia – inland states cargo identified in Table 22 uses USEC ports (represented by Norfolk in waterborne transportation cost calculations). Under with-project conditions, the same cargo identified in Table 22 uses the Port of Coos Bay at a substantial reduction in waterborne vessel operating costs (Table 23).

Table 23
Waterborne Vessel Operating Costs

	Loaded TEUs	Norfolk	Coos Bay	Cost Savings
2030	**491,469**	$251,887,000	$118,382,000	$133,505,000
2035	**1,012,818**	$511,972,000	$240,618,000	$271,354,000
2040	**1,134,765**	$569,138,000	$267,485,000	$301,653,000
2045	**1,152,050**	$572,936,000	$269,270,000	$303,666,000
2050	**1,185,804**	$582,946,000	$273,974,000	$308,972,000

Note: Values highlighted in bold referenced in Table 22

6.2 Panama Canal Operating Costs

Vessels transiting through the Panama Canal pay canal tolls based on a schedule of fees published by the Panama Canal Authority, which took effect in January of 2023. For containerships, fixed fees start at $60,000 per transit, rising to $300,000 for vessels of over 10,000 TEUs in size. A capacity fee ranging from $30-$40 per TEU is added to that, followed by a loaded container and empty container fee. Table 24 shows the fees for each class of vessel used in this analysis (average TEU capacity is rounded to the nearest 100 TEUs).

[8] Sea-distances.org

Table 24
Panama Canal Toll Structure for Containerships

Vessel Type	Average TEU Capacity	Vessel Fixed Fee	Vessel Capacity Fee (per TEU)	Laden Container Fee (per TEU)	Empty Container Fee (Per TEU)
PX	4,500	$60,000	$30	$30	$2
PPX1	6,000	$200,000	$30	$30	$2
PPX2	8,000	$200,000	$30	$30	$2
PPX3	13,000	$300,000	$30	$40	$2

As an example payment under the toll structure currently in place, a 13,000 TEU containership carrying 10,400 TEUs of laden containers and 2,080 TEUs of empty containers would pay a total of $1,110,160 in Panama Canal tolls per transit, which is comprised of the following fees:

1. $300,000 in fixed fees;
2. $390,000 in capacity fees at $30 per TEU;
3. $416,000 in laden TEU fees of $40 per TEU for 10,400 TEUs; and
4. $4,160 in empty TEU fees of $2 per TEU for 2,080 TEUs.

Annual Panama Canal toll costs were calculated based on the proportion of vessels projected for each vessel type (PX, PPX1, PPX2, and PPX3) in the Coos Bay fleet forecast (Table 18). The number of loaded TEUs onboard the vessel at each sailing draft in the distribution was calculated using an average 7.7 tons of cargo per TEU and a box weight of 2 tons. The number of empty TEUs onboard was assumed to be 20% of the number of loaded TEUs. For 2030, the overall weighted average Panama Canal toll cost per loaded TEU is $154.60 and the annual total Panama Canal toll cost is $75,983,000. The 2022 Panama Canal Annual Report indicates that operating expenses are 33% of toll revenues[9]. The Panama Canal operating costs avoided under with-project conditions for 2030 is $25,321,000. Table 25 presents operating costs avoided under with-project conditions for each 5-year interval from 2030 – 2050.

Table 25
Panama Canal Operating Costs Avoided

2030	$25,321,000
2035	$52,659,000
2040	$59,329,000
2045	$60,593,000
2050	$62,885,000

[9] Annual Panama Canal operating expenses include salaries, wages, employee benefits, materials and supplies, fuel, and contracted services for a total of $1,009,035. Annual Panama Canal toll revenues are reported as 3,027,943. All values in thousands of balboas (Panama Canal Annual Report 2022).

6.3 Landside Transportation Costs

Landside transportation costs are largely developed from overland distances the cargo is required to travel and mode-specific transportation cost parameters. The opportunity for rail intermodal between USEC ports and inland state locations is limited by the rail intermodal capacity at USEC ports. In 2022 there were less than 1.5 million rail intermodal TEUs transported between USEC ports and the inland 25 states (Transearch 2023). Planned improvements to USEC intermodal capacity (the largest being a nearly 2 million TEU proposed future increase in intermodal capacity at the Navy Intermodal Terminal at the Port of Charleston) will be insufficient to meet the rail intermodal demand associated with the forecasted USEC port TEU increases presented in Table 8: Updated USWC and USEC Ports Total TEU Forecasts. Even with improvements to the USEC rail intermodal capacity over the period of analysis, the vast majority of the TEUs delivered to USEC would continue to be delivered to the inland states via truck.

6.3.1 Overland Distances

Landside transportation costs are based on distances from Coos Bay and USEC ports to major cities in the 15 western inland states. Distances from the USEC were calculated as the average distance from the ports of New York and New Jersey (Newark, NJ), Norfolk VA, and Savannah GA. Weighted average distances were calculated based on the distribution of 2022 rail intermodal TEUs to each of the western state inland cities (listed in Appendix Table X). The weighted averages for Coos Bay and for USEC ports were calculated based on

- the proportion of 2022 rail intermodal TEUs between each city and the USEC ports (Transearch 2023)
- the distances from Coos Bay to each city, and
- the USEC three-port average distance to each city.

All distances, including rail distances, were calculated as road distances based on routing by Google Maps (2023). The weighted average distance for Coos Bay is 1,789 miles and the weighted average distance for USEC ports is 1,401 miles[10].

Cargo transit between the USEC ports and the major cities of the 15 western inland states is projected to be by truck with an average truckload of two TEUs. This analysis assumes that each truck movement is a loaded movement, so there are no empty truck hauls in the transportation cost calculations. At an average speed of 55 miles per hour, each truck trip takes 26 hours. Cargo transit between Coos Bay and the major cities of the 15 western inland states is projected to be by train with an average trainload of 560 TEUs (140 rail cars). At an average speed of 20.6 miles per hour[11], each train trip takes 87 hours. Table 26 presents the number of truckloads and trainloads for 2030 – 2050.

[10] Weighted average distance calculations are presented in Appendix Table A-17.
[11] 20.6 hours was calculated from Union Pacific schedule by RailPro (2023)

Table 26
Truckloads (USEC Ports) and Trainloads (Coos Bay)

	Loaded TEUs	Truckloads	Trainloads
2030	**491,469**	245,734	878
2035	**1,012,818**	506,409	1,809
2040	**1,134,765**	567,382	2,026
2045	**1,152,050**	576,025	2,057
2050	**1,185,804**	592,902	2,118
Note: Values highlighted in bold referenced in Tables 22 and 23			

Each truckload (two TEUs) travels a weighted average of 1,401 miles taking 26 hours at 55 miles per hour. Each trainload (560 TEUs) travels a weighted average of 1,789 miles taking 87 hours at 20.6 miles per hour. Table 27 presents total travel distance for truck and rail.

Table 27
Truck and Train Miles and Travel Time

	Truck Miles	Train Miles	Truck Hours	Train Hours
2030	344,273,700	1,570,100	6,259,500	76,200
2035	709,479,000	3,235,600	12,899,600	157,100
2040	794,902,700	3,625,200	14,452,800	176,000
2045	807,011,400	3,680,400	14,672,900	178,700
2050	830,656,000	3,788,200	15,102,800	183,900

6.3.2 Landside Transportation Cost Parameters

Landside transportation costs are calculated only for loaded containers projected for Coos Bay, as presented in Tables 22, 23, and 26. As presented earlier in Section 4: Without-project Conditions, Section 5.2: Coos Bay With-Project TEUs, and Tables 11 and 16, these TEUs represent a small proportion of the projected TEUs that would be trucked between USEC ports and the 15 western inland states.

Landside transportation cost parameters have been developed by the U. S. Department of Transportation and are presented in Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023. This guidance provides parameter values for use in the monetization of project impacts to be used in a benefit-cost analysis. These cost parameters are also incorporated into a spreadsheet template developed by USDOT and recommended for use by USDOT discretionary grant applicants. Although the spreadsheet template was not used in this analysis, the methodology and calculations used are identical.

The USDOT recommended monetization values[12] used in this analysis include:

- Truck driver per hour: $33.50
- Locomotive engineer per hour: $53.50
- Commercial truck operating cost per mile: $1.32
- Freight train operating cost per hour: $799
- Freight railcar operating cost per hour: $1.03.

6.3.3 Landside Transportation Cost Calculations

Truck operating costs are calculated using the USDOT recommended truck operating cost per mile and the calculated truck miles presented in Table 27. Train operating costs are calculated using the USDOT recommended cost per mile for freight train ($799) and freight railcar ($1.03 per car for 140 railcars per train). Train operating costs per hour are multiplied by the train hours presented in Table 27. Under without-project conditions, the TEUs are trucked the weighted average distance of 1,401 miles between USEC ports and the associated inland state destinations. Under with-project conditions, the same number of TEUs are transported by train a weighted average distance of 1,789 miles between the container terminal at Coos Bay and the same inland state destinations used in the trucking calculations (Appendix Table A-17). Table 28 presents truck and train operating costs and the with-project condition vehicle operating cost savings for each 5-year interval from 2030 - 2050.

Table 28
Truck and Train Operating Costs and Savings

	Truck Costs	Train Costs	Savings
2030	$454,441,000	$71,888,000	$382,553,000
2035	$936,512,000	$148,146,000	$788,366,000
2040	$1,049,271,000	$165,983,000	$883,288,000
2045	$1,065,255,000	$168,512,000	$896,743,000
2050	$1,096,466,000	$173,449,000	$923,017,000

Travel time costs are based on the hourly costs of the vehicle operators. Each truck trip takes a weighted average of 26 hours which would require two drivers based on the 14-hour per day limit set by the Federal Motor Carrier Safety Administration (USDOT). This analysis assumes that the drivers work in series and that only one driver is present in the truck while in transit. The American Association of Railroads indicates that a two-person crew in the locomotive cab is standard for

[12] The values are presented in 2022 dollars and are not adjusted in this analysis.

most Class 1 mainline operations[13]. This analysis assumes a three-person crew in recognition of the length of the train (140 rail cars). Note that there are no regulatory standards for train crew size. USDOT recommended hourly values for truckdriver ($33.50) and locomotive engineer ($53.50) are multiplied by the number of operators (1 for truck and 3 for train) and by the hours of operation identified in Table 23. Table 29 presents truck and train travel time costs and the with-project condition travel time cost savings.

Table 29
Truck and Train Operator Travel Time Costs and Savings

	Truck Operator Costs	Train Operator Costs	Operator Cost Savings
2030	$209,694,000	$12,233,000	$197,461,000
2035	$432,137,000	$25,209,000	$406,928,000
2040	$484,168,000	$28,245,000	$455,923,000
2045	$491,543,000	$28,675,000	$462,868,000
2050	$505,945,000	$29,515,000	$476,420,000

Total operating costs and travel time costs for truck and train and associated total landside transportation cost savings are presented in Table 30. Truck costs are the landside transportation costs that would be incurred under without-project conditions and train costs are the landside transportation costs that would be incurred under with-project conditions. The amount of cargo transported is unchanged and the cargo origins and destinations are unchanged under both without and with-project conditions.

Table 30
Truck and Train Total Costs and Savings

	Truck Costs	Train Costs	Savings
2030	$664,135,000	$84,120,000	$580,015,000
2035	$1,368,649,000	$173,355,000	$1,195,294,000
2040	$1,533,440,000	$194,228,000	$1,339,212,000
2045	$1,556,798,000	$197,187,000	$1,359,611,000
2050	$1,602,411,000	$202,964,000	$1,399,447,000

[13] American Association of Railroads: Freight Rail and Crew Size accessed at https://www.aar.org/issue/crew-size/#:~:text=For%20Class%20I%20railroads%2C%20recent,%2Dthe%2Droad%20mainline%20operations on 16May24

7 Total Transportation Cost Savings

Total transportation cost savings are the sum of waterborne operating cost savings (Table 23), Panama Canal operations cost savings (Table 25), and landside transportation cost savings (Table 30). Increases in TEUs and fleet shifts to larger vessels continue from 2030 through 2050 and then are held constant for the remainder of the period of analysis (through 2079). Each year, cost savings are discounted using the FY24 federal discount rate (2.75%). The discounted values are summed, and this discounted sum is the basis for the average annual equivalent value (AAEQ) that is used as the benefit side of the benefit-cost ratio. Table 31 presents the AAEQ values for each of the three components of transportation costs savings and their sum.

Table 31
AAEQ Transportation Cost Savings

Vessel Operating Cost Savings	$290,870,000
Panama Canal Operations Cost Savings	$58,144,000
Landside Transportation Cost Savings	$1,303,560,000
Total Transportation Cost Savings	**$1,652,574,000**

Note: AAEQ values discounted over 50 years at the FY24 federal discount rate of 2.75%

8 Benefit-Cost Analysis

The transportation cost savings resulting from the project – project benefits – compare favorably to project costs, yielding a benefit-to-cost ratio greater than one under multiple scenarios. All annualized benefits and costs were discounted using the federal FY24 discount rate of 2.75%.

8.1 Project Costs

Project costs are developed in the Project Cost Appendix. Project costs include costs allocated to design, permitting, construction, interest during construction, contingency, and operations and maintenance (O&M). These components of project cost have been estimated for the federal navigation channel improvements, improvements to the Coos Bay rail line, improvements to Union Pacific’s Eugene railyard, and building the rail intermodal container terminal at Coos Bay.

Design and permitting are project to take 24 months to complete. Construction of the Coos Bay Rail Line improvements and container terminal are projected to start in month-13 and will be concurrent with the second year of design and permitting. Coos Bay Rail Line improvement construction is projected to have a 48-month duration. Container terminal construction is also projected to have a 48-month duration. Improvements to the federal navigation channel are projected to begin in Month 21 with a 40-month duration. Improvements to the Union Pacific Eugene Railyard are projected to begin in Month 49 with a 12-month duration. Overall, design, permitting, and construction is projected to have a duration of 60 months with construction having a duration of 48 months.

Table 32 presents project costs. Interest during construction was calculated based on the design, permitting, and construction schedule presented above using the federal FY24 discount rate of 2.75%. Contingency is 25% of the sub-total of costs including design, permitting, construction, and interest during construction.

Table 32
Project Costs

Design & Permitting Year-1	$70,722,000
Design & Permitting Year-2	$30,000,000
Rail Segment 1	$274,796,000
Rail Segment 2	$1,019,922,000
Container Terminal	$1,254,025,000
Eugene Railyard	$104,489,000
Navigation Channel	$551,368,000
Sub-Total	**$3,305,322,000**
Interest During Construction	$182,731,000
Sub-Total	**$3,488,053,000**
Contingency (25%)	$872,013,000
Total Costs	**$4,360,066,000**

Note: IDC calculated at the FY24 federal discount rate of 2.75%

Total O&M costs include the incremental increase in federal O&M dredging costs of the navigation channel, container terminal operations and maintenance, including berth dredging, and increased operations and maintenance costs of the Coos Bay Rail Line. Annualized total O&M costs calculated at the FY24 federal discount rate (2.75%) are $114,892,700.

Benefit-to-cost ratios are presented in Table 33. These ratios range from 6.0, when all appropriate benefits are considered, down to 1.1, when only vessel operating costs are considered. All benefit-to-cost comparisons are calculated on an average annual equivalent basis.

Table 33
Benefits to Costs Comparisons (AAEQ)

Design, Permitting, and Construction Costs	$161,501,000
O&M Costs	$114,892,000
Total Project Costs	**$276,393,000**
Vessel Operating Cost Savings	$290,870,000
Panama Canal Operations Cost Savings	$58,144,000
Landside Transportation Cost Savings	$1,303,560,000
Total Transportation Cost Savings	**$1,652,574,000**
Total Cost Savings to Total Project Costs	6.0
Waterborne Transportation Cost Savings to Total Project Costs	1.3
Vessel Operating Cost Savings to Total Project Costs	1.1

Note: AAEQ calculated at the FY24 federal discount rate of 2.75% over the 50-year project life

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10 Appendix Tables

Table A-1 presents recent historical worldwide and Far East Asia containerized export and import Twenty-foot Equivalent Unit (TEU) totals for the 25 inland states and the 15 western inland states. Census Bureau data is presented in kilograms. Worldwide tonnage to TEU conversion factors were sourced from four USACE feasibility studies[14] that identified average cargo weights for loaded containers to be calculated for worldwide trade. Containerized cargo weights of 6.4 metric tons for imports and 9.3 metric tons for exports were used consistently for worldwide containerized cargo weights throughout this analysis. The number of empty containers for worldwide trade is calculated from values reported in the USACE feasibility studies.[15] The commodity forecast baselines are calculated as the 5-year (2018 – 2022) average number of TEUs per year.

Table A-1
Worldwide – 25 Inland States Containerized Trade 2018 – 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	11,108,100	10,137,000	9,675,200	11,722,100	12,432,700
Import Empty TEUs	833,100	760,300	725,600	879,200	932,500
Total Import TEUs	11,941,200	10,897,300	10,400,800	12,601,300	13,365,200
Export Loaded TEUs	3,371,600	3,109,600	3,066,300	2,928,700	2,734,500
Export Empty TEUs	2,323,000	2,142,500	2,112,700	2,017,900	1,884,100
Total Export TEUs	5,694,600	5,252,100	5,179,000	4,946,600	4,618,600
Total TEUs	17,635,800	16,149,400	15,579,800	17,547,900	17,983,800
Baseline Total Import TEUs		**11,841,200**			
Baseline Total Export TEUs		**5,138,200**			
Baseline Total TEUs		**16,979,300**			

Table A-2 presents Far East Asia containerized export and import TEU totals for the 25 inland states. Tonnage to TEU conversion factors were sourced from the Port of Long Beach Deep Draft Navigation Feasibility Study[16] that identifies average weights for loaded containers on the Northeast Asia Container route that most closely matches the Far East Asia region identified in the Census Bureau data. Containerized cargo weights of 5.7 metric tons for imports and 9.7 metric tons for exports were used consistently for Far East Asia cargo throughout this analysis.

[14] Charleston, Savannah, Seattle, and Long Beach
[15] Based on worldwide empty projections for 2025 from all USACE feasibility studies: Import empties 7.5% of loaded imports and Export empties 68.9% of loaded exports.
[16] Port of Long Beach Deep Draft Navigation Feasibility Study (2021) Table 2-4

The number of empty containers for Far East Asia Cargo is calculated from the Northeast Asia – USWC and Far East – Panama Canal – USEC routes, as reported in the USACE feasibility studies[17]. The commodity forecast baseline for Far East Asia trade with the 25 inland states is calculated as the average number of TEUs per year from 2018 – 2022.

Table A-2
Far East Asia: 25 Inland States Containerized Trade 2018 - 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	4,049,100	3,475,600	3,355,800	4,010,200	4,412,500
Import Empty TEUs	323,900	278,000	268,400	320,800	353,000
Total Import TEUs	**4,373,000**	**3,753,600**	**3,624,200**	**4,331,000**	**4,765,500**
Export Loaded TEUs	2,137,000	1,890,700	1,941,900	1,741,400	1,572,500
Export Empty TEUs	1,577,100	1,395,300	1,433,100	1,285,100	1,160,500
Total Export TEUs	**3,714,100**	**3,286,000**	**3,375,000**	**3,026,500**	**2,733,000**
Total TEUs	**8,087,100**	**7,039,600**	**6,999,200**	**7,357,500**	**7,498,500**
Baseline Total Import TEUs			**4,169,500**		
Baseline Total Export TEUs			**3,226,934**		
Baseline Total TEUs			**7,396,400**		

Table A-3 presents 2018 – 2022 Far East Asia containerized trade with the 15 western inland states. The number of empty containers and the baseline for the commodity forecast for the 15 western inland states was calculated in the same way as used for the 25 inland states values.

[17] Import empty containers are calculated as 8.0% of loaded import containers and export empty containers are calculated as 73.8% of loaded export containers as reported in the feasibility studies for 2025.

Table A-3
Far East Asia: 15 Western Inland States Containerized Trade
2018 - 2022 and Forecast Baseline

	2018	2019	2020	2021	2022
Import Loaded TEUs	1,292,325	1,123,475	1,180,394	1,222,784	1,235,843
Import Empty TEUs	103,583	90,049	94,611	98,009	99,056
Import Total TEUs	**1,395,907**	**1,213,524**	**1,275,005**	**1,320,793**	**1,334,899**
Export Loaded TEUs	718,003	653,150	706,913	676,631	588,095
Export Empty TEUs	529,891	482,029	521,707	499,359	434,019
Export Total TEUs	**1,247,894**	**1,135,179**	**1,228,620**	**1,175,989**	**1,022,114**
Total TEUs	**2,643,801**	**2,348,703**	**2,503,625**	**2,496,783**	**2,357,013**
Baseline Total Import TEUs			**1,308,026**		
Baseline Total Export TEUs			**1,161,959**		
Baseline Total TEUs			**2,469,985**		

Table A-4
Far East Asia Proportion of Trade 25 Inland States Containerized Trade
2018 - 2022 (metric tons)

	Export	Imports	Total
Far East Asia	90,049,270	110,028,555	200,077,825
World	141,458,989	352,481,289	493,940,278
Far East Asia %	64%	31%	41%

Table A-5
25 Inland States Worldwide Trade Rail Intermodal TEUs 2018 - 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	2,484,537	2,420,485	2,403,990	2,791,284	2,957,473
Import Empty TEUs	186,340	181,536	180,299	209,346	221,811
Total Import TEUs	2,670,878	2,602,022	2,584,290	3,000,630	3,179,284
Export Loaded TEUs	1,209,285	1,138,752	1,105,909	1,010,881	1,004,402
Export Empty TEUs	833,197	840,399	816,161	746,030	741,248
Total Export TEUs	2,042,482	1,979,151	1,922,070	1,756,912	1,745,650
Total TEUs	4,713,360	4,581,172	4,506,360	4,757,542	4,924,934
Baseline Total Import TEUs			**2,807,421**		
Baseline Total Export TEUs			**1,889,253**		
Baseline Total TEUs			**4,696,674**		

Table A-6
25 Inland States Far East Asia Trade Rail Intermodal TEUs 2018 - 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	770,207	750,350	745,237	865,298	916,817
Import Empty TEUs	57,765	56,276	55,893	64,897	68,761
Total Import TEUs	827,972	806,627	801,130	930,195	985,578
Export Loaded TEUs	773,942	728,801	707,782	646,964	642,817
Export Empty TEUs	533,246	537,855	522,343	477,459	474,399
Total Export TEUs	1,307,189	1,266,656	1,230,125	1,124,424	1,117,216
Total TEUs	2,135,161	2,073,283	2,031,255	2,054,619	2,102,794
Baseline Total Import TEUs			**870,300**		
Baseline Total Export TEUs			**1,209,122**		
Baseline Total TEUs			**2,079,422**		

Table A-7
15 Inland States Worldwide Trade Rail Intermodal TEUs 2018 - 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	460,982	468,540	489,690	569,479	602,644
Import Empty TEUs	34,574	35,140	36,727	42,711	45,198
Total Import TEUs	495,556	503,680	526,417	612,190	647,842
Export Loaded TEUs	278,730	262,258	264,302	225,400	224,199
Export Empty TEUs	192,045	180,696	182,104	155,300	154,473
Total Export TEUs	470,775	442,955	446,407	380,700	378,673
Total TEUs	966,330	946,635	972,824	992,889	1,026,515
Baseline Total Import TEUs			**557,137**		
Baseline Total Export TEUs			**423,902**		
Baseline Total TEUs			**981,039**		

Table A-8
15 Inland States Far East Asia Trade Rail Intermodal TEUs 2018 - 2022

	2018	2019	2020	2021	2022
Import Loaded TEUs	142,904	145,247	151,804	176,538	186,820
Import Empty TEUs	10,718	10,894	11,385	13,240	14,011
Total Import TEUs	153,622	156,141	163,189	189,779	200,831
Export Loaded TEUs	178,387	167,845	169,153	144,256	143,488
Export Empty TEUs	122,909	115,645	116,547	99,392	98,863
Total Export TEUs	301,296	283,491	285,700	243,648	242,350
Total TEUs	454,918	439,632	448,890	433,427	443,182
Baseline Total Import TEUs			**172,712**		
Baseline Total Export TEUs			**271,297**		
Baseline Total TEUs			**444,010**		

Table A-9
Adjusted USEC Loaded TEU Forecasts and Growth Rates (thousands of TEUs)

	2025	2030	2035	2040	2045	2050
Import TEUs	14,733	19,018	21,957	24,989	29,012	32,910
Import Rate	11.0%	5.2%	2.9%	2.6%	3.0%	2.6%
Export TEUs	5,994	7,320	8,517	9,774	11,195	12,559
Export Rate	11.0%	4.1%	3.1%	2.8%	2.8%	2.3%
Total TEUs	20,727	26,338	30,474	34,763	40,207	45,469
Total Rate	11.0%	4.9%	3.0%	2.7%	3.0%	2.5%

Note: 2025 growth rate calculated as the 3-year increment from observed 2022 data

Table A-10
2022 FEA-PAN-ECUS Estimates from 2022 Actual Totals

Imports

	NYNJ	Norfolk	Charleston	Savannah
Baseline Year	**2018**	**2015**	**2011**	**2010**
Baseline Total	2,644,118	1,022,179	554,397	1,399,215
Baseline FE-PAN-ECUS	542,000	324,087	75,186	584,802
Baseline % FE-Pan-ECUS	20.5%	31.7%	13.6%	41.8%
2022 Actual Total	4,799,994	1,728,911	1,383,491	2,873,103
Estimated 2022 FE-PAN-ECUS	983,919	548,160	187,625	1,200,814
			Total Imports	**2,920,518**

Exports

	NYNJ	Norfolk	Charleston	Savannah
Baseline Year	**2018**	**2015**	**2011**	**2010**
Baseline Total	1,286,000	944,504	517,606	1,091,049
Baseline FE-PAN-ECUS	289,176	296,492	60,887	292,230
Baseline % FE-Pan-ECUS	22.5%	31.4%	11.8%	26.8%
2022 Actual Total	1,297,769	1,076,147	665,459	1,348,851
Estimated 2022 FE-PAN-ECUS	291,823	337,816	78,279	361,280
			Total Exports	**1,069,198**

Table A-11
Adjusted Far East Asia-Panama Canal-USEC
Loaded TEU Forecast and Growth Rates (thousands of TEUs)

	2025	2030	2035	2040	2045	2050
Import TEUs	4,069	5,561	6,423	7,303	8,690	10,061
Import Rate	**11.7%**	**6.4%**	**2.9%**	**2.6%**	**3.5%**	**3.0%**
Export TEUs	1,490	1,795	2,087	2,389	2,719	3,041
Export Rate	**11.7%**	**3.8%**	**3.1%**	**2.7%**	**2.6%**	**2.3%**
Total TEUs	5,559	7,356	8,510	9,692	11,409	13,102
Total Rate	**11.7%**	**5.8%**	**3.0%**	**2.6%**	**3.3%**	**2.8%**

Note: 2025 growth rate calculated as the 3-year increment from observed 2022 data

Table A-12
USWC and USEC Ports Empty TEU Forecasts (thousands of TEUs)

USWC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	852	983	1,125	1,271	1,392	1,516
Export TEUs	4,322	5,469	6,727	7,999	8,699	9,720
Total TEUs	5,174	6,452	7,852	9,270	10,091	11,236
USEC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	1,559	1,972	2,259	2,550	2,904	3,250
Export TEUs	3,092	3,808	4,405	5,021	5,785	6,529
Total TEUs	4,651	5,780	6,664	7,571	8,689	9,779

Table A-13
Far East Asia-Panama Canal-USEC Empty TEU Forecast (thousands of TEUs)

	2025	2030	2035	2040	2045	2050
Import TEUs	273	373	430	489	579	668
Export TEUs	979	1,183	1,372	1,565	1,785	2,002
Total TEUs	1,252	1,556	1,802	2,054	2,364	2,670

Table A-14
Far East Asia - USWC and USEC Ports Empty & Loaded TEU Forecasts
(thousands of TEUs)

Imports Loaded	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
FEA - USWC	8,003	9,907	11,901	13,927	15,640	17,536
FEA-Pan-USEC	4,069	5,561	6,423	7,303	8,690	10,061
Total Imports Loaded	12,072	15,468	18,324	21,230	24,330	27,597
Incr. Growth Rates	9.5%	5.1%	3.4%	3.0%	2.8%	2.6%
Imports Empty	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
FEA - USWC	549	631	716	804	883	961
FEA-Pan-USEC	273	373	430	489	579	668
Total Imports Empty	822	1,004	1,146	1,293	1,462	1,629
Total FEA Imports	**12,894**	**16,472**	**19,470**	**22,523**	**25,792**	**29,226**
Exports Loaded	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
FEA - USWC	2,610	3,248	3,909	4,604	5,095	5,711
FEA-Pan-USEC	1,490	1,795	2,087	2,389	2,719	3,041
Total Exports Loaded	4,100	5,043	5,996	6,993	7,814	8,752
Incr. Growth Rates	8.0%	4.2%	3.5%	3.1%	2.2%	2.3%
Exports Empty	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
FEA - USWC	2,047	2,572	3,137	3,715	4,061	4,543
FEA-Pan-USEC	979	1,183	1,372	1,565	1,785	2,002
Total Exports Empty	3,026	3,755	4,509	5,280	5,846	6,545
Total FEA Exports	**7,126**	**8,798**	**10,505**	**12,273**	**13,660**	**15,297**
	2025	**2030**	**2035**	**2040**	**2045**	**2050**
Total All FEA TEUs	**20,020**	**25,270**	**29,975**	**34,796**	**39,452**	**44,523**
Incr. Growth Rates	**8.9%**	**4.8%**	**3.5%**	**3.0%**	**2.5%**	**2.4%**

Note: 2025 growth rate calculated as the 3-year increment from observed 2022 data

Table A-15
Worldwide: 25 Inland States Loaded and Empty TEU
Forecast and Incremental Growth Rates (thousands of TEUs)

	2025	**2030**	**2035**	**2040**	**2045**	**2050**
USWC – All States	24,473	30,508	37,048	43,679	48,446	54,208
USEC – All States	25,377	32,117	37,138	42,334	48,896	55,248
Total – All States	49,850	62,625	74,186	86,013	97,342	109,456
Incr. Growth Rates	10.0%	4.7%	3.4%	3.0%	2.5%	2.4%
World-25 State Baseline	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
16,979	**22,580**	**28,366**	**33,602**	**38,959**	**44,091**	**49,577**

Note: World-25 State Baseline first presented in Table 1; 2025 growth rate calculated as the 3-year increment from observed 2022 data

Table A-16
25 Inland States Proportion of Intermodal Rail Capacity 2018 – 2022
(Thousands of Loaded TEUs)

	2018	**2019**	**2020**	**2021**	**2022**
All States Imports	1,584	1,501	1,456	1,337	1,333
All States Exports	4,664	4,583	4,556	5,307	5,637
Total All States	**6,248**	**6,084**	**6,012**	**6,644**	**6,970**
25 States Imports	1,159	1,092	1,060	969	963
25 States Exports TEUs	2,790	2,718	2,699	3,134	3,320
Total 25 States	3,949	3,810	3,759	4,103	4,283
All States 2018 – 2022 Total			**31,959**		
25 States 2018 – 2022 Total			**19,905**		
25 States Proportion			**62.3%**		

Table A-17
Landside Weighted Average Distance Calculations

Location	2022 TEUs	%	Raw Distance		Weighted Avg Distance	
			Coos	USEC	Coos	USEC
Kansas City, MO	333,731	45.0%	2,032	1,133	914.6	509.8
Salt Lake City, UT	99,986	13.5%	1,010	2,219	136.2	299.3
Denver, CO	81,341	11.0%	1,474	1,731	161.7	189.9
Omaha, NE	112,601	15.2%	1,890	1,269	287.0	192.8
Minneapolis, MN	54,844	7.4%	2,060	1,282	152.4	94.8
Des Moines, IA	28,598	3.9%	1,912	1,147	73.7	44.3
Duluth, MN	13,133	1.8%	2,056	1,343	36.4	23.8
Casper, WY	13,166	1.8%	1,201	1,899	21.3	33.7
Reno, NV	1,345	0.2%	536	2,688	1.0	4.9
Albuquerque, NM	1,041	0.1%	1,487	1,853	2.1	2.6
Phoenix, AZ	880	0.1%	1,273	2,268	1.5	2.7
Las Vegas, NV	677	0.1%	971	2,410	0.9	2.2
Tucson, AZ	121	0.0%	1,383	2,228	0.2	0.4
Total	**741,465**	**1**			**1,789**	**1,401**