

Washington State Rail Plan

Technical Note 4a. Freight Forecasts and Capacity Analysis

Final Report

prepared for

Washington State Department of Transportation (WSDOT)

prepared by

Cambridge Systematics, Inc.

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Key Findings

Technical Note 4a: *Freight Forecasts and Capacity Analysis* summarizes the projected future-year (2035) conditions on Washington’s freight rail system. It builds off the findings from Technical Note 3a: *Freight Rail Demand, Commodity Flows and Volumes*; and Technical Note 2: *Freight and Passenger Rail Inventory*. The first part of this technical note is a brief review of market factors that are likely to drive the increase in freight moved by rail. Next, the forecasted 2035 commodity flow profile is presented, including a description of projected inbound and outbound key commodities and volumes.

Finally, high-level rail capacity analysis for a base year (2010) and forecast year (2035) are presented. This broad analysis is meant to show what a future rail system would look like with the anticipated freight and passenger rail¹ growth, if no additional capacity or operational improvements were made. In reality, it is anticipated that the Class I railroads, BNSF Railway (BNSF) and Union Pacific Railroad (UP), will likely address critical freight-related capacity issues as they emerge. Therefore, the 2035 capacity assessment is included here to illustrate the magnitude of growth anticipated for Washington’s rail system, and to underscore the need for continued planning and action to address safety, capacity and mobility concerns throughout the system.

Some of the key findings from this freight, commodity and capacity analysis include the following:

WHAT ARE THE MARKET FACTORS DRIVING FREIGHT GROWTH?

- The two main factors that drive freight growth are population and income. In most cases, increased consumption leads to increased business activity, and greater demands for goods carried into (or out of) Washington on the rail system. By 2040, Washington’s population is anticipated to grow to almost 9 million people—an increase of almost 3 million from 2000. Per capita income is also expected to grow steadily from about \$40,000 in 2013 to almost \$60,000 (in 2005 dollars) by 2040. This increased income is likely to translate into increased demand for consumer goods; some of which are carried into the region via the state’s freight rail network.
- Growing demand from freight intensive industries, such as retail and wholesale trade, municipal solid waste and construction, also can drive freight growth. Washington’s freight intensive industries, as measured by

¹ Passenger rail projected ridership growth by 2035.

labor force forecasts, are projected to grow at a steady rate of about 0.6 percent annually between 2010 and 2035. The fastest growth will occur in transportation and warehousing (22 percent), retail trade (21 percent), construction (16 percent) and manufacturing (15 percent). All of these sectors depend, to some extent, on the rail system for their inbound and/or outbound logistics, and will contribute to demand on Washington's freight rail system.

- Growth in international trade will also drive demand for freight rail, as international trade makes up 29 percent of total rail tonnage in Washington.² Already, export-supported jobs linked to manufacturing account for an estimated 8.6 percent of Washington's total private-sector employment, and about 40.2 percent of all manufacturing workers in Washington depend on exports for their jobs. This sector is anticipated to remain as one of Washington's key economic engines in the future, with aggregate international trade volume projected to grow from 105.7 million tons in 2010 to 190.4 million tons in 2030. This figure may be conservative, since President Obama's export initiative has called for an aggressive increase in exports. This could drive increased demand for rail systems that connect to important export ports, including the Ports of Seattle and Tacoma.
- Implications of not meeting this demand for rail could be significant. For example, the lack of strong rail connections could decrease the attractiveness of Washington ports for discretionary cargo, and could contribute to a loss of competitiveness for the Pacific Northwest ports. Likewise, though many of the products shipped by manufacturing or retail industries could shift to trucking, this would have several negative impacts to the state's economy. Direct and increased transportation costs would in the end be borne by the consumer. These would include not only the generally higher shipping costs associated with motor carriage, but also the indirect effects resulting from increased highway congestion, wear and tear on area roadways, emissions, etc. A 2011 survey of 1,000 private-sector freight-dependent industries found that 56 percent indicated they would pass rising business costs onto the consumer, 6 percent indicated they would be forced to close, 3 percent would relocate, 19 percent would absorb the costs, and 16 percent would make internal operational changes to offset increasing transportation costs.³
- There are several unknown economic variables that are not reflected in the 2035 forecasts, but could, if realized, impact the demand for rail from that

² Federal Highway Administration Freight Analysis Framework Commodity Flows Database Version 3.3 Data. The international trade percentage of the total tonnages (all modes included) was computed excluding the through flows; that is flows neither originating nor terminating in Washington.

³ Washington State University Social and Economic Research Center in 2011.

presented in this technical note. For example, potential new coal exports through terminals located in the Pacific Northwest are not included in the current commodity flow forecast. If completed, this could significantly increase the demands placed on the state's rail system—including its east-west routes as well as the I-5 corridor. Likewise, dry bulk commodities, including potash, ore and other dry bulk cargo demand, are also expected to rise worldwide. Though the commodity forecast in this technical note assumes modest growth in coal and potash, it is possible that the demand will actually be much higher. These uncertainties, as well as fluctuating fuel costs, global supply chain changes and more, could all cause future freight rail volumes to differ from those shown within this technical note.

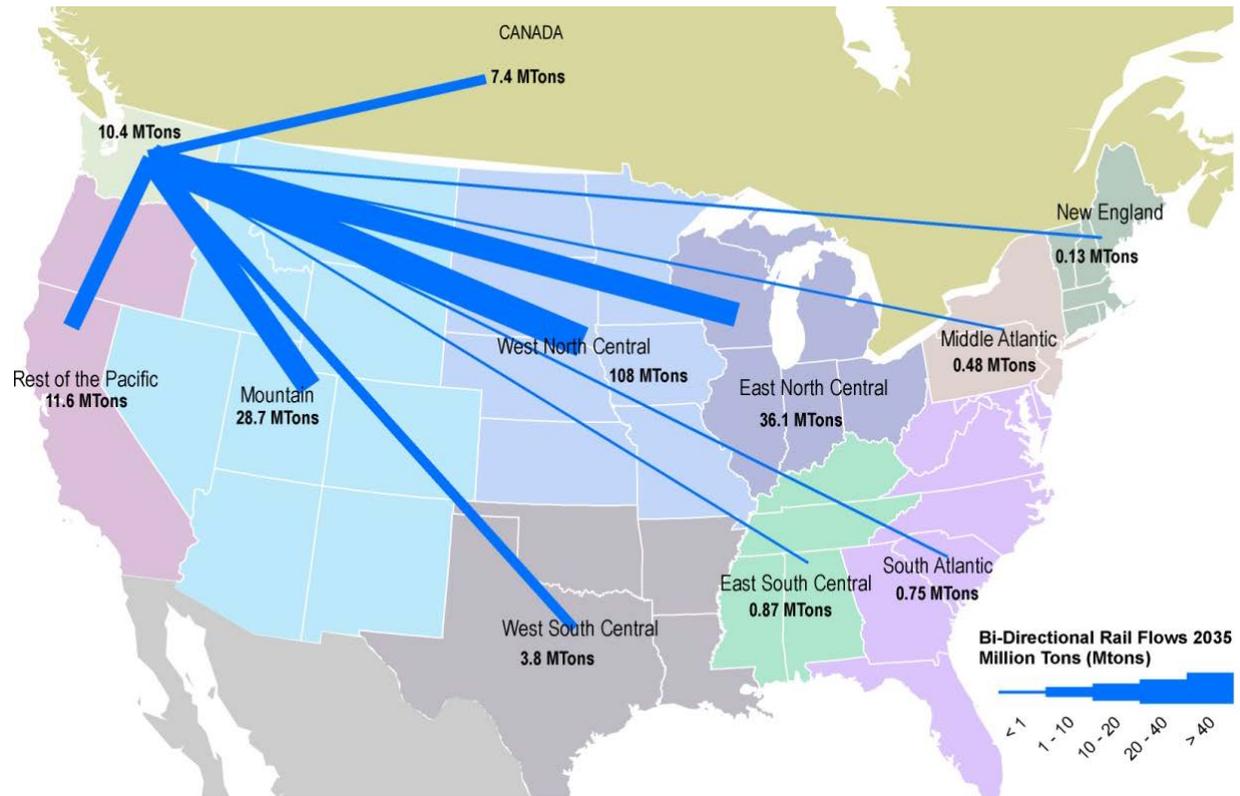
COMMODITY FLOW PROFILE

- The forecast utilized for this study projects that Washington's rail system will have to accommodate approximately 268 million annual tons of cargo by 2035, an increase of 151 million tons and 130 percent from 2010 volumes. This amounts to an average compound annualized growth rate of 3.4 percent. Of the 268 million annual tons, 55 percent of these flows (roughly 148 million tons) are expected to be inbound on the rail system into Washington state, 19 percent (roughly 50 million tons) are expected to move outbound, almost 22 percent (59 million tons) are projected to be through movements, and the remaining 4 percent (11 million tons) are intrastate flows. The growth is projected to be heavily weighted to inbound flows, which are projected to increase 90 million tons, compared to an increase of 50 million tons for outbound movements. This growth appears to be primarily linked to increased exports through Washington and other Pacific Northwest and British Columbia ports, along with increased consumption associated with a growing state population and per-capita income.
- By 2035, Washington's main trading regions⁴ for rail-bound traffic (as shown in Figure 1) are projected to include:
 - The West North Central region of the United States, which includes North and South Dakota, Kansas, Nebraska, Minnesota, Iowa and Missouri, will receive or ship 108 million tons.
 - The East North Central region, which includes Wisconsin, Michigan, Illinois, Indiana and Ohio, will receive or ship 36 million tons.
 - The Mountain region, which includes Montana, Idaho, Nevada, Arizona, Wyoming, Utah, Colorado and New Mexico, will receive or ship 28 million tons.

⁴ Regions are defined by the U.S. Census Bureau, and their boundaries are determined overtime through political, socio-economical and geographical factors.

- Compared to 2010 data, the highest trade growth is projected to occur with the East North Central region, growing at 4.6 percent annually; and West North Central, growing at 4.4 percent annually. (These regions are shown in Figure 1).

Figure 1 Annual Bidirectional Rail Volumes to U.S. Regions, 2035



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

- Rail service composition⁵ in 2035 is anticipated to remain similar to that of 2010, with the fastest growth experienced in intermodal (5.0 percent annually) and bulk-other (4.3 percent) service types. However, as mentioned in Technical Note 3a, intermodal has considerably less physical density than the major bulk commodities, such that equivalent growth in intermodal tonnage will produce far higher unit growth than the same increase in bulk tonnage. In fact, in terms of carload equivalents of traffic, intermodal service type makes up a majority (66 percent) of the total carloads for commodity flows in Washington, followed by bulk-other, general merchandise, bulk-coal

⁵ For definitions of the rail service types, please see Technical Note 3a: *Freight Rail Demand, Commodity Flows and Volumes*.

and assembled motor vehicle service types, each accounting for 17 percent, 13 percent, 3 percent and 1 percent of the total carloads, respectively.

- In 2035 top commodities carried by rail inbound to Washington are projected to be dominated by agricultural products (about 53.3 million tons or 36 percent of the total) and cereal grains (about 48.6 million tons or 33 percent of the total). Other commodities will include coal (about 11.4 million tons or 8 percent of the total), mixed freight (about 7.4 million tons or 5 percent of the total), and animal feed products (about 4.6 million tons or 3 percent of the total). These commodities point to the fact that bulk carload and container freight will dominate freight movement in the future. As noted previously, this forecast is based on existing operating and economic conditions. Other trends could change the volumes or types of commodities carried inbound to Washington. For example, the development of coal ports or increased U.S.-based manufacturing could substantially change the 2035 commodity flow from what is projected in this technical note.
- In 2035 outbound commodities carried by rail in Washington are projected to include mixed freight (e.g. intermodal, about 29.1 million tons or 59 percent of the total), waste and scrap (about 4.6 million tons or 9 percent of the total), wood products (about 2.5 million tons or 5 percent of the total), and pulp and paper products (about 2.4 million tons or just under 5 percent of the total).

VOLUME AND CAPACITY ASSESSMENT

- The growth in freight train volumes on Washington's rail network is projected to vary throughout the system. For example, BNSF's Spokane-Sandpoint, Idaho corridor is projected to see an increase of 66 trains from 2010 conditions, while BNSF's Bellingham to Everett segment is projected to see an increase of only eight trains from 2010 conditions.
- Not included in the volume projections is any volume resulting from the development of new bulk export terminals in the Pacific Northwest. These developments could add additional daily train traffic over and above what is shown in this memo. For example, the Gateway Pacific Terminal west of Burlington is projected to increase by nine trains per day on the Burlington to Everett track segment (each one arriving full and leaving empty for the return trip).⁶ BNSF traffic will flow through Washington state irrespective of whether the terminal(s) are located in Washington, Oregon or British Columbia. If handled by UP, traffic destined for export terminals in Washington and British Columbia would travel through Washington state.

⁶ Gateway Pacific Terminal Website: <http://gatewaypacificterminal.com/the-project/f-a-q/>.

- Based on the 2010 capacity estimates, there were no recognized capacity constraints on Washington's rail system in 2010; the highest utilization was on BNSF's Pasco-Spokane segment at about 87 percent, followed by BNSF's Portland-Pasco segment of about 70 percent.
- Since 2012 BNSF's directional running of empty eastbound bulk trains on the Stampede Pass route (Auburn-Pasco via Yakima), with the Fallbrook (Pasco-Vancouver) and Seattle subdivisions handling the loaded trains, has substantially increased rail capacity over the previous bidirectional rail operation. For Stampede Pass, capacity has increased from about ten trains per day to 39 trains per day. Therefore, the use of this route is one of the lowest, both in the current and future years. The other subdivisions affected by this change, Fallbrook and Seattle subdivisions, have also gained capacity through this change, but to a lesser degree.
- In 2035 several rail segments are projected to become capacity constrained, if no additional improvements or capacity enhancements are made. These include Pasco-Spokane (about 174 percent); Seattle-Spokane via Wenatchee (about 157 percent); Spokane-Sandpoint, Idaho (about 152 percent); and Portland-Pasco (about 141 percent). Seattle-Portland and Everett-Burlington are just at the 100 percent utilization mark (105 percent and 100 percent, respectively), making it difficult to handle variations or additional traffic without adding excessive delays. All of these segments handle passenger train traffic, and thus will be affected if capacity is not sufficiently improved.

1.0 Introduction

Technical Note 4a: *Freight Forecasts and Capacity Analysis* summarizes the projected future-year (2035) rail commodity flow profile for Washington state. It builds off the findings from Technical Note 3a: *Freight Rail Demand, Commodity Flows and Volumes*. Technical Note 3a analyzed current (2010) rail commodity flows, rail volumes and trading partners. This report will discuss the freight commodities projected to move on the state's rail system by 2035. It also discusses projected freight train volumes by major commodity and business line in 2035 and identifies potential rail system capacity constraints and issues.

The first part of this technical note is a brief review of some of the market factors that are likely to drive the increase in freight moved by rail. Next, the forecasted 2035 commodity flow profile is presented, including a description of projected inbound and outbound key commodities and volumes. Finally, a high-level capacity assessment for 2010 and 2035 conditions is presented. The 2010 assessment is provided as a baseline, while the 2035 assessment shows the impact of projected 2035 freight and passenger rail volumes on today's infrastructure. The 2035 capacity assessment is included here to illustrate the magnitude of growth anticipated for Washington's rail system, and to underscore the need for continued planning and action to address safety, capacity and mobility concerns throughout the system.

This document is organized into the following sections:

- **Section 2.0** summarizes the key **market factors driving freight growth**, including growing population, per capita income, employment and international trade.
- **Section 3.0** presents the future freight rail **commodity flow profile**, including inbound and outbound commodity growth since 2010, import and export growth since 2010, and flows to different trading regions within the United States projected for 2035.
- **Section 4.0** presents a 2010 and 2035 **capacity assessment**, which are high-level overviews of the baseline (2010) and future year (2035) rail system capacity against expected rail traffic.

2.0 Market Factors Driving Freight Growth

By 2035 it is projected that 268 million tons of freight will move by rail into, out of, within or through Washington. This represents an increase of almost 132 percent from 2010 (when roughly 116 million tons of goods were moved).⁷ This commodity growth forecast was created from several different data sources, including the 2010 Surface Transportation Board Confidential Carload Waybill Sample data, as well as the growth rates from the Federal Highway Administration (FHWA) Freight Analysis Framework Version 3.3 (FAF3.3) commodity flow database.⁸

The projected growth is consistent with several macroeconomic trends that are briefly described below, including Washington's population growth, overall economic growth and the continued importance of international trade and global supply chains to Washington's economy. This section will review some of these trends in order to set Washington's 2035 demand forecasts in context.

2.1 WASHINGTON'S PROJECTED POPULATION AND INCOME GROWTH

Population Growth

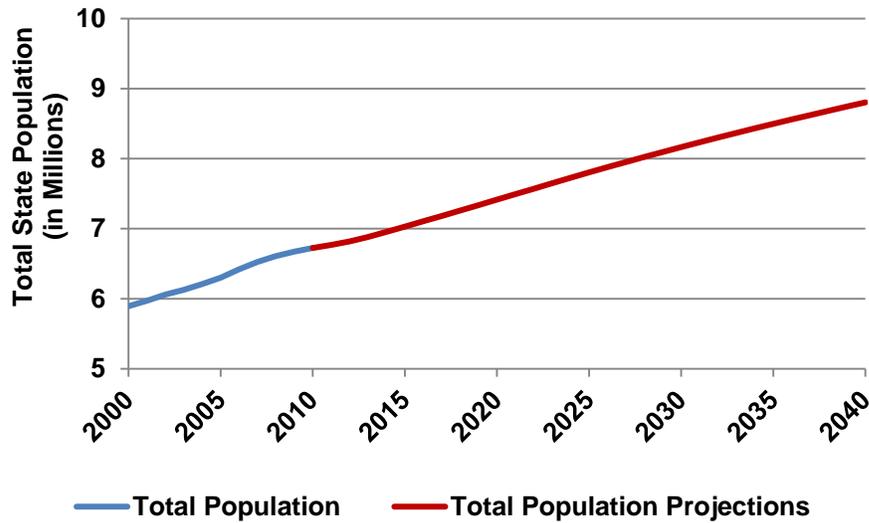
Two of the main predictors of demand of goods movement are population and income, since increased goods movement generally corresponds to increased consumption and business activity from population growth and spending power. Washington is rapidly increasing in both. In fact, by 2040, Washington's population is anticipated to grow to almost 9 million people—an increase of almost 3 million from 2000.⁹ This historic and projected growth is shown in Figure 1.

⁷ See Appendix A – Data and Methodology for 2035 Freight Forecasting for Washington State.

⁸ More information about these data sources and freight rail flows forecasting is provided in Sections A.1 and A.2 of Appendix A.

⁹ U.S. Census, Washington State Office of Financial Management.

Figure 2.1 Washington’s Projected Population Growth, 2000 to 2040



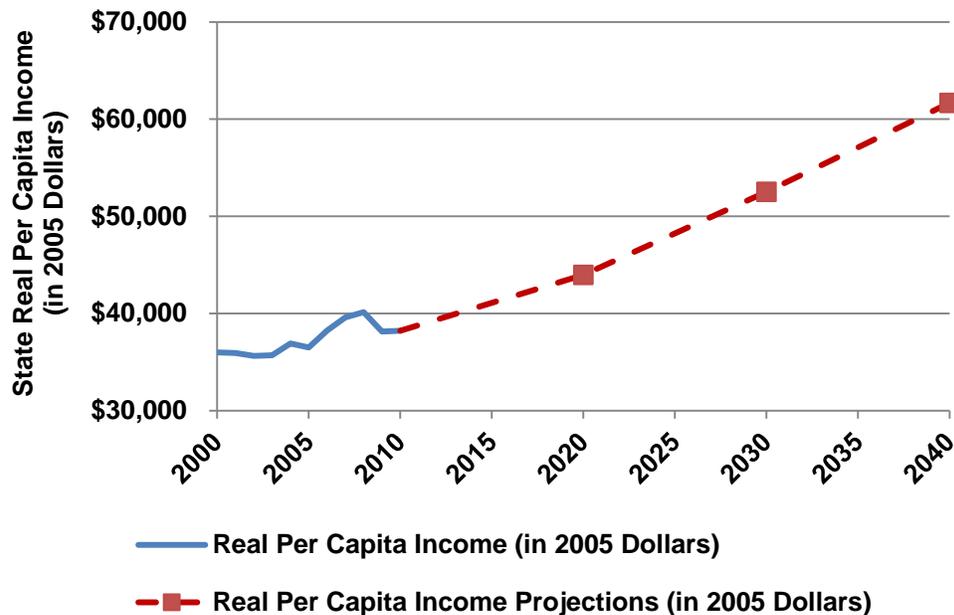
Source: Washington State Office of Financial Management, Forecasting Division, March 2012.

Washington’s Per Capita Income Growth

Another strong indicator for increasing freight demand is per capita income. Despite a slight dip in income growth between 2008 to 2010 (Figure 2.2), incomes are projected to rise steadily, from about \$40,000 in 2013 to about \$60,000 (in 2005 dollars) by 2040.¹⁰ Growing incomes, in general, translate to increased consumption of items, including consumer products, food, housewares, textiles and other goods and services. And, as will be explained in a later section of this technical note, some of the commodities expected to experience the greatest proportion of growth are mixed freight categories, generally consisting of consumer products shipped in containers. Thus, Washington’s predicted income and population trends are consistent with the predicted rise in consumer products shipped by rail by 2035.

¹⁰ Washington State Office of Financial Management, Forecasting Division, March 2012.

Figure 2.2 Washington's Per Capita Income Growth, 2000 to 2040



Source: Washington State Office of Financial Management, Forecasting Division, March 2012.

2.2 WASHINGTON'S EMPLOYMENT TRENDS

Labor Force Growth

Another factor that affects demand for freight rail is the growth (or decline) of freight intensive industries like manufacturing, agriculture, retail and wholesale trade, and transportation and warehousing. Rail service is a critical part of the supply chains of these industries, since it enables them to ship heavy or bulk commodities over long distances at relatively low costs. Therefore, growth in the demand for freight transportation will generally track the growth trends in these freight intensive industries. Employment trends are a key indicator, as employment usually directly correlates with output.

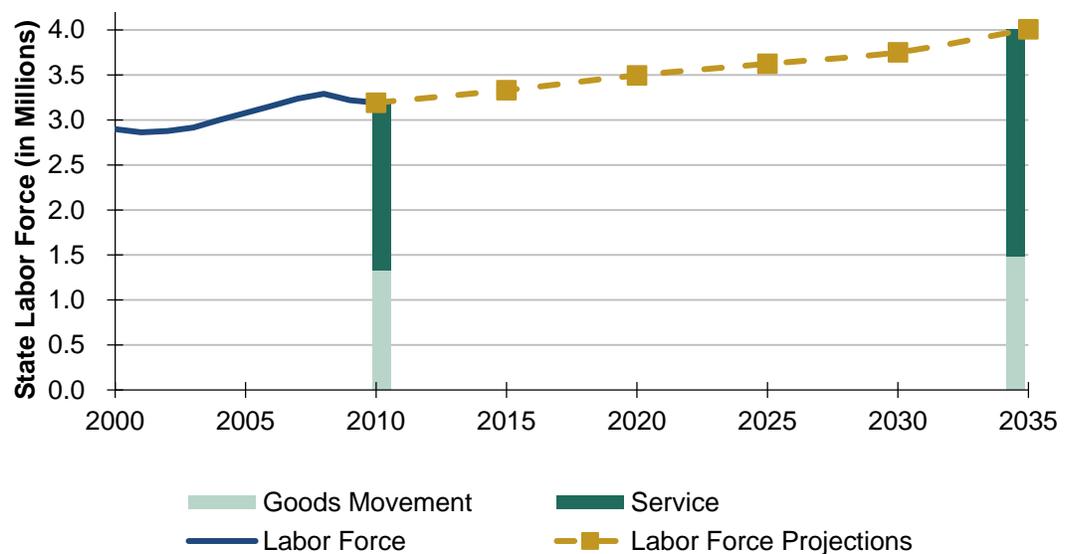
As shown in Figure 2.3, Washington's aggregate labor force¹¹ grew by about 10 percent from 2000 to 2010, or about 1.0 percent annually.¹² Between 2010 and 2035, the labor force is anticipated to continue to grow, at about 0.9 percent annually. Roughly 36 percent of this employment (1.5 million jobs) will be

¹¹ The labor force includes all people employed in all sectors in Washington, including farming.

¹² Washington State Office of Financial Management, Forecasting Division, March 2012.

concentrated in freight intensive industries, including farming. The remaining 1.9 million jobs will be located in the service sector. Though service jobs rely on a certain amount of goods movement—for example, to deliver office supplies, paper or furniture—they differ from freight intensive industries in that they generally do not ship and/or receive a substantial volume of freight to support their daily operations. The growth in employment in freight intensive industries signifies healthy, growing industries that will help drive demand for freight rail.¹³

Figure 2.3 State Labor Force Projections for Washington, 2000 to 2035



Source: Washington State Office of Financial Management, Forecasting Division, March 2012.

Taking a closer look at employment growth in freight intensive industries shows that employment growth will be largest in retail trade, manufacturing, construction, and transportation and warehousing (Figure 2.4). Between 2010 and 2035, employment in freight intensive sectors (not including agricultural production)¹⁴ is anticipated to grow from 1.02 million (in 2010) to about 1.17 million in 2035. Two of the fastest growing subsectors among the freight intensive industries will be aerospace (projected to grow by 100,000 jobs, or

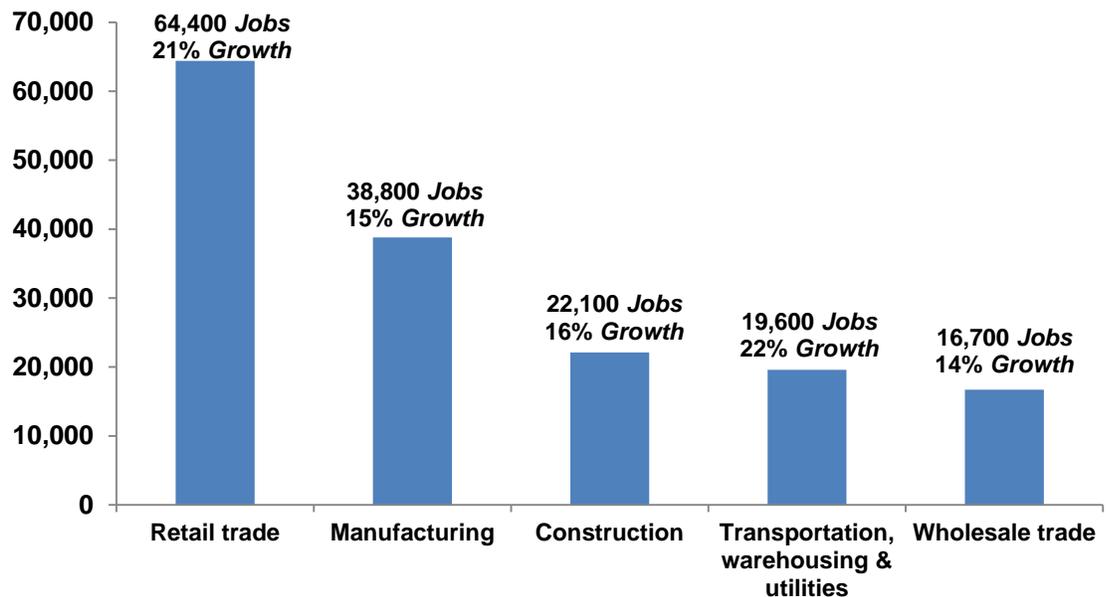
¹³ U.S. Bureau of Labor Statistics' "Economy at a glance" web site for Washington: www.bls.gov/eag/eag.wa.htm.

¹⁴ Farming data is not available at the disaggregated level.

24 percent) and food manufacturing (which is anticipated to grow by 7,200 people or 21 percent) by 2035.

The direct correlation between output and employment weakens over time, with growth in output typically exceeding employment growth. This is due to productivity gains, which occur in most industries over time, through the adoption of improved processes, and the substitution of capital for labor.

**Figure 2.4 Employment Trends of Key Freight Intensive Industries
2010 to 2035**



Source: Washington State Office of Financial Management, Forecasting Division, March 2012. Employment forecasts for farming and forestry are not available, hence, not included in Figure 2.4.

Although employment in the major freight intensive sectors shown in Figure 2.4 is projected to grow through 2035, some sectors will see declines. For example, paper and paper products, printing and related, primary metals and wood products will together account for a loss of about 8,900 jobs, which is about 0.8 percent of total non-agricultural employment in 2035. However, relatively high projected growth in freight intensive industries, such as retail trade and manufacturing, will offset the projected employment decline in these industries and generate an overall positive employment picture for Washington in the future. Furthermore, sectors showing stable or modest declines in employment may still experience growth in freight volumes, on account of productivity improvements and production shifts.

2.3 INTERNATIONAL TRADE GROWTH

As stated in Technical Note 3a, international trade is a vital industry in Washington. Export-supported jobs linked to manufacturing account for an estimated 8.6 percent of Washington’s total private-sector employment,¹⁵ and it is estimated that “two-fifths (40.2 percent) of all manufacturing workers in Washington depend on exports for their jobs.”¹⁶ In addition, international trade is one of the main drivers of freight rail demand. By 2035, international trade is likely to be responsible for approximately 78 million tons of goods carried by Washington’s Class I railroads—or roughly 29 percent of the total rail tonnage.¹⁷

International trade is anticipated to grow substantially in the future. As shown in Table 2.1, aggregated volumes of bulk and break-bulk (non-containerized) traffic is projected to grow from 109.1 million tons in 2010 to between 189.1 million tons (under a “moderate” forecast) and 272.9 million tons (under a “high” forecast) by 2030. This “moderate” forecast includes roughly one-half of the market opportunities currently under consideration by Washington seaports and associated industries, while the “high” forecast includes all of the market opportunities under consideration. Market opportunities include a wide range of projects—for example, the high growth forecast for grain and related projects is dependent on the potential realization of new grain elevators in Portland, Kalama, Grays Harbor, Cherry Point and Vancouver, WA. Likewise, the high growth forecast for liquid bulk is dependent on whether crude oil commences railed shipments from North Dakota to replace some of the current waterborne volumes in the future.

Regardless of whether the “moderate” or “high” forecast is realized, both scenarios are driven by increasing dry bulk cargoes and exports of dry bulk, such as grain, minerals, ores and other bulk commodities;¹⁸ most of which are compatible with rail. Each of the cargo categories is discussed in the sections following the table.

¹⁵ www.trade.gov/mas/ian/statereports/states/wa.pdf.

¹⁶ www.trade.gov/mas/ian/statereports/states/wa.pdf.

¹⁷ FHWA FAF3.3 Data.

¹⁸ BST Associates and MainLine Management, Pacific Northwest Marine Cargo Forecast Update and Rail Capacity Assessment, Final Report, December 2011.

Table 2.1 Marine Cargo Growth Forecasts, 2030

Category	Base Year	Moderate Growth Forecast ^a		High Growth Forecast ^b	
	2010	2030	Compound Annual Growth Rate 2010-2030	2030	Compound Annual Growth Rate, 2010-2030
By Commodity (includes all regions)					
Containers (Million TEUs) ^c	3.7	8.3	4.1%	12.3	6.2%
Break-Bulk/Neo-Bulk (Million Tons)	8.3	10.5	1.2%	12.7	2.2%
Grain and Related Products (Million Tons)	34.0	39.1	0.7%	53.3	2.3%
Dry Bulk Cargoes (Million Tons)	26.0	97.1	6.8%	155.3	9.3%
Liquid Bulks (Million Tons)	40.7	42.4	0.2%	51.6	1.2%
By Region (includes all commodities, containerized, bulk and other)					
Lower Columbia Washington Cargo Total (Million Tons)	21.3	49.4	4.3%	82.5	7.0%
Puget Sound and Washington Coast Cargo Total (Million Tons)	84.4	141.0	2.6%	192.3	4.2%
SUB-TOTAL	105.7	190.4		274.8	
Lower Columbia Oregon and Oregon Coast Cargo Total (Million Tons)	26.7	44.6	2.6%	70.5	5.0%
TOTAL	132.4	235.0		345.3	

Source: Pacific Northwest Marine Cargo Forecast Update and Rail Capacity Assessment, December 2011.

^a The moderate growth forecast included a portion of the market opportunities (approximately one-half) currently under consideration by the Washington seaports of the Pacific Northwest Rail Coalition.

^b The high growth forecast included all of the market opportunities currently under consideration by the Washington seaports of the Pacific Northwest Rail Coalition.

^c TEU – twenty-foot equivalent units.

Containerized Freight

The deep-water ports in Washington provide vital links that connect the Pacific Coast of the United States to Asian markets and Alaska, in particular to the thriving containerized consumer product trade. As discussed in Technical

Note 2: *Freight and Passenger Rail Inventory*, a substantial portion of imported cargoes reach inland destinations by rail. Thus, increases in container import demand directly relates to the growth in freight rail volumes. Container volumes are measured in 20-foot equivalent units (TEU), a standard size that corresponds to one 8.6-foot by 20-foot container.¹⁹ In 2010, 3.7 million TEUs were imported into or exported out of Washington’s ports. This amount is anticipated to grow to 8.3 million TEUs in the “moderate” estimate, and 12.3 million TEUs in the “high” estimate;²⁰ however, this is unlikely to be realized given current trends. This growth will be driven by factors, including growing population, income and industries, but tempered by potential increased competition from Canadian ports, and potential diversion to East Coast ports once the upgraded Panama Canal is in active use.

Break-Bulk/Neo-Bulk

Break-bulk cargo is noncontainerized, general cargo stored in boxes, bales, pallets or other units.²¹ In Washington, much of the break-bulk cargo handled includes iron, steel, machinery, logs and woodpulp. Closely related is neo-bulk cargos, which are uniformly packaged goods (such as woodpulp bales) that can be stowed as solidly as bulk commodities, but are handled as individual items.

The “moderate” forecast (totaling 10.5 million tons in 2030) and the “high” forecast (12.7 million tons) are both predicated in part on a resumption of growth in domestic construction, which will have a dampening effect on lumber and log exports. Thus, under the “high” forecast, break-bulk and neo-bulk volumes are expected to remain at higher levels than is the case with the “low” forecast.

Export Grain

Grain and related products (including wheat, barley, soybeans and similar products) headed for export are expected to remain strong, with projected volumes of 39.1 million tons by 2030 under the “moderate” growth forecast (about 21 percent of all “moderate” forecast tonnage), and 53.3 million tons under the “high” growth forecast (about 20 percent of all “high” forecast tonnage). The new Export Grain Terminal²² elevator in Longview began operations in February 2012, with a focus on handling the export of Washington wheat, corn, soybeans and other products to Asian marketplaces. Other expansion projects are planned or underway in Portland, Kalama and

¹⁹ Note that many of the containers seen on docks or carried by rail are actually 40-foot containers, which are equal to two TEUs.

²⁰ Pacific Northwest Marine Cargo Forecast Update and Rail Capacity Assessment, December 2011.

²¹ www.aapa-ports.org.

²² www.egtgrain.com.

Vancouver, WA. Combined, these elevators are expected to provide most of the capacity needed to absorb the anticipated future growth. Increased capacity also is being added at the Ag Processing, Inc. facility at the Port of Grays Harbor, and the proposed bulk port at Cherry Point (discussed in the following section) north of Bellingham may include a grain facility.

Most of the grain processed through these facilities is carried by rail, including the 118 cars that are currently operated as part of the state's "Grain Train" (operated jointly by the Washington State Department of Transportation and the Ports of Walla Walla, Moses Lake, and Whitman County). This program, alone, has delivered 1.2 million tons of grain from Washington farmers to national and international markets since 1994.²³

Dry Bulk Cargoes

Dry bulk cargoes, driven by growing overseas demand for potash, ore, coal and other bulk commodities, are projected to be the most rapidly growing category of waterborne freight. According to the *Pacific Northwest Marine Cargo Forecast Update and Rail Capacity Assessment*, the U.S. and Canada have substantial supplies of these key commodities that can be delivered through the Washington seaports at a competitive price. Thus, both the "moderate" forecast (97.1 million total tons in 2030) and the "high" forecast (155.3 million tons) reflect increasing overseas demand for a variety of dry bulk cargoes. These cargoes are anticipated to contribute to an increase in freight rail volumes, given their high suitability for rail transport and geographic sourcing in the upper Great Plains, Wyoming and Montana.²⁴

Several market trends and potential infrastructure developments could drive the demand for dry bulk commodities even higher than the "high" forecast. Most notable are current developments in the coal markets. The largest coal producing region in the U.S. has long been Wyoming's Powder River Basin (PRB). PRB coal, while consistently being the least expensive to produce on a global scale, has low energy content (and thus is not suitable for metallurgical applications); and is distant from major overseas markets. This may be about to change, due to potential shifts in Asian markets, and China in particular. China has been sourcing coal from its own fields, followed by imports from Indonesia, Vietnam and Australia. Domestic and international suppliers have had some difficulties in meeting the growing demand, with the result that Chinese and other Asian power producers are looking to diversify their sourcing by purchasing PRB coal.

How large this opportunity is likely to be remains to be seen, particularly given the far higher transportation costs associated with hauling coal across the Pacific

²³ www.wsdot.wa.gov/Freight/Rail/GrainTrain.htm.

²⁴ www.wsdot.wa.gov/NR/rdonlyres/E1743FB8-9376-4A4C-8316-14283E42A5F7/0/PNW2011PortRailForecastFinalReport.pdf.

Ocean versus existing suppliers. However, exports of PRB coal already occur through the Westshore Terminal at Roberts Bank near Vancouver, British Columbia. BNSF currently handles this traffic on routes that cross Washington state.

Currently, there are several proposals in consideration to increase port capacity in the Pacific Northwest to help link this supply with demand. Two potential sites in Washington are currently being considered for development:

1. **Gateway Pacific Terminal at Cherry Point (Carrix/SSA Marine, Peabody Energy).** The terminal would be located at Cherry Point, about 17 miles south of the Canadian border. It has naturally deep water that will accommodate ships without the need for dredging. This terminal is proposed to be a multi-commodity, dry bulk cargo-handling facility to be built on nearly 1,500 acres of land in Whatcom County, Washington.²⁵ It will be capable of handling up to 54 million dry metric tons of bulk commodities, mostly exporting coal.²⁶
2. **Millennium Bulk Terminal at Longview (Ambre Energy, Arch Coal).** This is a proposed terminal at the site of the former Reynolds Aluminum smelter in Cowlitz County. The terminal would be capable of receiving, stockpiling, blending and loading coal by conveyor onto ships for export. The project will be developed in two stages. Under Stage 1 plans, up to 25 million metric tons of coal would be handled and under Stage 2, the maximum would increase to 44 million metric tons of coal.²⁷

In addition to these two sites, other locations in the U.S. and British Columbia are also being evaluated. The development of these coal ports, or any coal port within the U.S. or southern British Columbia, would lead to increased train volumes in Washington. More information is expected to emerge from the feasibility studies planned for 2013 and later. As of January 2013, an environmental impact study is underway for the Gateway Pacific Terminal.²⁸ Preliminary estimates are that at full build out, the Gateway Pacific Terminal would generate nine additional trains per day on the Seattle to Everett track segment (each one arriving full and leaving empty for the return trip).²⁹

²⁵ <http://gatewaypacificterminal.com/the-project>.

²⁶ www.ecy.wa.gov/geographic/gatewaypacific/.

²⁷ www.ecy.wa.gov/geographic/millennium/index.html.

²⁸ Ibid.

²⁹ Gateway Pacific Terminal Website: <http://gatewaypacificterminal.com/the-project/f-a-q/>.

Liquid Bulk Cargoes

Liquid bulk in Washington is comprised mainly of petroleum products (including crude oil and refined petroleum), as well as some fertilizer and chemicals. Among the major bulk commodity categories analyzed in the *Marine Cargo Forecast Update*, growth in volume between 2010 and 2030 is expected to be weakest. The “moderate” forecast (totaling 42.4 million tons in 2030) and the “high” forecast (51.6 million tons) both assume that crude oil shipments from Alaska will decline. However, these may be replaced by railed shipments of crude oil from the Bakken shale oil formation in North Dakota, Saskatchewan and other Northern Plains states. As this is written, distribution patterns associated with this product are rapidly evolving. Long a commodity almost solely handled by pipeline, the development of new fields with insufficient pipeline infrastructure has led to a rethinking of the crude oil supply chain. Although rail transportation is more expensive than pipeline, it offers far more flexibility in accessing markets, and an ability to exploit differences in prices. Thus, it has been economically efficient to transport crude oil from North Dakota to Washington refineries by rail. In the future, it is possible that this crude could also be exported to foreign refineries through Washington ports.

In addition, the “high” forecast recognizes potential new developments to export this oil, such as the proposed Hoquiam crude oil export terminal, and the Coos Bay (Oregon) liquefied natural gas export terminal. This terminal received permission to export natural gas in 2011, but is still under development as of early 2013.³⁰

³⁰ www.jordancoveenergy.com/

3.0 Commodity Flow Profile

By 2035 it is projected that 268 million tons of cargo will move by freight rail into, out of, within or through Washington. This represents a growth of almost 132 percent (or about 3.4 percent compound annual growth rate) from 2010, when almost 116 million tons of goods were moved. This section discusses the types of goods that make up the future rail flows, as well as projected future rail commodity tonnages. The translation of tonnages into train volumes will be the focus in Section 4.0 of this technical note.

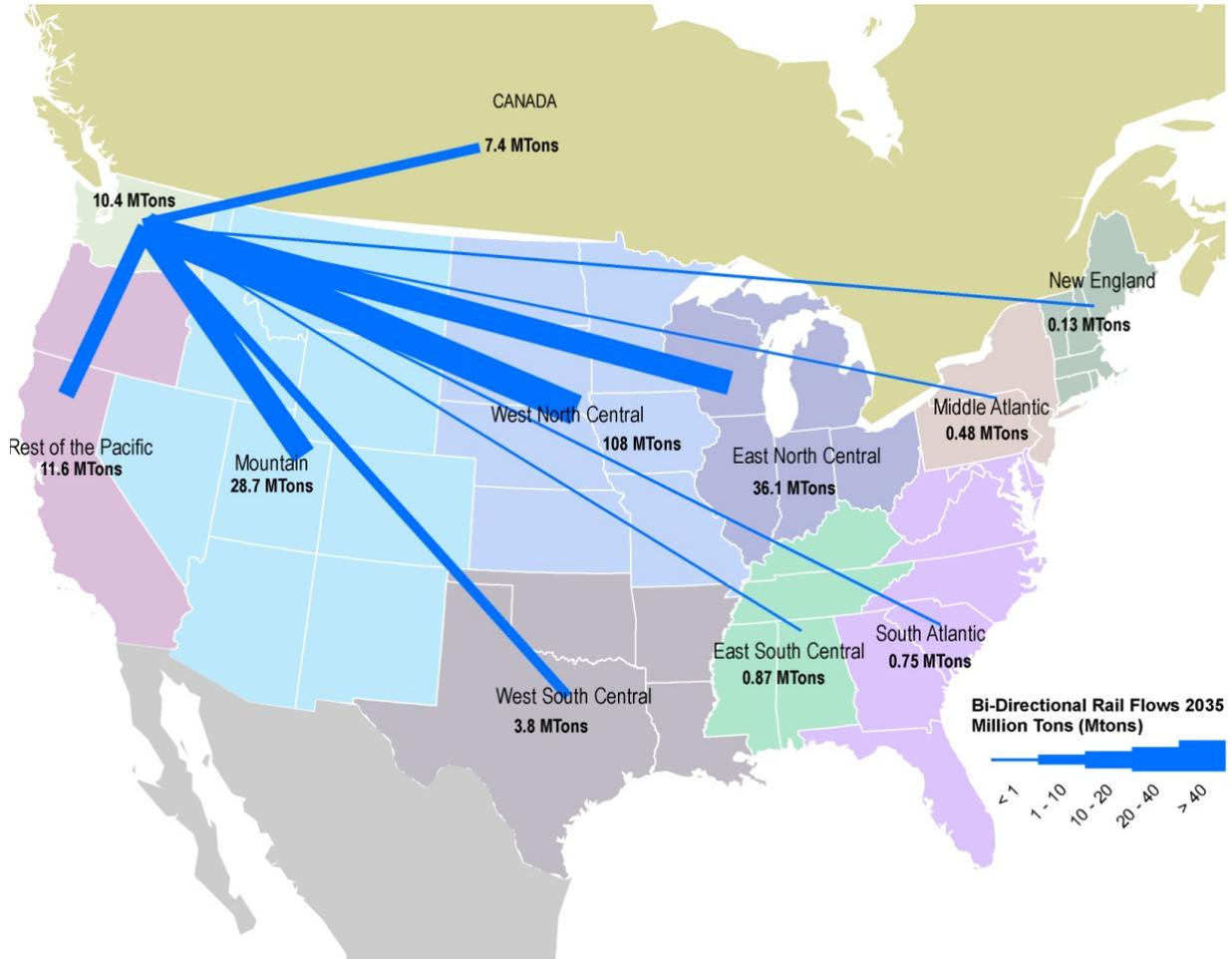
Data sources used to compute the tonnages include the 2010 Surface Transportation Board (STB) Confidential Carload Waybill Sample data for Washington and the growth factors from the Federal Highway Administration (FHWA) Freight Analysis Framework Version 3.3 (FAF3.3) commodity flow database. More information about these data sources and freight rail flows forecasting is provided in Sections A.1 and A.2 of Appendix A.

3.1 WASHINGTON'S RAIL TRADING PARTNERS

A map of key trading regions with Washington helps to set the context for the commodity flow profile. The term “trading partner” (as shown in Figure 3.1) is used here to describe bidirectional rail volumes moving between Washington and different U.S. regions.³¹ In comparison with the 2010 data (see Figure 3.2), volumes of trade between Washington and its trading partner regions are projected to increase for a majority of these partners.

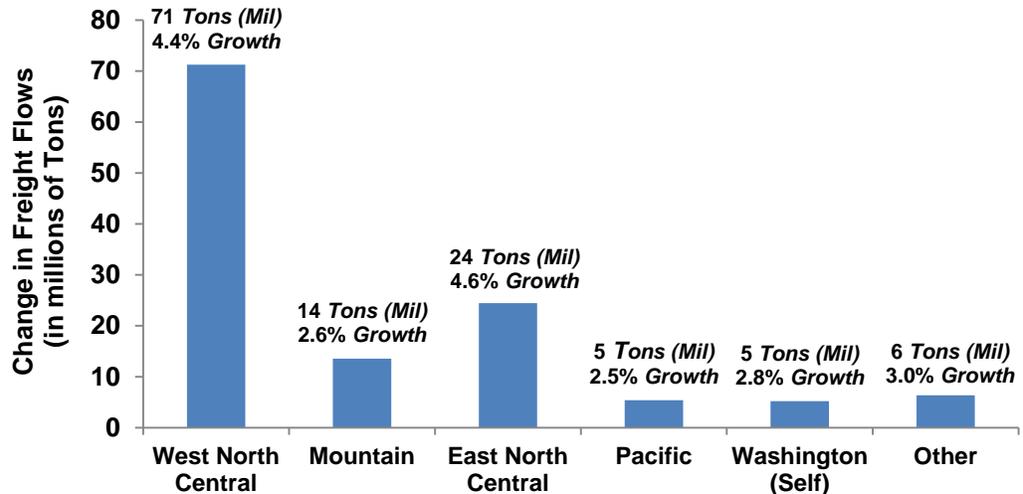
³¹ The U.S. regions are loosely based on the geographic regions defined by the TRANSEARCH commodity flow dataset. They are not formalized definitions, they merely are a way to group states that tend to have similar types of commodity movements inbound to and outbound from each region.

Figure 3.1 Annual Bidirectional Rail Volumes to U.S. Regions, 2035



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

Figure 3.2 Washington’s Commodity Flows by U.S. Region, 2010 to 2035
In Millions of Tons



Source: Cambridge Systematics’ 2035 Freight Rail Flows Forecasting.

Note: The numbers in Figure 3.2 represent changes in freight flows between 2010 and 2035. The growth is also expressed as a compound annualize growth rate between these years. The tons included belong to inbound, outbound, and intrastate flows only.

Three regions, in particular, are forecast to have the most substantial commodity volume trade with Washington by 2035:

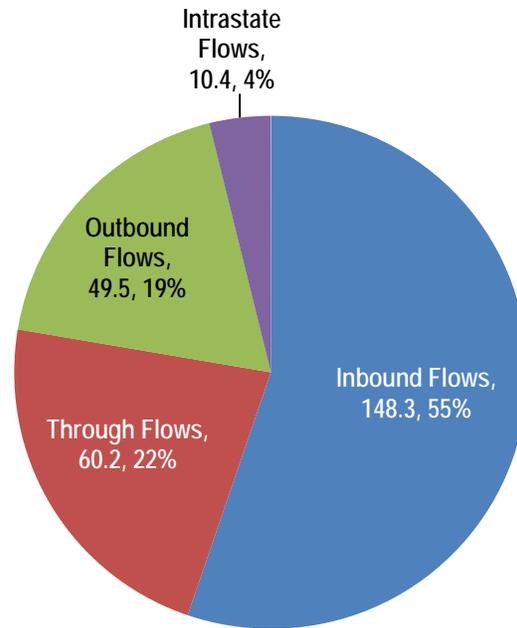
- The West North Central region (108 million tons, about 52 percent) includes North and South Dakota, Kansas, Nebraska, Minnesota, Iowa and Missouri. Growth between Washington and this region is expected to be driven by grain trade, as well as mixed freight and some wood and paper products.
- East North Central region (36 million tons, about 17 percent), which includes Wisconsin, Michigan, Illinois, Indiana and Ohio. Growth between Washington and this region is expected to be driven by mixed freight, as well as some agricultural and cereal products (including corn, soybeans and seed).
- Mountain region (29 million tons, about 14 percent) includes Montana, Idaho, Nevada, Arizona, Wyoming, Utah, Colorado and New Mexico. Growth between Washington and this region is expected to be driven by coal, cereal grains and other agricultural products (including corn, soybeans and seed).

3.2 2035 INBOUND, OUTBOUND, INTRASTATE, AND THROUGH COMMODITY MOVEMENTS

Rail movements are classified into inbound, outbound, intrastate, and through flows. Inbound flows originate somewhere outside of Washington and terminate within the state. Examples include assembled automobiles shipped by rail from Michigan to Washington, for sale within the state. They also include commodities, such as grain, that may come into Washington from the Midwest for export through a Puget Sound deep-water port. Outbound flows originate in Washington with a destination outside of the state. Examples include goods arriving at Washington's ports from Asia with a Midwest destination, as well as products manufactured in Washington being transported to markets throughout North America. Intrastate moves originate and terminate within Washington. Examples of intrastate moves are shipments of grain that originate in eastern Washington and are destined for export at a Washington deep-water port. Finally, through flows are those that travel through the state, for example a rail shipment moving over BNSF Railway between North Dakota and Portland, Oregon, which would travel through Washington state. The composition of each type of movement is shown in Figure 3.3, and the growth rate between 2010 and 2035 is shown in Figure 3.4. Each type of flow is discussed more in the following sections.

The total annual rail flows are shown in Figure 3.3, with growth rates shown in Figure 3.4. As shown in Figure 3.4, all types of movements are projected to increase between 2010 and 2035. Inbound flows are projected to grow the fastest, and reach 148 million tons by 2035 (55 percent of total 2035 flows). Through flows will total 60 million tons (22 percent of the total), and outbound flows will total 50 million tons (19 percent of the total). Intrastate moves will comprise about 10 million tons (4 percent of the total).

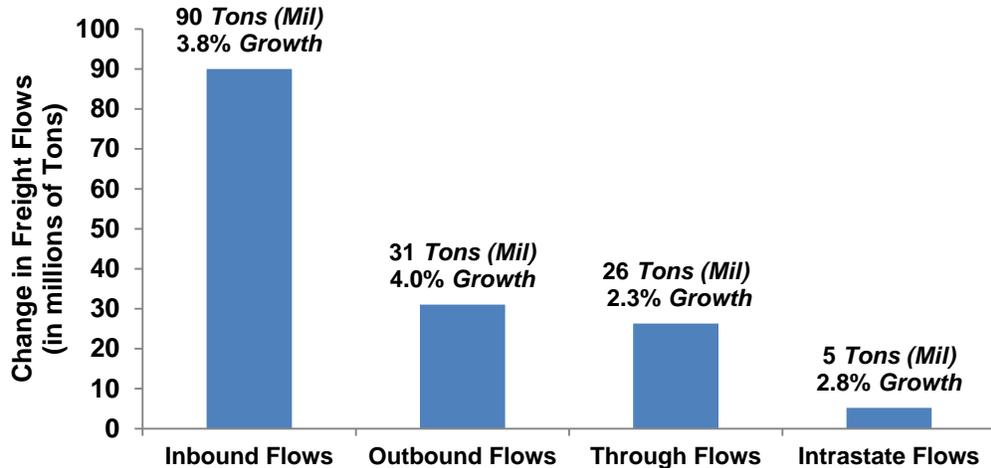
Figure 3.3 Inbound, Outbound, Intrastate and Through Movements, 2035
In Millions of Tons



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

Note: **Inbound Flows:** rail movements that terminate in Washington, but do not originate in Washington; **Outbound Flows:** rail movements that originate in Washington, but do not terminate in Washington; **Through Flows:** rail movements that neither originate nor terminate in Washington; and **Intrastate Flows:** rail movements that both originate and terminate in Washington.

Figure 3.4 Projected Growth in Washington’s Rail Tonnage, 2010 to 2035
In Millions of Tons and Compound Annual Growth Rate (CAGR)



Source: Cambridge Systematics’ 2035 Freight Rail Flows Forecasting.

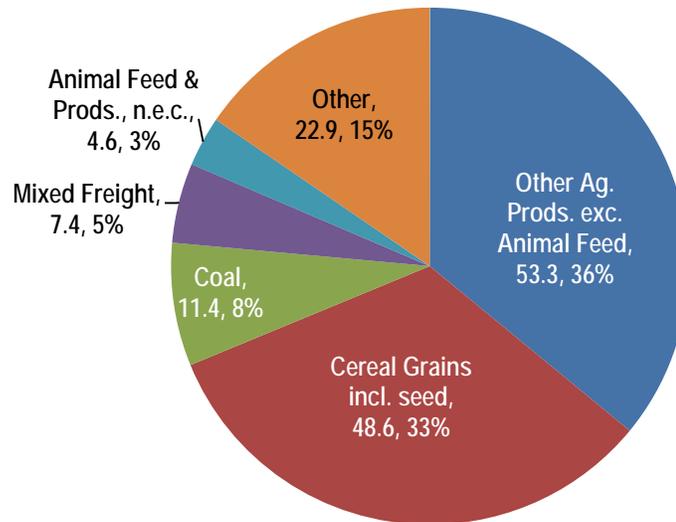
Note: **Inbound Flows:** rail movements that terminate in Washington, but do not originate in Washington; **Outbound Flows:** rail movements that originate in Washington, but do not terminate in Washington; **Through Flows:** rail movements that neither originate nor terminate in Washington; and **Intrastate Flows:** rail movements that both originate and terminate in Washington.

Inbound Flows

Inbound flows are anticipated to grow by 90 million tons between 2010 and 2035, reaching 148.3 million tons (55 percent of the total) by 2035. Inbound products are projected to be dominated by agricultural products (about 53.3 million tons), cereal grains (about 48.6 million tons), coal (about 11.4 million tons), and mixed freight (e.g. intermodal, about 7.4 million tons) (Figure 3.5).

- **Cereal grains including seeds and other agricultural products** (a category including wheat, corn and soybeans except for animal feed) dominate the inbound traffic mix in 2035. The rise in grain exports is responsible for a majority of the growth in these sectors. Some key trading partners for these commodities will be the West North Central and Mountain regions. Combined, these trade flows are projected to grow at an average compound annual growth rate (CAGR) of 4.3 percent.

Figure 3.5 Top Inbound Annual Commodities by Rail, 2035
In Millions of Tons 2035



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

Note: n.e.c. = not elsewhere classified, 2-Digit Standard Classification of Transported Goods (SCTG2) definitions in FAF3.3 Commodity Flow Database are used.

- **Coal** is anticipated to grow by about 11 million tons, or 8 percent. Excluding growth from any anticipated new facilities, the growth in tonnage is likely to come from trade between Mountain region and Washington, at a combined CAGR of 1.7 percent. The increase in the volume may be attributed to an increase in coal exports with available coal terminal capacity on the West Coast and future power generation needs in the state.³²
- **Mixed freight** or "Freight All Kinds" (FAK)³³, comprised primarily of containerized goods, is mainly concentrated in trade with the East North Central, West North Central, and the Pacific regions of the U.S. Together, these three trade flows will grow at a CAGR of 3.0 percent. The increase in

³² The forecast for coal does not take into account potential developments related to proposed coal export facilities, as well as the planned closures of the Centralia and Portland (OR) General Electric power generating stations.

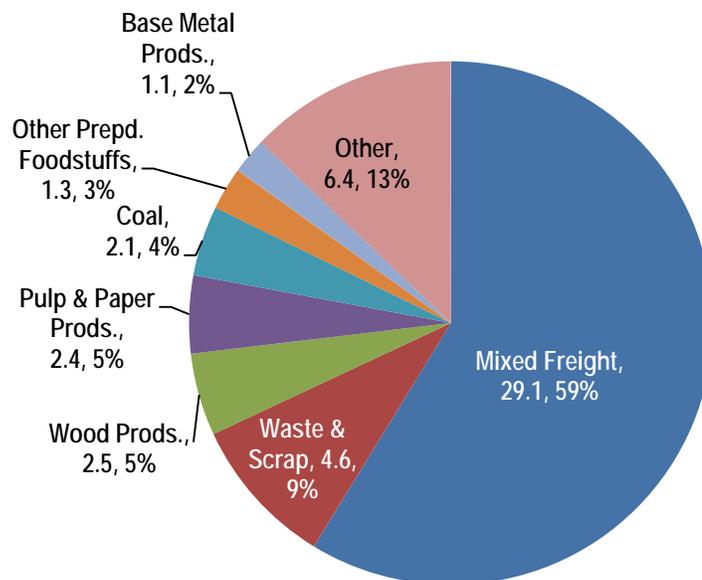
³³ This category includes items for grocery and convenience stores, supplies and food for restaurants and office supplies. These types of commodities are generally containerized.

the inbound mixed freight flows is most likely attributed to state population growth and increases in business activities.

Outbound Flows

Outbound flows are anticipated to grow by 31 million tons between 2010 and 2035, reaching 50 million tons (19 percent of the total) by 2035. Outbound products are projected to include mixed freight or FAK (29.1 million tons), waste and scrap (4.6 million tons), and wood products (2.5 million tons) (Figure 3.6).

Figure 3.6 Top Annual Outbound Commodities by Rail, 2035
In Millions of Tons



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

NOTE: n.e.c. = not elsewhere classified, SCTG2 definitions in FAF3.3 Commodity Flow Database are used.

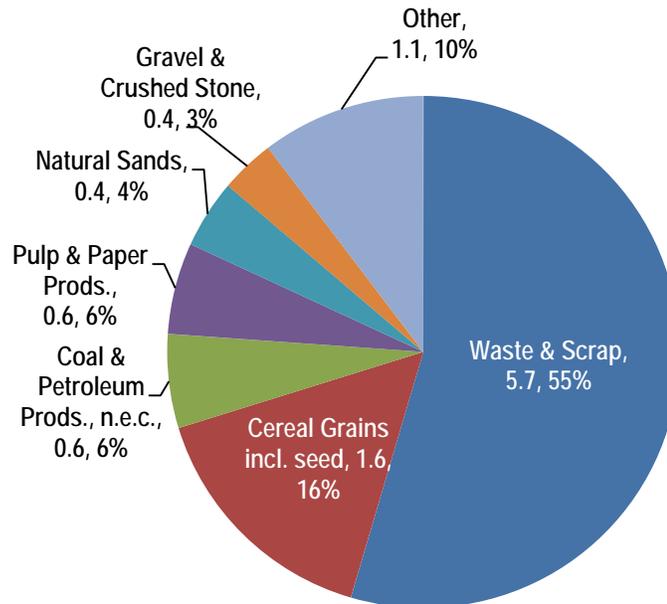
- **Mixed freight**, or FAK, dominates the outbound traffic mix, due to continued increases in containerized imports destined for inland U.S. locations primarily in the East North Central and West North Central regions. Together, flows between Puget Sound and these two regions will have a CAGR of 6.2 percent between 2010 and 2035.
- **Waste and scrap** growth in tonnage is mainly between Washington and the Pacific Region, with a CAGR of 6.0 percent.
- **Wood products** and **pulp and paper products** combined growth in tonnage is projected to mostly terminate in the Mountain, Pacific, and West North

Central regions of the U.S. The CAGR for these commodities is forecast at 1.2 percent.

Intrastate

As mentioned in Technical Note 3a, rail is most efficient in handling high volumes of traffic over distances of more than 500 miles. As expected, therefore, Figure 3.7 intrastate traffic represents the smallest portion of the state's rail traffic. Intrastate moves are anticipated to reach 10.4 million tons in 2035 (representing 4 percent of the total traffic), an increase of 5 million tons over 2010. Projected volumes in 2035 will be dominated by waste and scrap, accounting for 5.7 million tons, and cereal grains at 1.6 million tons.³⁴

Figure 3.7 Annual Top Intrastate Commodities by Rail, 2035
(In Millions of Tons)



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

Note: n.e.c. = not elsewhere classified, SCTG2 definitions in FAF3.3 Commodity Flow Database are used.

Flows of commodities in intrastate traffic are described using Washington's Regional Transportation Planning Organizations (RTPO) clusters. They are included in Table 3.1 as reference.

³⁴ Actual intrastate volumes are somewhat higher than what is shown in Figure 3.7. Short-line traffic tends to be underreported in the STB Waybill Sample.

- By 2035 the largest intrastate commodity moved by rail is projected to be **waste and scrap**, e.g. Municipal Solid Waste. The growth in tonnage will almost entirely be in flows headed to the Peninsula/Southwest Washington (including the Peninsula RTPO, Southwest Washington RTPO, and the Southwest Washington Regional Transportation Council as shown in Table 3.1).
- **Cereal grains (including corn and seeds)** growth in tonnage will almost entirely be comprised of movements originating in the East Central region and moving to the Peninsula/Southwest Washington region.
- Other commodities carried intrastate by rail include a small volume of **natural sands** transported by rail from Northeast Washington region to Central Puget Sound region (CAGR of 6.6 percent), and **gravel and crushed stone** transported by rail from East Central Washington region to Peninsula/Southwest Washington region (CAGR of 2.3 percent). All of these commodities are used in construction activities associated with the housing and population growth in the Central Puget Sound region.

Table 3.1 Regions in Washington

Region Name	RTPOs Included	Counties Included (in Alphabetical Order)
Peninsula/Southwest	Peninsula RTPO, Southwest Washington RTPO, Southwest Washington Regional Transportation Council	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Kitsap, Klickitat, Lewis, Mason, Pacific, Skamania, Wahkiakum
Central Puget Sound	Puget Sound Regional Council, Thurston Regional Planning Council, Whatcom Council of Governments, Skagit/Island RTPO	Island, King, Pierce, San Juan, Skagit, Snohomish, Thurston, Whatcom
East Central	North Central RTPO, Wenatchee Valley Transportation Council, Quad-County RTPO, Yakima Valley Conference of Governments	Adams, Chelan, Douglas, Grant, Kittitas, Lincoln, Okanogan, Yakima
Southeast	Benton-Franklin-Walla Walla RTPO, Palouse RTPO, Lewis Clark Valley Metropolitan Planning Organization	Asotin, Benton, Columbia, Franklin, Garfield, Walla Walla, Whitman
Northeast	Northeast Washington RTPO, Spokane Regional Transportation Council	Ferry, Pend Oreille, Spokane, Stevens

Note: Region definitions are based on using Washington’s RTPO boundaries map shown at: www.wsdot.wa.gov/planning/Regional/ (last accessed on October 17, 2012).

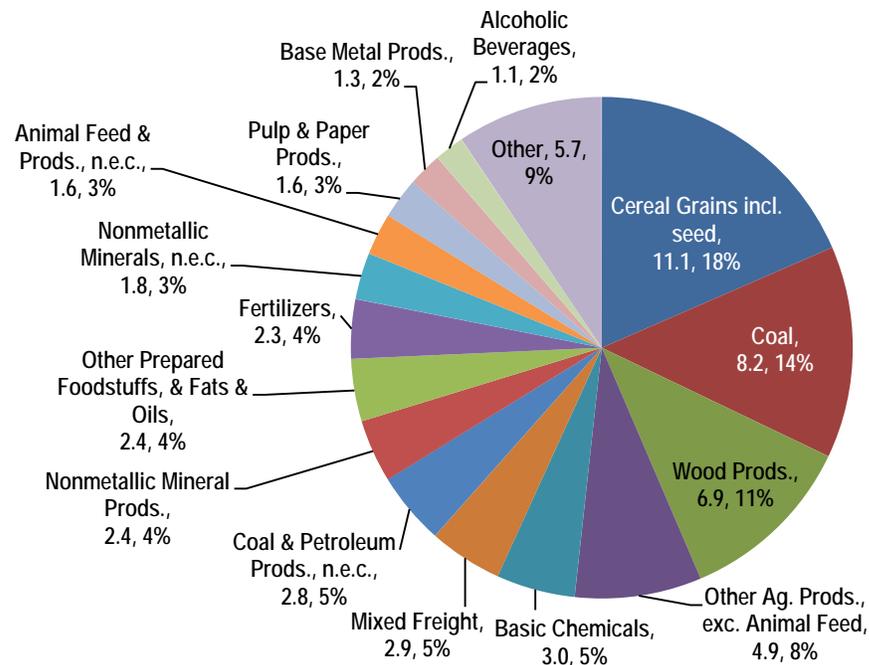
Through Flows

Through flows are anticipated to grow by 26 million tons between 2010 and 2035, reaching 60 million tons (22 percent of the total) by 2035. Commodities handled

in through traffic are highly diverse, as is evident from Figure 3.8. The three largest commodity groups, cereal grains, coal and wood products, comprise 43 percent of the total through volumes.

- **Cereal grains** comprise 11.1 million tons (18 percent) of rail traffic that moves through Washington. Most of this is moved between West North Central and Mountain regions of the U.S. to Pacific region of the U.S.
- **Coal** comprises 8.2 million tons (14 percent) of rail traffic that moves through Washington, mainly from Mountain region of the U.S. to Canada.
- **Wood products** comprise 6.9 million tons (11 percent) of tonnage moved through Washington between several pairs of trade partner regions, a majority of which originate in Canada, Mountain region of the U.S. and Pacific region of the U.S.

Figure 3.8 Annual Top Through Commodities by Rail, 2035
 In Thousands of Tons



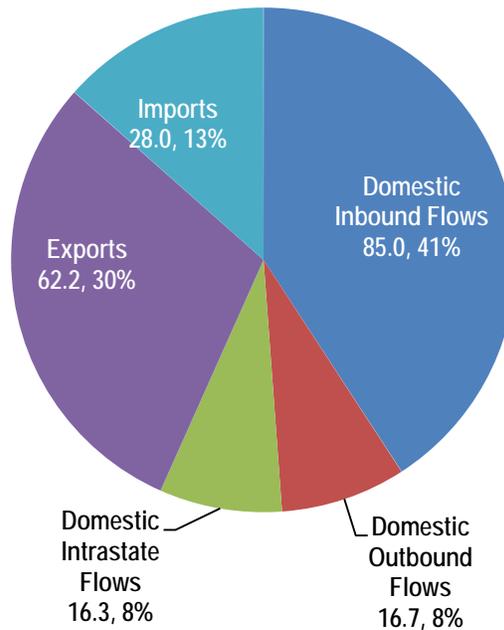
Trade Splits

Figure 3.9 shows the projected distribution in 2035 of inbound, outbound, intrastate, import and export traffic. From this total, which does not include through traffic, domestic flows are expected to account for 57 percent and 118 million tons of the total volume, while 43 percent and 90 million tons will be associated with international trade. Domestic inbound flows—primarily bulk commodities—will comprise the largest single category at 85 million tons at

41 percent. The smallest volumes will be associated with domestic intrastate and outbound flows, at 16 million and 17 million tons, respectively.

Figure 3.9 Rail Traffic Composition by Trade Type, 2035

In Thousands of Tons



Source: FAF3.3 Commodity Flow Database; and Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

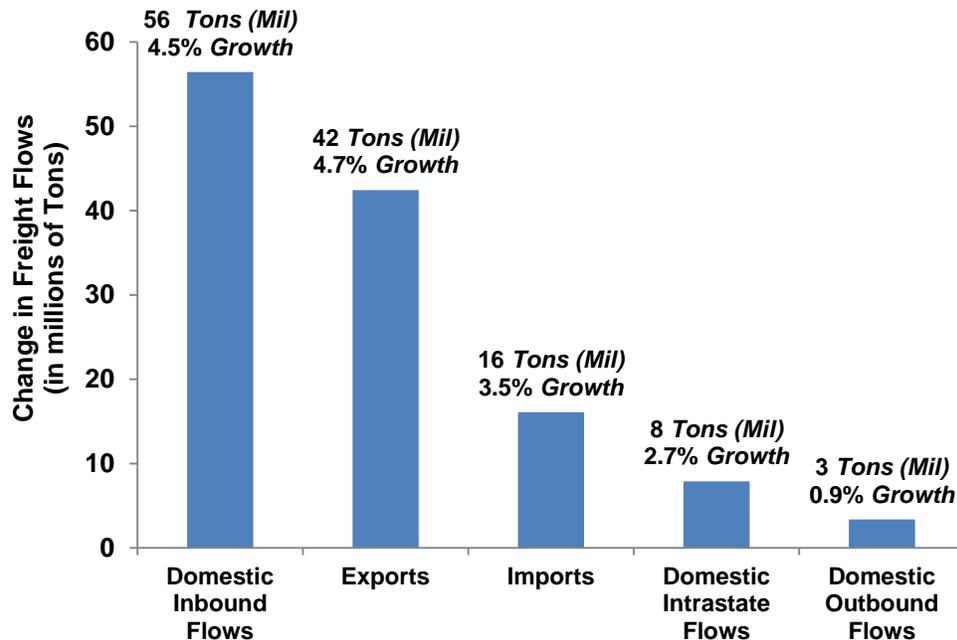
Note: The tons included belong to inbound, outbound and intrastate flows only. The tons included are a total of "rail" and "multiple modes and rail" modes in the FAF3.3 data. This includes truck-rail, truck-water, and rail-water intermodal shipments involving one or more end-to-end transfers of cargo between two different modes.

Compared to 2010 (see Figure 3.10), volumes are expected to increase for all of the trade types by 2035. Exports are projected to grow the fastest, 4.7 percent—primarily driven by increased demand in international markets for dry bulk products including potash, ores and coal (discussed in the previous section). Domestic inbound flows will grow by 4.5 percent, driven by increasing demand from Washington's industrial, population and income growth. Imports are anticipated to grow at 3.5 percent, and intrastate flows at 2.7 percent.

These projections imply a continuation of rail industry trends that emphasize high volumes of traffic moving over longer distances in point to point service, and most likely either beginning and/or ending their trip in a congested terminal area, such as Tacoma, Seattle, or Vancouver WA. To handle this traffic, not only will main line capacity have to keep up with demand, terminals and nearby rail facilities will also require expansion. These terminals are often located where suitable land is scarce, and expansion will be difficult. Alternative solutions include construction of new facilities located in less developed areas, improved

technologies for handling higher volumes at existing facilities, and diverting traffic to locations outside of Washington.

Figure 3.10 Estimated Washington Rail Flow Changes by Trade Type, 2010 to 2035
In Millions of Tons and CAGR



Source: FHWA FAF 3.3 commodity flow database.

3.3 RAIL SERVICE COMPOSITION

Figure 3.11 shows the tonnage distribution by rail service type in Washington. Bulk coal is projected to account for almost 22 million tons (8 percent of total rail tonnage).³⁵ Bulk-other is projected to account for almost 117 million tons (43 percent of total rail tonnage). Intermodal service type is projected to account for 56 million tons (21 percent of the total commodity flows), and Auto service type is projected to account for 2 million tons (less than 1 percent of total

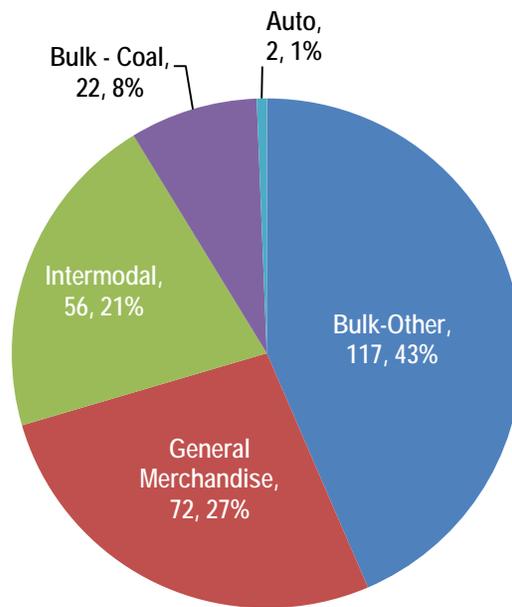
³⁵ Figure 3.11 shows the splits of 2035 rail flows by rail service types. Bulk coal forecasts shown do not consider potential growth in coal traffic that may result from proposed coal export facilities on the West Coast.

statewide tonnage). General-Merchandise service type is projected to account for almost 72 million tons (27 percent of total rail tonnage).

Since freight rail cars are considerably larger than highway-compatible trailers and containers, bulk and general merchandise service types typically carry two to six times the tonnage per unit of shipment. Therefore, it does not necessarily mean that more tonnage equates to more carload traffic. In fact, in terms of unit volumes, intermodal service type makes up a majority (66 percent) of the total units for commodity flows in Washington, followed by bulk-other, general merchandise, bulk-coal and auto service types; each accounting for 17 percent, 13 percent, 3 percent, and 1 percent of the total carloads, respectively.

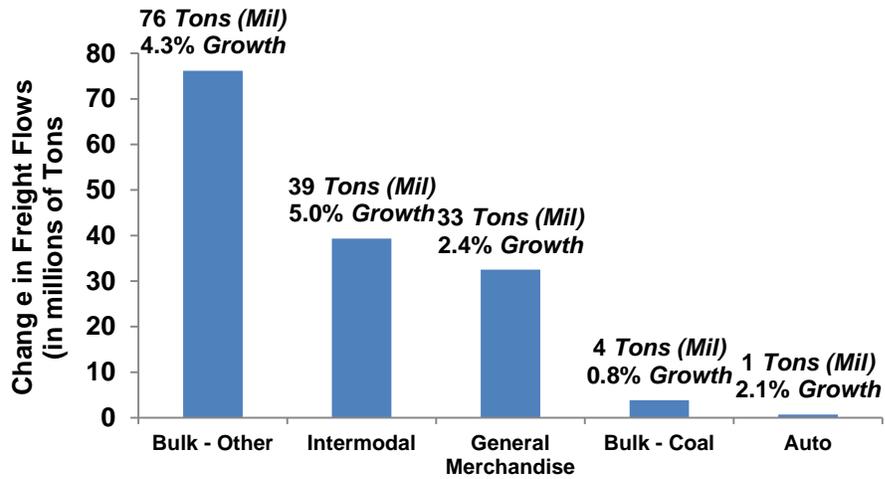
Compared to the 2010 data (Figure 3.12), intermodal and bulk-other are the fastest growing service types.

Figure 3.11 Annual Rail Flows by Service Type in Washington, 2035
In Millions of Tons



Source: Cambridge Systematics' 2035 Freight Rail Flows

Figure 3.12 Estimated Annual Tonnage Change and Annualized Growth by Service Type, 2010 to 2035
In Millions of Tons



Source: Cambridge Systematics' 2035 Freight Rail Flows Forecasting.

Note: The tons included belong to inbound, outbound and intrastate flows only.

4.0 Capacity Assessment

4.1 GROWTH IN FREIGHT TRAIN VOLUMES

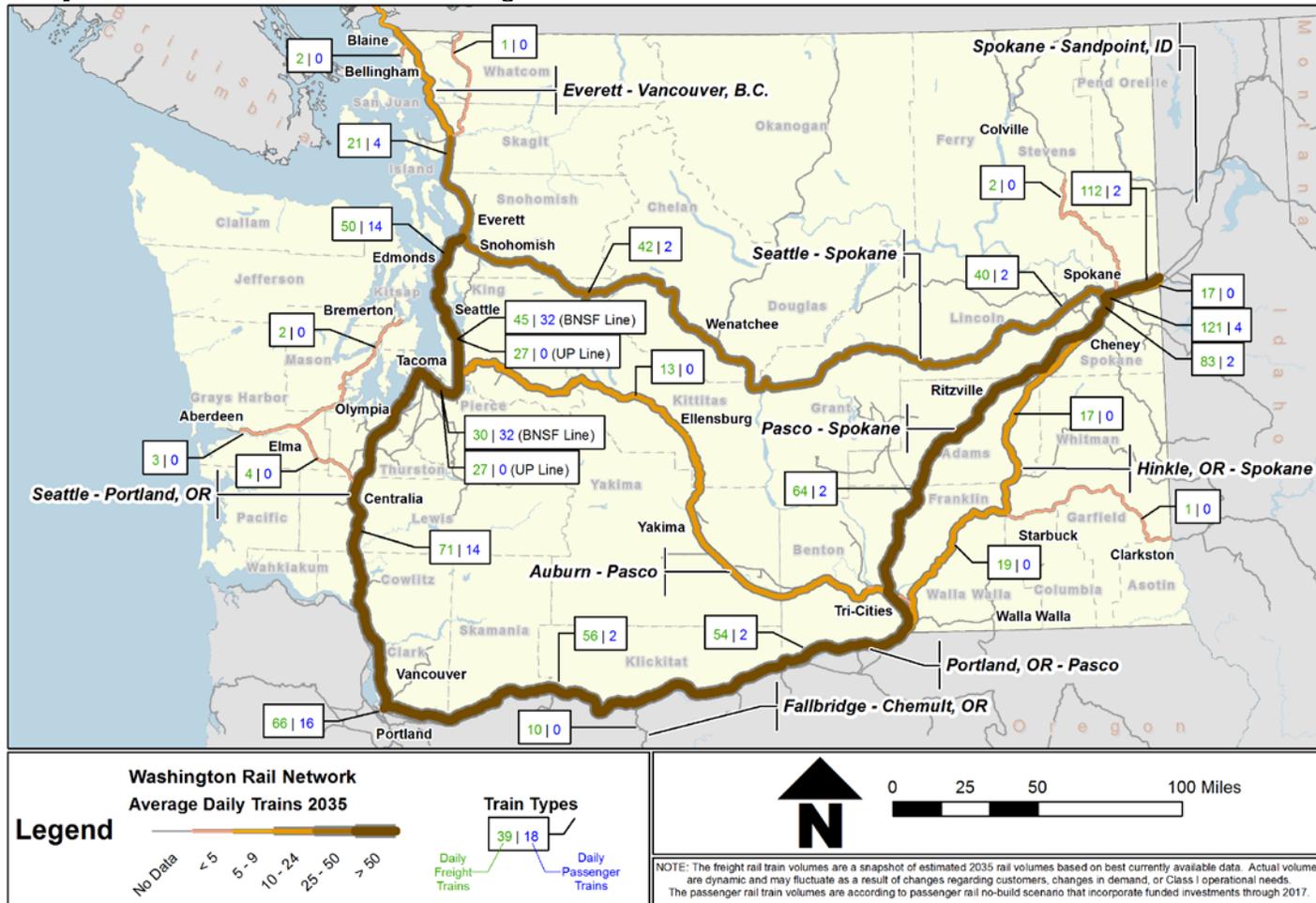
This section discusses growth in train volumes moving on Washington’s freight rail system between 2010 and 2035. Daily total train volume estimates for 2035 were made for several locations on Washington’s rail network. The methodology for using rail freight flows forecast to determine train volumes is summarized in Section A.3 of Appendix A. It is similar in approach to the 2007 Association of American Railroads (AAR) *National Rail Freight Infrastructure Capacity and Investment Study*, and relied on three main data sources:

1. **2010 Confidential Carload Waybill sample - Surface Transportation Board (STB).** The AAR collects Waybill data annually for the STB from railroads that have moved at least 4,500 carloads each year for each of the previous three years, or which move 5 percent or more of any state’s total rail traffic. It was provided to the Washington State Department of Transportation under a confidential user agreement.
2. **Federal Highways Administration (FHWA) Freight Analysis Framework Version 3.3 (FAF3.3).** FAF3.3 provides tonnage estimates by commodity type, mode and 123 U.S. regions that consist of major metropolitan areas, state remainders and 16 entire states. The primary basis for FAF3.3 is a 2007 survey of the shipping behavior of 100,000 U.S. manufacturers and wholesalers (i.e., the Commodity Flow Survey), supplemented by the Journal of Commerce’s Port Import Export Reporting System, the Army Corps of Engineers’ Waterborne Commerce Database, and the STB’s Carload Waybill Sample for rail. The FAF3.3 forecasts were applied to the 2010 Carload Waybill sample to project 2035 commodity volumes.
3. **Class I Railroad Train Counts and Data.** BNSF Railway (BNSF) and Union Pacific Railroad (UP) train counts were both used to validate flows created through other data sources.

Figure 4.1 shows the outcome of the 2035 train volume estimation exercise. The map shows the relative levels of traffic on major corridors and certain key branch lines on which Class I railroads operate. Passenger daily train volumes shown on the map show funded passenger train volume increases, and are included only to highlight the extent of their interactions with freight trains.

Table 4.1 summarizes the growth in freight train movements for major corridors, and contributions of the traffic (train service type) mix to this growth.

Figure 4.1 Projected Train Movements in Washington, 2035



Sources: 1) BNSF 2010 Train Counts Data for Washington; 2) UP 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho (ID) corridor; 3) Cambridge Systematics' Estimation of 2035 Train Volumes and Capacity Analysis using 2035 Freight Rail Flows Forecasting, the 2011 BNSF Northwest Division timetable data, 2011 BNSF R-1 report data and a TransCAD Model of Oak Ridge National Laboratory's (ORNL) Rail Network.

Note Directional running of trains is assumed on the Stampede Pass route (Auburn-Pasco via Yakima), which was implemented by BNSF in 2012.

Table 4.1 Summary of Growth in Freight Train Movements on Washington’s Major Rail Corridors, 2035

Name of Major Corridor (Freight Operator(s))	Change in Number of Daily Freight Trains, 2010-2035		% Change in Number of Daily Freight Trains, 2010-2035		General Merchandise Trains Compounded Annual Growth Rate, 2010-2035		Intermodal & Auto Trains Compounded Annual Growth Rate, 2010-2035		Bulk Trains Compounded Annual Growth Rate, 2010-2035	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Auburn-Pasco (BNSF)	7	7	117%	117%	0.0%	0.4%	0.0%	0.0%	3.1%	3.2%
Everett-Vancouver, B.C., Canada (BNSF)	< 5	10	67%	91%	3.1%	3.2%	5.0%	7.5%	0.0%	0.2%
Hinkle-Spokane (UP, and partly BNSF)	8	8	73%	89%	1.7%	2.0%	0.9%	1.1%	2.9%	3.2%
Pasco-Spokane (BNSF, Partly UP)	34	36	113%	120%	2.0%	2.1%	2.3%	2.4%	3.5%	3.8%
Portland-Pasco (BNSF)	28	30	108%	115%	2.1%	2.4%	2.3%	2.9%	3.4%	3.5%
Seattle-Portland (BNSF, UP)	17	40	128%	170%	1.7%	3.7%	4.0%	4.9%	2.7%	5.3%
Seattle-Spokane (BNSF)	27	31	163%	208%	0.0%	3.1%	4.5%	4.7%	0.0%	0.3%
Spokane-Sandpoint, ID (BNSF)	66	66	143%	143%	1.9%	1.9%	4.2%	4.2%	3.8%	3.8%
Spokane-Sandpoint, ID (UP)	9	9	113%	113%	2.0%	2.0%	NA	NA	3.9%	3.9%
Wishram-Chemult, OR (BNSF)	5	5	100%	100%	2.8%	2.8%	3.2%	3.2%	2.7%	2.7%

Sources: BNSF 2010 Train Counts Data for Washington; UP 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor; and Cambridge Systematics’ Estimation of 2035 Train Volumes using 2035 Freight Rail Flows Forecasting, the 2011 BNSF Northwest Division timetable data, 2011 BNSF R-1 report data, and a TransCAD Model of Oak Ridge National Laboratory’s (ORNL) Rail Network.

The key findings based on the freight rail traffic growth analysis are:

- The growth in freight train volumes on Washington’s rail network is projected to vary throughout the system. For example, BNSF’s Spokane-Sandpoint, Idaho (ID) corridor is projected see an increase of 66 trains per day compared to 2010 conditions, while the BNSF Wishram to Chemult, Oregon (OR) is only projected see an increase of five trains per day compared to 2010 conditions. Likewise, the percent increase (or decrease) by segment varies between 67 percent and 208 percent under existing rail infrastructure and network routing conditions.
- Though it is not shown on this map, it is anticipated that different train service types will dominate the growth in certain corridors. For example, for general merchandise, intermodal and auto train service types, the BNSF’s Seattle-Spokane corridor and BNSF’s Everett-Vancouver, British Columbia (B.C.), Canada corridor are expected to see the largest gains. Likewise, bulk train service type is expected to grow along BNSF’s Pasco-Spokane and UP’s Hinkle, OR-Spokane corridors.
- The majority of 2035 east-west train movements (about 110 freight trains per day) are projected to travel along BNSF’s Spokane-Sandpoint, ID corridor. The Seattle-Portland corridor is also projected to see heavy traffic by 2035, (about 70 freight trains per day).

4.2 CAPACITY ASSESSMENT

The vast majority of the state’s roughly 3,200-mile rail system is owned by the two Class I railroads, BNSF and UP. As private entities, their expansion and capital improvement plans are part of their regular business activities. Similar to most other privately held businesses, this information is considered confidential, and therefore not made available to the public. Thus, this capacity assessment entails a high-level estimate of the impacts that could be expected to occur if the 2035 projected freight and passenger train volumes were to be loaded onto the existing statewide rail infrastructure.

As noted in the introduction to this technical note, the 2010 assessment is meant as a baseline, while the 2035 assessment shows the impact of projected 2035 freight and passenger rail volumes on today’s infrastructure and improvements that are already funded and programmed. In reality, it is anticipated that the Class I railroads will generally address critical capacity issues as they emerge. Therefore, the 2035 capacity assessment is included here to illustrate the magnitude of growth anticipated for Washington’s rail system, to underscore the need for continued planning and action to address safety, capacity and mobility concerns throughout the system.

The basic methodology followed for this capacity assessment was a parametric approach similar to the 2007 AAR *National Rail Freight Infrastructure Capacity and*

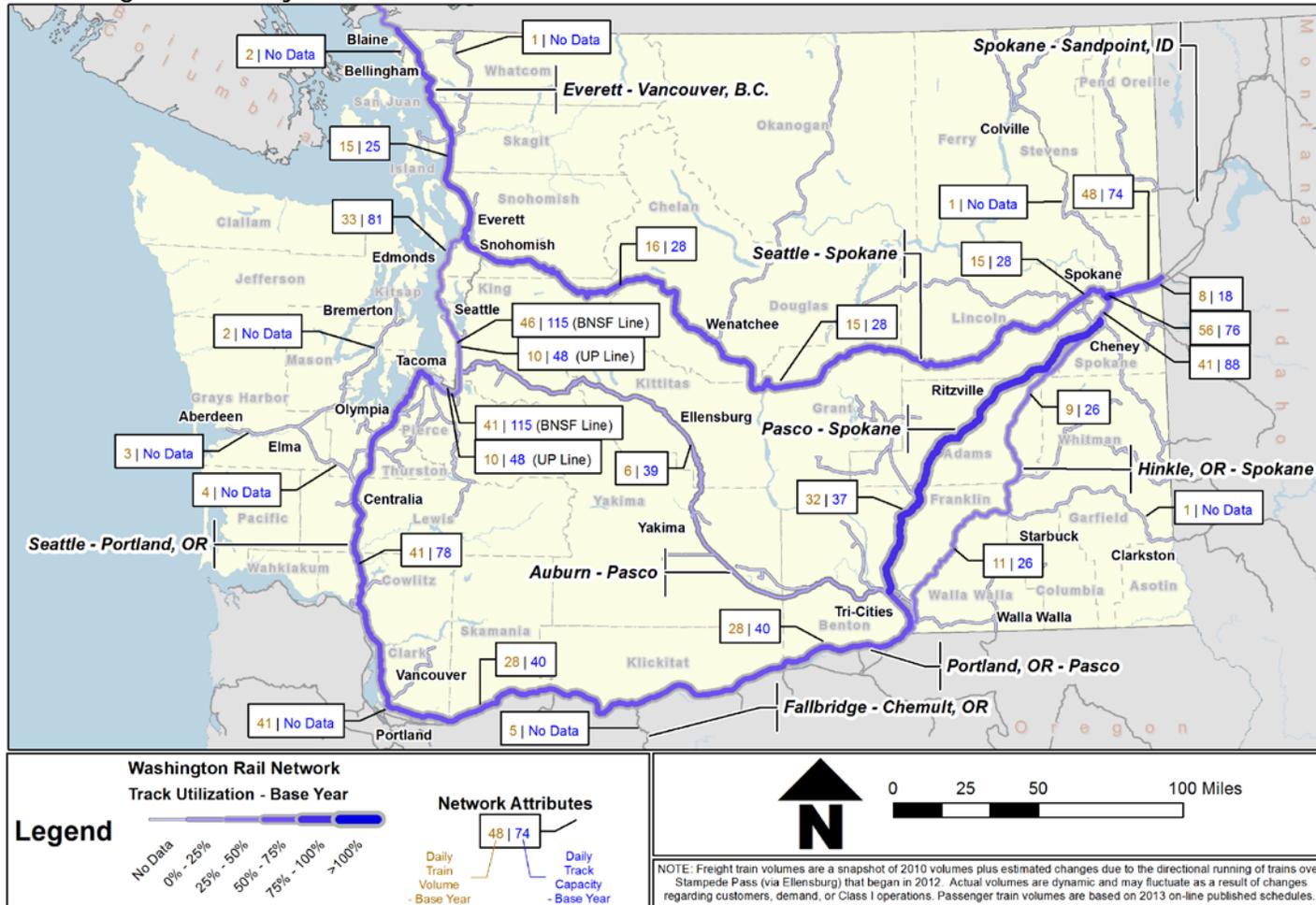
Investment Study, though improved with current data and refinement of the methodology for single track main lines.

Though the methodology is described in detail in Section A.4 of Appendix A, in essence it included the following steps:

1. The 2035 train volumes were estimated as discussed in Section 4.1.
2. The maximum practical capacity for each segment of the rail infrastructure was calculated using the signal type, number of tracks, and the presence of geometric limitations. The BNSF timetable data was the main source to establish signal type, number of tracks and siding information for the BNSF rail system. For the UP rail system, signal type and number of tracks information is collected from the ORNL's rail network.
3. In certain exception cases, such as the Stampede Pass route (Auburn-Pasco via Yakima), and the Cascade Tunnel section of the Stevens Pass route (Seattle-Spokane via Wenatchee), additional calculations were made to account for special operational parameters. More details about the methodology are shown in Section A.4 in Appendix A.

Figure 4.2 shows the outcome of this analysis for the 2010 "baseline" conditions. Figure 4.3 shows the outcome for the anticipated growth in passenger and freight rail traffic by 2035.

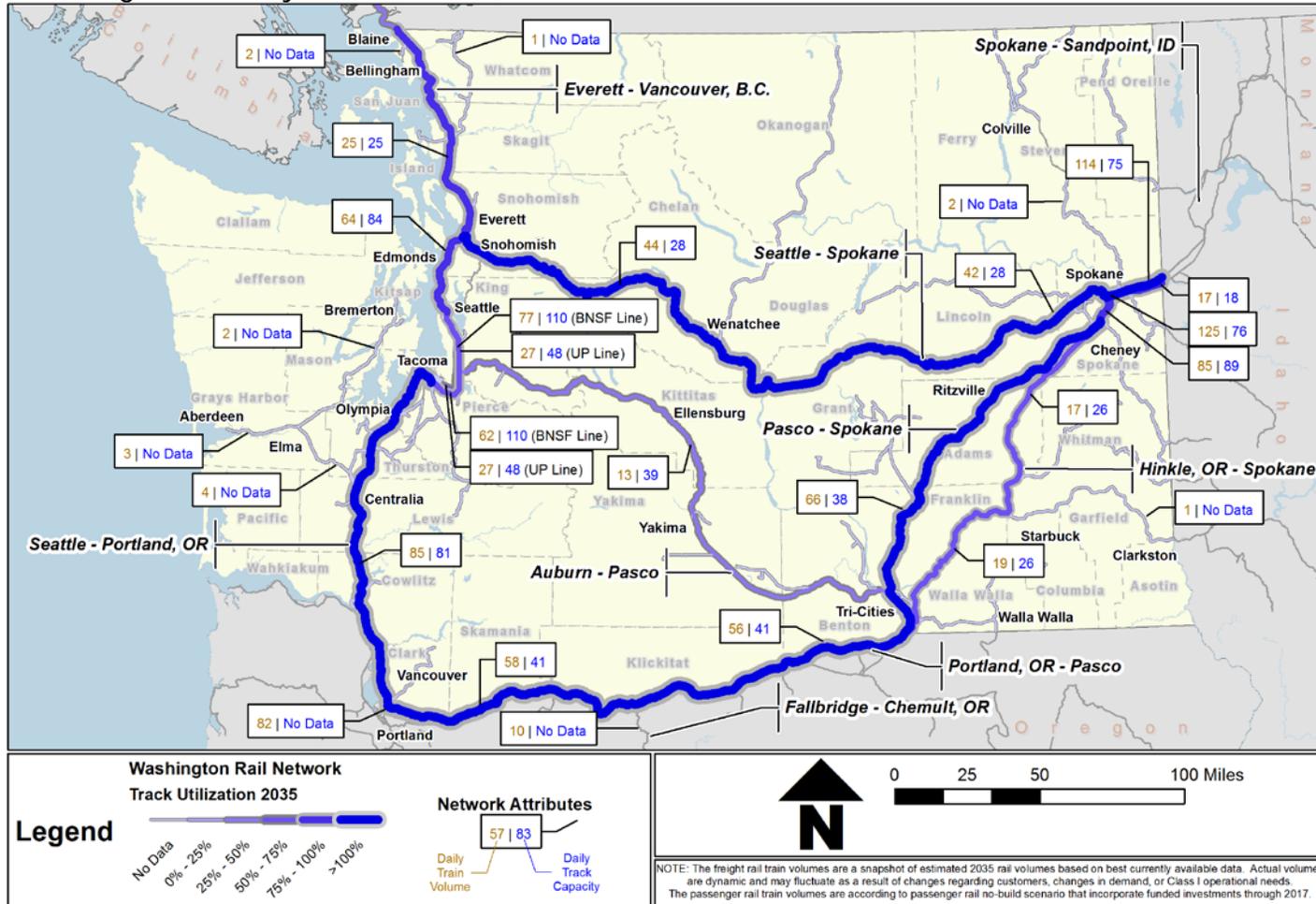
Figure 4.2 Washington's Rail System Utilization, 2010



Sources: 1) BNSF 2010 Train Counts Data for Washington; 2) UP 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor; and 3) Cambridge Systematics' Estimation of 2010 Train Volumes and Capacity Analysis using the 2011 BNSF Northwest Division timetable data, 2011 BNSF R-1 report data and a TransCAD Model of ORNL's Rail Network.

Note: Directional running of trains is assumed on the Stampede Pass route (Auburn-Pasco via Yakima), which was implemented by BNSF in 2012.

Figure 4.3 Washington's Rail System Utilization, 2035



Sources: 1) BNSF 2010 Train Counts Data for Washington; 2) UP 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor; and 3) Cambridge Systematics' Estimation of 2010 Train Volumes and Capacity Analysis using the 2011 BNSF Northwest Division timetable data, 2011 BNSF R-1 report data and a TransCAD Model of ORNL's Rail Network.

Note: Directional running of trains is assumed on the Stampede Pass route (Auburn-Pasco via Yakima), which was implemented by BNSF in 2012.

The key findings are as follows:

- The maximum practical capacity over the major rail corridors in Washington varies over a wide range of about 18 trains per day (Spokane-Sandpoint, ID on UP Spokane subdivision) to about 110 trains per day (Seattle-Tacoma on BNSF Seattle subdivision). The modeling includes funded increases to passenger train volumes, though it does not take into account infrastructure improvements associated with the volume increases.
- Based on the 2010 estimates, there were no recognized capacity constraints on Washington's rail system; the highest use was on BNSF's Pasco-Spokane segment at about 86 percent, followed by BNSF's Portland-Pasco segment of about 70 percent. Similarly, within Washington state, UP does not face any capacity constraints on its own trackage.
- BNSF's 2012 implementation of directional running of empty eastbound bulk trains on the Stampede Pass route (Auburn-Pasco via Yakima), with the Fallbrook (Pasco to Vancouver) and Seattle subdivisions handling the loaded trains, has substantially increased rail capacity over the previous bidirectional operation. For Stampede Pass, capacity has increased from about 10 trains per day to 39 trains per day. Therefore, the use of this route is one of the lowest, both in 2012 and 2035. The other subdivisions affected by this change—Fallbrook and Seattle subdivisions—have also gained capacity through this change, but to a lesser degree.
- Increased variety of freight train types, such as bulk, intermodal and merchandise, causes capacity utilization to increase more rapidly than traffic volumes over some network segments by 2035. However, these impacts are modest.
- In 2035, several rail segments are projected to become capacity constrained, if no capacity enhancements are made beyond those specifically funded and programmed in 2012. These include Pasco-Spokane (about 174 percent, west of Cheney), Seattle-Spokane via Wenatchee (about 157 percent), Spokane-Sandpoint, ID (about 152 percent) and Portland-Pasco (about 141 percent). Seattle-Portland and Everett-Burlington are just at the 100 percent utilization mark (105 percent and 100 percent, respectively), making it difficult to efficiently handle the inevitable fluctuations in traffic without adding excessive delays. All of these routes currently handle passenger traffic, and thus will be particularly sensitive to congestion-related delays.
- Existing track conditions on the capacity constrained segments and potential capacity needs are summarized in Table 4.2. The table indicates the segment characteristics, including length, signal type, train volumes and train capacity. *Track Ratio* indicates the average number of tracks on the segment; a ratio of 1 would imply that a rail segment is comprised entirely of a single main track, without any passing sidings. A ratio of 2 indicates that the line consists of two main tracks on average. BNSF's Seattle-Portland route falls

into that category; in actuality, it consists of one short single track segment (Nelson-Bennett tunnel) and some third main, thus pushing the track ratio over 2.0.

Table 4.2 Existing Conditions on Rail Segments with Capacity Constraints in 2035

Name of Major Corridor	Existing Length of Segment (in Miles)	Existing Track Ratio	Existing Signal Type Mileage Shares ^a	2035 Daily Train Volume	Rail Capacity in Trains/Day	Utilization %	Potential Capacity Need?
Severely Capacity Constrained							
Pasco-Spokane	146	1.28	100% CTC-TCS	66	38	174%	Inadequate Track Ratio
Spokane-Spokane via Wenatchee	290 ^b	1.22	91% CTC-TCS, 9% ABS	44	28	157%	Inadequate Track Ratio & Signal Type
Spokane-Sandpoint, ID	21 ^c	1.79	100% CTC-TCS	114	75	152%	Inadequate Track Ratio
Portland-Pasco	220 ^d	1.21	100% CTC-TCS	58	41	141%	Inadequate Track Ratio
Capacity Constrained							
Seattle-Portland	137	2.02	100% CTC-TCS	85	81	105%	Inadequate Track Ratio
Everett-Burlington	46	1.12	76% CTC-TCS, 24% ABS	25	25	100%	Inadequate Track Ratio & Signal Type

Sources: 1) BNSF 2010 Train Counts Data for Washington; 2) UPRR 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor; and 3) Cambridge Systematics' Estimation of 2035 Train Volumes and Capacity Analysis using 2035 Freight Rail Flows Forecasting, the 2011 BNSF Northwest Division timetable data, 2011 BNSF R-1 report data and a TransCAD Model of ORNL's Rail Network.

- ^a CTC is Centralized Traffic Control, TCS is Traffic Control System and ABS is Automatic Block Signaling. These are defined in Appendix A on page A-6.
- ^b Constrained segment is Everett to Spokane.
- ^c Distance provided from Spokane to the Washington-Idaho border.
- ^d Constrained segment is Tacoma to the Washington-Oregon border.

A. Appendix

A.1 COMMODITY FLOWS DATA SOURCES³⁶

This section discusses the commodity flows data used to conduct an assessment of the current freight rail system operations and markets.

2010 Confidential Carload Waybill Sample - Surface Transportation Board (STB). The Association of American Railroads (AAR) collects Waybill data annually for the STB from railroads that have moved at least 4,500 carloads each year for each of the previous three years, or which move five percent or more of any state's total rail traffic. The Waybill dataset was used to assemble county-to-county 2010 tonnage estimates of rail flows and information on railway routing. It was provided to the Washington State Department of Transportation under a confidential user agreement. This sample formed the basis for the base year (2010) freight rail traffic.

Federal Highways Administration (FHWA) Freight Analysis Framework Version 3.3 (FAF3.3). Developed and provided by the FHWA, FAF3.3 provides tonnage estimates by commodity type, mode, and 123 U.S. regions that consist of major metropolitan areas, state remainders, and 16 entire states. The primary basis for FAF3.3 is a 2007 survey of the shipping behavior of 100,000 U.S. manufacturers and wholesalers (i.e., the Commodity Flow Survey), supplemented by the Journal of Commerce's Port Import Export Reporting System, the U.S. Army Corps of Engineers' Waterborne Commerce Database, and the STB's Carload Waybill Sample for rail. The forecast incorporated into FAF3.3, produced by IHS-Global Insight using Quarter 2 of 2010 as the base period, was applied to the 2007 Carload Waybill sample to project volumes in 2040, as well as the intermediate years of 2015, 2020, 2025, 2030, and 2035. FAF3.3 also includes provisional estimates for 2010. The last updated version of FAF3.3 is Version 3.3, dated July 1, 2012. This data formed the basis for the future year (2035) freight rail flows forecasting.

TradeStats Express™ Data - U.S. Department of Commerce. TradeStats Express displays the latest annual U.S. merchandise trade statistics:

- At national and state levels.
- In maps, graphs and tables.
- As exports, imports and trade balances.
- Custom-tailored to your year and dollar ranges and display preferences.

³⁶ As also noted in Appendix A of Technical Note 3a.

The trade data are available as full year totals for 1989 through 2009 and Year-To-Current-Quarter for 2009 through June 2012. Data are available for individual countries, trade/economic groups or geographic regions. These statistics can be tabulated using any of three product classification systems: Harmonized System codes (at 2- and 4-digit levels), North American Industry Classification System codes (up to the 4-digit level), or Standard International Trade Classification codes (up to the 3-digit level). The data can be displayed for exports, imports or balance of trade.

A.2 FREIGHT RAIL FLOW FORECASTING

The freight rail flow forecasting in this rail plan was carried out using the following method and assumptions:

- **Method.** For each record in the Carload Waybill Sample data, a growth factor with matching origin, destination, commodity type and mode category in FAF3.3 data was found. In cases where such a combination leads to a missing growth factor in the FAF3.3 data, growth factor with matching commodity type and mode category in FAF3.3 data was used.
- **Origin/destination zone assumptions.** To derive a set of growth factors, FAF3.3 definitions of zones were used as origins/destinations within Washington, and states were used as origins/destinations in rest of the U.S., and Mexico/Canada were treated as separate origin or destination zones. This implies that within a Washington FAF3.3 zone,³⁷ future year commodity flow pattern for counties constituting the FAF3.3 zone is the same as that of the current year.
- **Commodity type assumptions.** The Standard Classification of Transportation Goods 2-digit commodity group in FAF3.3 data equivalent to the Standard Transportation Commodity Codes 7-digit commodity type in the Carload Waybill Sample data was used.
- **Mode category assumptions.** The growth in “Rail” mode category in FAF3.3 data was used to represent growth in carload type rail traffic in Carload Waybill Sample data. The growth in “Multiple Modes & Rail” mode category in FAF3.3 data was used to represent growth in intermodal type rail traffic in Carload Waybill Sample data.

³⁷ There are two Washington FAF3.3 Zones in FAF3.3 data, one called Washington Seattle zone that includes Island, King, Kitsap, Mason, Pierce, Skagit, Snohomish and Thurston Counties. All other counties fall under the Remainder of Washington zone.

A.3 DATA AND METHODOLOGY FOR DETERMINING TRAFFIC (TRAIN SERVICE TYPE) MIX BY RAIL SEGMENT³⁸

Daily total train volume counts³⁹ at several locations of the Washington rail network were collected from the railroads, but this is not sufficient for describing the freight rail traffic. Therefore, this section describes the methodology used for estimation of service type mix of freight trains by rail segment. It is similar in approach to the 2007 AAR *National Rail Freight Infrastructure Capacity and Investment Study*.⁴⁰

The AAR methodology uses the annual carloads data from the Carload Waybill Sample data along with the information on its origin, destination and transporting railroad; and a model based assignment is done to automatically estimate the total daily freight train volumes by rail segment.

However, there are situations where the estimated train volumes can be either lower or higher than the actual train volumes. This can happen due to the following reasons: 1) the Carload Waybill Sample data uses expansion factors to estimate the annual train volumes, which may not be accurate; 2) there are simplifications to the rail network model and assignment method in the AAR approach resulting in incorrect routing; and 3) the general railroad assumptions made in the AAR study for estimation of number of daily trains from carloads, including cars per train and empty return ratios, do not reflect current operations of Class I railroads in Washington.

Therefore, adjustments were made to routing, as well as the assumptions used in estimation of number of daily freight trains from carloads. For example, a large number of carload/container trains originating or terminating in the Central Puget Sound region were assigned to Stampede Pass corridor by the model, but in current practice, this corridor has a limited number of train movements due to the fact that the tunnel height is not sufficient to accept a double-stack train, as well as the fact that it contains a steep grade requiring very high locomotive power. The routing of these movements was thus corrected to reflect these realities.

The carloads per train values published in the AAR study by individual Class I railroads substituted the general railroad assumptions made in the AAR study.

³⁸ As also noted in the Appendix A of Technical Note 3a.

³⁹ BNSF Railway (BNSF) 2010 Train Counts Data for State of Washington, and Union Pacific Railroad (UP) 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor.

⁴⁰ www.aar.org/~media/aar/Files/natl_freight_capacity_study.ashx (last accessed on October 19, 2012).

The latest 2011 Uniform Rail Costing System (URCS) data⁴¹ on empty return ratios for BNSF, UP and other western railroads was used to improve the daily freight train volume estimates. To these estimates, the current passenger rail services were added to estimate the total daily train volumes by rail segment.

Based on the above adjustments, the total daily train volume estimates were found to be in general agreement with the base year train volume counts. The ratio of the estimates to the actual counts ranged between 0.6 and 1.3 with very few exceptions, with a mode value of 0.8. This indicates that the model after adjustments estimated train volumes in a slight excess of actual train counts.

Accepting the model changes, both the model based train volume estimates for locations with no base year total train volume counts, and traffic mix for all segments (including locations with base year total train volume counts) were determined and used in describing the current rail traffic in this technical note.

The methodology described above, with the exception of the validation step, will be applied on the carload/container forecasts that are being developed as part of this State Rail Plan to determine the growth by rail segment and forecast year train service type mix.

In addition, the 2007 AAR study, as mentioned above, states that the railroads are anticipating improvement in train productivity by up to 0.5 percent per year up to 2035. Accounting for this, in the forecast year (2035) train estimations, the compounded annualized growth rates or growth factors that are used to estimate the forecast year (2035) flows were thus reduced by this percentage.

A.4 RAIL CAPACITY ANALYSIS METHODOLOGY

The rail line capacity at various locations on the Washington rail system is estimated using a methodology that is very similar to the parametric capacity model used in the development of the 2007 AAR *National Rail Freight Infrastructure Capacity and Investment Study*, though improved with current data, and refinement of the methodology for single track main lines. This approach involves estimating maximum practical capacity in number of trains per day on major rail corridors determined by signal type, number of tracks and any geometric limitations.

There are six steps to the process. The process relies, as much as possible, on published data available from BNSF and other sources. The 6-Steps Methodology relies on the following data and assumptions:

⁴¹ www.stb.dot.gov/stb/industry/urcs.html (last accessed on October 19, 2012).

Data Used in BNSF^a Rail Capacity Assessment:

Data Type	Source
Signal type	2011 BNSF Northwest Timetable data
Number of tracks	
Sidings (name, MP, lengths)	
Rail capacity assumptions	2007 AAR <i>National Rail Freight Infrastructure Capacity and Investment Study</i>
Passenger daily trains	Published timetables (Amtrak, Sound Transit)
Average siding length	Assumption based on AAR study, others
Estimated train mixes (i.e., unit trains, bulk trains)	Modeled by Cambridge Systematics for the State Rail Plan. This is based on data including the STB Waybill Sample, the Washington State Transportation Commission's <i>2006 Rail Capacity and System Needs Study</i> , and others

^a UP timetable data is not available at this time, and thus UP segment(s) capacity is estimated using a simpler approach that does not take actual passing sidings into account, however, uses signal type and number of tracks.

2011 BNSF R-1 Report Data Used in this Assessment:

Data Type	Value
Miles of passing tracks, crossovers and turnouts	3,406 miles
Miles of road	32,303 miles
Miles of second main track	4,964 miles
Miles of all other main tracks	372 miles

The 6-step methodology to calculate rail line capacity is as follows:

Step 1. The BNSF timetable data is used as the main source to establish signal type, number of tracks and siding information for the BNSF rail system and proceed to Step 2.

For the UP rail system, signal type and number of tracks information is collected from Oak Ridge National Laboratory's rail network, and proceed to Step 3.

Step 2. "Track ratio" is calculated by summing the number of main line tracks and siding tracks, and dividing it by route miles. The result will be a number called the "track ratio."

For example: If 50 percent are single-track (1 MT – 1 main line track), and 50 percent are double track (2 MT) on a subcorridor, the average number of tracks is 1.5 for this subcorridor.

Step 3. The track ratio in the case of BNSF (or the number of tracks in the case of UP) will be used to identify the minimum and maximum practical capacities. The

lower and upper bounds for practical capacities are based on those in the 2007 AAR *National Rail Freight Infrastructure Capacity and Investment Study*. They are shown below. The following definitions apply:

- **Centralized Traffic Control (CTC)** uses electrical circuits in the tracks to monitor the location of trains, allowing railroad dispatchers to control train movements from a remote location.
- **Automatic Block Signaling (ABS)** is a system that provides protection from rear-end collisions by indicating occupancy of subsequent sections of track through electrically operated track circuits and signals. Trains are controlled over a route with ABS in a manner similar to unsignalled territory, using track warrants issued from a central dispatching office.
- **Traffic Control System (TCS)** is a type of CTC, which relies on electrical circuits in the tracks to monitor the location of trains, allowing railroad dispatchers to control train movements from a remote location (generally a central dispatching office).
- **Track Warrant Control (TWC)** is an occupancy permission system that does not require any signaling system, and instead relies on verbal permission given by a dispatcher to a train crew via radio.

Track Type	Signal Control Type	Lower Boundary for Practical Capacity (Trains/Day)	Upper Boundary for Practical Capacity (Trains/Day)
1	1 CTC-TCS	30	48
2	2 CTC-TCS	75	100
3	3 CTC-TCS	133	163
4	4 CTC-TCS	173	230
5	5 CTC-TCS	248	340

*For example: ABS 1 MT (main line track) maximum capacity = 25 trains per day; whereas, ABS 2 MT maximum capacity = 80 trains per day. For a subcorridor with track ratio of 1.5, the maximum capacity under ABS signal control is $25 + (1.5-1)/(2-1) * (80 - 25) = 52.5$ trains per day, by linear interpolation.*

Step 4. A maximum practical capacity estimate is made for each track segment based on the standard deviation of the train mix. Train types include General Merchandise, Intermodal and Auto (as one category), Bulk and Passenger.

For example: A train mix of 25 percent, 25 percent, 25 percent, and 25 percent would have a standard deviation of zero; whereas, a train mix of 100 percent, 0 percent, 0 percent, 0 percent would have a standard deviation of 0.5. All other percentage combinations would lie between 0 and 0.5.

Step 5. On occasions when a segment has multiple signal control types, an average rail maximum practical capacity is calculated using a line length-based weighted average of the rail capacities.

The rationale for this is that most subcorridors have a leading signal control type, either CTC or ABS/TWC. Small stretches of low signal control type (ABS/TWC) noticed within a subcorridor that is predominantly CTC is not likely to be a capacity issue (scheduling will help bypass the problem area unless nearing a volume to capacity ratio of 1.0). On the other hand, short stretches of CTC within a predominantly ABS/TWC corridor is not assumed to significantly increase capacity.

Step 6. For single-track systems, siding spacing information from the BNSF timetable data is used to refine the average maximum practical capacity estimate for a segment from Step 5. The capacity value will be refined by using a ratio of the BNSF rail system average siding spacing (based on the BNSF R-1 data, one 8,000-foot siding is likely to occur after about 12 miles of main line track) and the maximum siding spacing observed in the segment. This step is not carried out for the UP single-track systems due to lack of UP timetable data.

Exceptions to the 6-Step Methodology:

The Stampede Pass route (Auburn-Pasco via Yakima) and the Cascade Tunnel section of Stevens Pass route (Seattle-Spokane via Wenatchee) are exceptions to the above described methodology. This is mainly due to the special operational parameters that apply to these segments. The alternate methodologies for each route are shown below.

Stampede Pass Route. This route underwent an operational change in mid-year of 2012, switching from bidirectional to paired operation with the Columbia River route between Pasco and the Puget Sound region. Under the new scheme, loaded westbound bulk trains take advantage of the lower grades along the river, and once emptied, return east over the Stampede Pass route. With this change, the capacity of the route has been vastly enhanced over the previous bidirectional rail operation. The estimate for maximum practical capacity is about 39 trains per day, using the following formulae:⁴²

$$\text{Maximum Practical Capacity} = \text{Operator Efficiency} \times \text{Throughput}_{max}$$

$$\text{Throughput}_{max} = \frac{24V}{L_B(N_S - 1) + L_t}$$

Where,

$$\text{Operator Efficiency} = 60\% \text{ (assumed)}$$

⁴²Subhro Mitra, Denver Tolliver, and Sushil Mitra. Estimation of Railroad Capacity Using Parametric Methods, Journal of the Transportation Research Forum, Volume 49, Number 2 (summer 2010), pages 111-126.

$V = \text{Operating Train Speed} = 15 \text{ mph (assumed near Stampede Tunnel)}$

$L_B = \text{Block length (or train stopping distance)}$
 $= 3.0 \text{ miles (assumed for N/S or TWC Operation)}$

$N_S = \text{Number of Signal Aspects} = 3 \text{ (assumed for N/S or TWC Operation)}$

$L_t = \text{Train length} = 8,000 \text{ ft (assumed)}$

Stevens Pass Route. The Cascade Tunnel on Stevens Pass route is seven miles long, and freight trains are allowed to operate at a maximum speed of 15 mph (as per the 2011 BNSF Northwest Division timetable). Following a train's movement through the tunnel, about 20 to 30 minutes (or an average of about 25 minutes) are consumed to clear the tunnel of exhaust before the next train passes. Therefore, the maximum practical capacity of the route is estimated as follows:

$$\begin{aligned} \text{Maximum Practical Capacity} &= \frac{24 \text{ hrs/day}}{((7 \text{ miles}/15 \text{ mph}) + (25 \text{ min}/60 \text{ min per hr}))} \\ &= 28 \text{ trains per day (approx.)} \end{aligned}$$