CAMBRIDGE SYSTEMATICS

Washington State Rail Plan

Technical Note 3b: Passenger Rail Usage and Impacts of the Rail System on Washington State

Final Report

prepared for

Washington Department of Transportation

prepared by

Cambridge Systematics, Inc.

December 2013

www.camsys.com

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date

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Key Findings

This report summarizes the Cambridge Systematics, Inc. analysis of existing and historical ridership on the long-distance, intercity and commuter rail services in Washington. It further summarizes the freight and passenger rail system impacts on the state transportation system, the economy and the environment. The key findings and conclusions of this report are as follows:

Passenger Rail Ridership Findings

- **Annual ridership on the Empire Builder and Coast Starlight (long-distance service) has generally remained between 300,000 and 600,000 passengers (for each entire route) between 1982 and 2012.** Between 1982 and 1994, ridership remained relatively constant, with a large dip in the mid-1990s, followed by increases in the late 1990s. Within Washington, ridership on the Empire Builder peaked in 2008 at approximately 117,000 riders per year and declined to approximately 101,000 in 2011. The Coast Starlight ridership has varied between a high of approximately 93,000 in 2003 to 78,000 in 2011.
- **Annual ridership on Amtrak Cascades (intercity service) has increased by a factor of almost three since 1996.** In 1996 there were approximately 305,000 annual passengers. In 2011 there were almost 850,000 annual passengers (entire route). The most significant growth in ridership occurred in the late 1990s and early 2000s. This growth occurred consistently with the addition of new equipment and additional service along the route.
- **Annual ridership on Sounder (commuter service) has steadily increased since the service began operation in 2000. In 2012, ridership totaled just over 2.8 million riders.** The effects on ridership, due to the route extension and opening of stations at Lakewood and South Tacoma in October 2012, were not available at the time this report was prepared.

Demographic, Economic and Modal Trends

- **Population trends and population density influence demand for passenger rail.** In general, as population density increases in the vicinity of attractive (e.g. convenient, timely, cost-competitive) passenger rail service, more people will choose rail as a transportation option. Washington has a population density of 102 inhabitants per square mile (greater than the national average of 88 inhabitants per square mile).[1] In addition, the state's population grew from just under five million people in 1990 to approximately 6.8 million in

[1] United States Census Bureau. Estimates for July 1, 2011.

2010. Factors driving this growth include migration from other states and countries, life expectancy and birth rates.

- **Seventy-eight percent of Washington residents live in the western part of the state, a pattern which has remained relatively constant over the last 20 years.** Given the fact that more than three-quarters of the population lives in western Washington, it follows that passenger rail demand is high and growing along the Pacific Northwest Rail Corridor (PNWRC).
- **Intercity rail (Amtrak Cascades) ridership trends have followed a trend similar to Gross State Product (GSP) and median household income.** Between 1997 and 2008, GSP has grown steadily from $185.0 to $355.1 billion (current) dollars.
- **The Amtrak Cascades service is one of many transportation options on the PNWRC including automobile, intercity bus and airplane travel.** Between Seattle and Portland, Amtrak Cascades is an alternative to automobile and air travel based on time and cost. However, auto travel tends to be more convenient between other origins and destinations along the corridor.

Impacts of Rail Findings

- **Passenger and freight trains can both play a role in absorbing some of the expected growth in highway traffic**. By shifting travelers from road to rail, traffic volume along the parallel highways will decrease. In addition, moving more goods via rail will similarly decrease truck travel. Each truck shipment diverted to rail releases the equivalent highway capacity of two to three passenger vehicles.
- **Freight and passenger rail operations present opportunities to lower greenhouse gas emissions (GHG) and reduce energy consumption levels.** The inherent efficiency of a steel wheel rolling on a steel rail, combined with the gains from moving trainloads of freight instead of individual truckloads offers a two- to four-fold savings in energy consumption over highway transport. This reduced fuel consumption leads to a direct reduction in GHG by 75 percent compared with moving the same amount of freight by truck.
- **The safety and security of the rail network is crucial to attracting and maintaining passenger travelers and freight rail operators.** According to the Federal Railroad Administration's Office of Safety Analysis, in 2011 there were 207 combined total train incidents within Washington. These consisted of operational/train accidents, highway-rail incidents, and those classified as "other." Most incidents in the "other" category involve trespassers. The number of annual average total train incidents in Washington state is consistent with national state averages and follows similar trends.
- **There can be both positive and negative impacts to communities in Washington state as a result of increased freight and passenger rail service.** Increases in passenger rail frequency and operating speeds can bring positive

economic benefits to communities with stations and lead to indirect benefits from tourism spending. Increases in freight rail traffic can divert shipments from trucks and connect Washington ports and shippers to national and international markets. However, increases in freight rail daily train counts can adversely affect communities on higher-volume freight corridors, blocking highway-rail grade crossings more frequently and leading to noise and air quality concerns.

1.0 Introduction

Technical Note 3b provides a summary of historical and current passenger rail ridership demand in Washington. Passenger rail ridership is driven by a number of factors, including population and population density, average income, the type of rail service offered, and the presence of comparable transportation options (such as intercity air service, bus or highways). It further summarizes the freight and passenger rail system impacts on the state transportation system, the economy, and the environment. The information developed in this technical note will be used to support the forthcoming needs analysis and project evaluation process.

For definitional purposes, three different passenger rail service types are discussed:

- **Long-Distance Routes** – consisting of the Empire Builder and the Coast Starlight both operated by Amtrak. The Empire Builder is a daily service connecting Seattle and Portland, Oregon (OR) with Chicago. The Coast Starlight also operates daily between Seattle and Los Angeles.
- **Intercity Route** – The Amtrak Cascades connects Eugene, OR and Vancouver, British Columbia along the Pacific Northwest Rail Corridor.
- **Commuter Service** – Sound Transit provides Sounder Commuter rail between Everett and Seattle, and Lakewood and Seattle.

This technical note is organized as follows:

- **Section 2.0 – Existing Passenger Rail System Usage** presents an overview of historical and current ridership on the long-distance, intercity and commuter rail services in Washington.
- **Section 3.0 – Demographic, Employment and Modal Trends** summarizes statewide population, population density, and income and the influence on passenger rail demand in Washington.
- **Section 4.0 – Impacts of Freight and Passenger Rail** discusses some of the positive and negative environmental, safety and transportation system impacts of rail.

2.0 Existing Passenger Rail System Usage

2.1 PASSENGER RAIL RIDERSHIP AND TRENDS

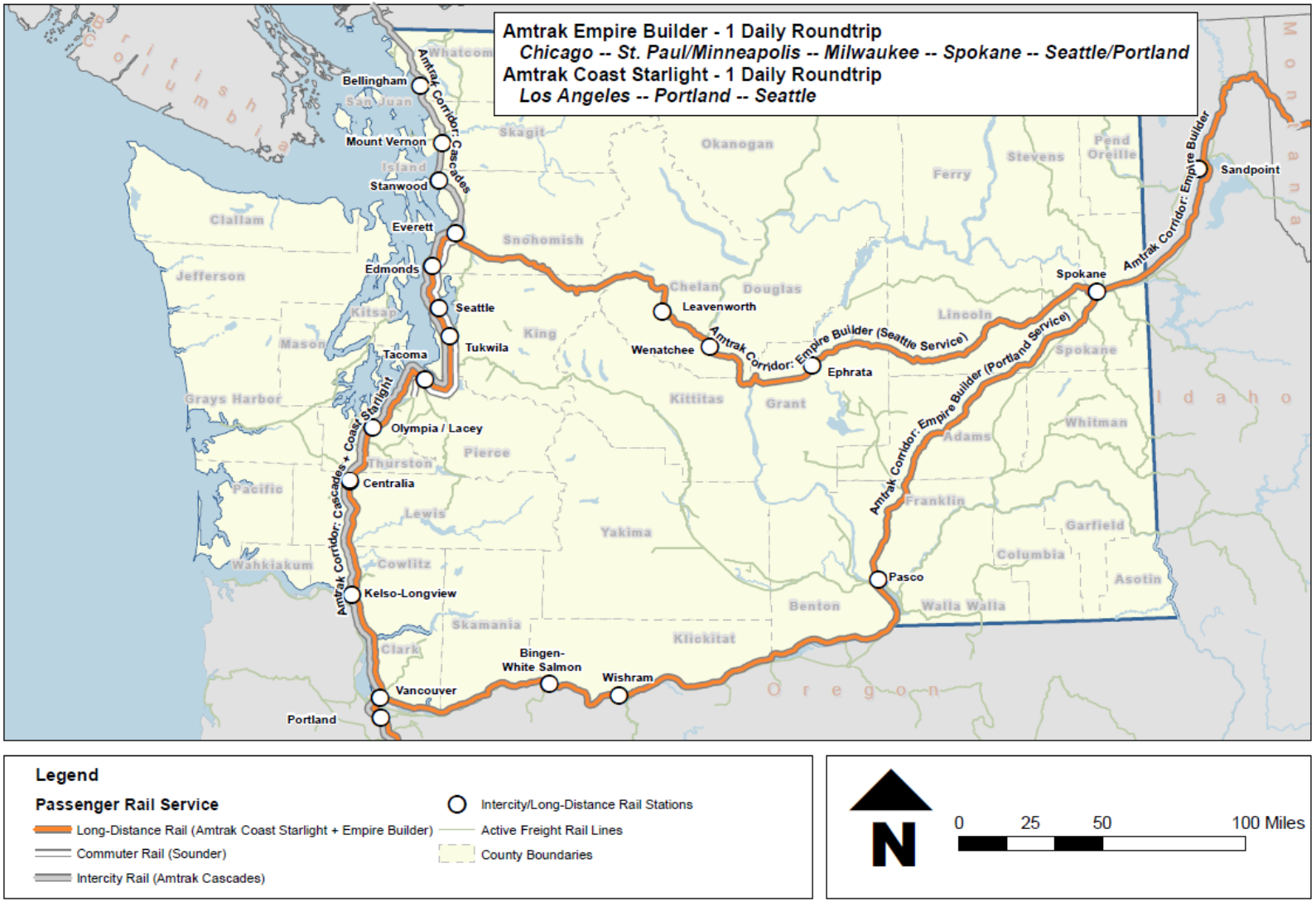
Historical Ridership

Existing and historical ridership data are presented for the long-distance, intercity and commuter rail lines in Washington state. Amtrak provided Empire Builder and Coast Starlight data, the Washington State Department of Transportation (WSDOT) provided data for Amtrak Cascades, and Sound Transit provided commuter rail data.

Long-Distance Routes – Empire Builder and Coast Starlight

The Empire Builder and the Coast Starlight are long-distance passenger rail services that operate in Washington; both routes are shown in Figure 2.1. The Empire Builder provides daily service between Chicago and Seattle/Portland via Spokane. The Empire Builder service is 326 miles between Seattle and Spokane. The Portland to Spokane Empire Builder route is 376 miles through the Columbia River Gorge, southeastern Washington and on to Spokane. The two routes combine in Spokane and continue as one train to Chicago for an additional 1,879 miles. The Coast Starlight service also operates once daily between Los Angeles, Oakland, Portland and Seattle—a distance of 1,377 miles.

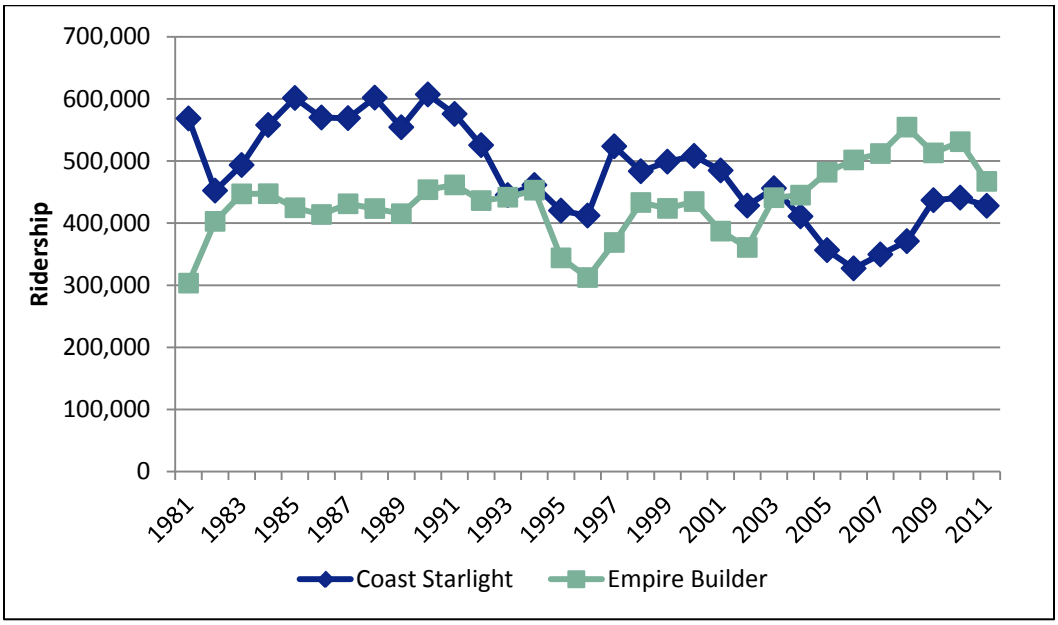
Figure 2.1 Amtrak Long-Distance Passenger Rail in Washington



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Washington, D.C. (2010). National Transportation Atlas Database 2010.

Figure 2.2 shows the Empire Builder and Coast Starlight ridership from 1981 to 2011. For both services, the ridership information is for the complete route. As shown, ridership trends on both routes were similar until 2004, when the Empire Builder ridership continued to increase and Coast Starlight ridership declined. Both routes also saw a decline in ridership during the recent recession. The Coast Starlight's ridership peaked in the 1990s with approximately 607,000 passengers; Empire Builder's ridership peaked in 2008 with approximately 555,000 passengers. In 2011, the most recent complete calendar year of data, ridership was approximately 428,000 on the Coast Starlight and approximately 467,000 on the Empire Builder.

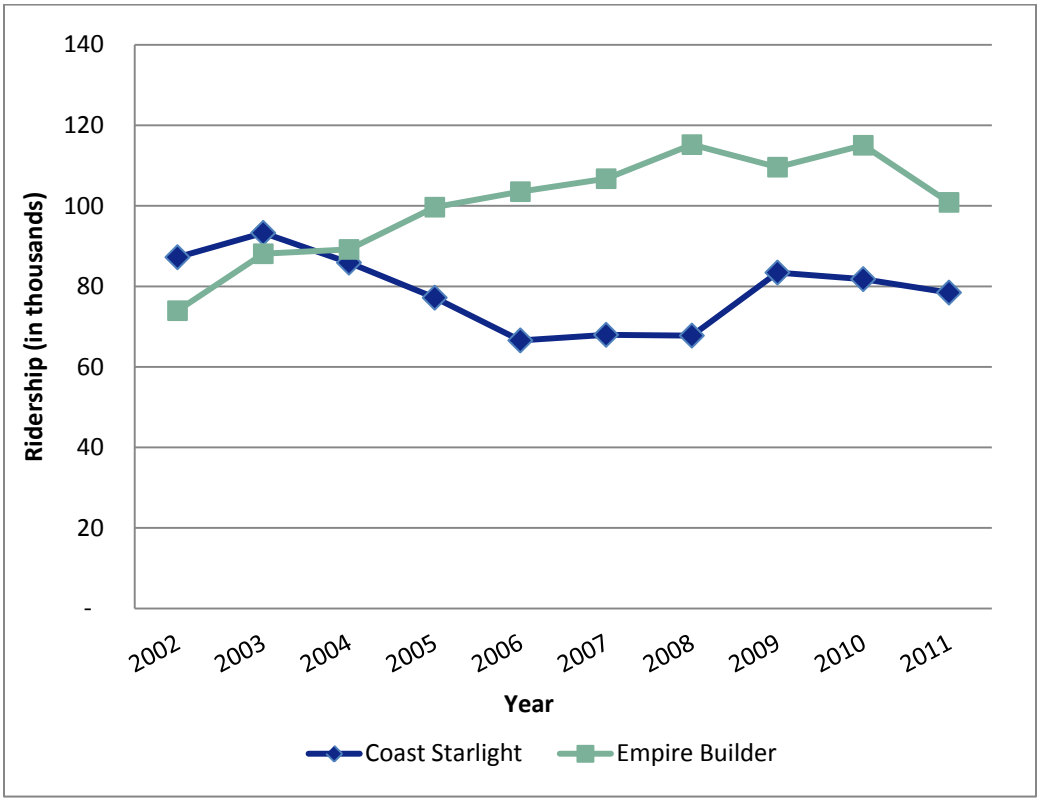
Figure 2.2 Empire Builder and Coast Starlight Ridership, 1981-2011



Source: Amtrak. (2012).

Figure 2.3 presents the Washington-only ridership for these two routes between 2002 and 2011. As shown within Washington, ridership on the Empire Builder peaked in 2008 at approximately 117,000 riders per year and declined to approximately 101,000 in 2011. The Coast Starlight ridership has varied between a high of approximately 93,000 in 2003 to 78,000 in 2011.

Figure 2.3 Empire Builder and Coast Starlight Ridership in Washington, *2002-2011*



Source: Amtrak. (2012).

Notes: a) Ridership is presented by calendar year. b) Ridership is defined as "Ons" + "Offs" divided by 2. c) There are no data for the Washington stations in February and March 2008, so the 2008 ridership number shows only 10 months of data.

Figure 2.4 shows Empire Builder annual station level ridership between 2002 and 2011. Station specific ridership has been consistently highest at the Seattle and Spokane stations.

Figure 2.4 Empire Builder Ridership at Washington Stations

2002 to 2011

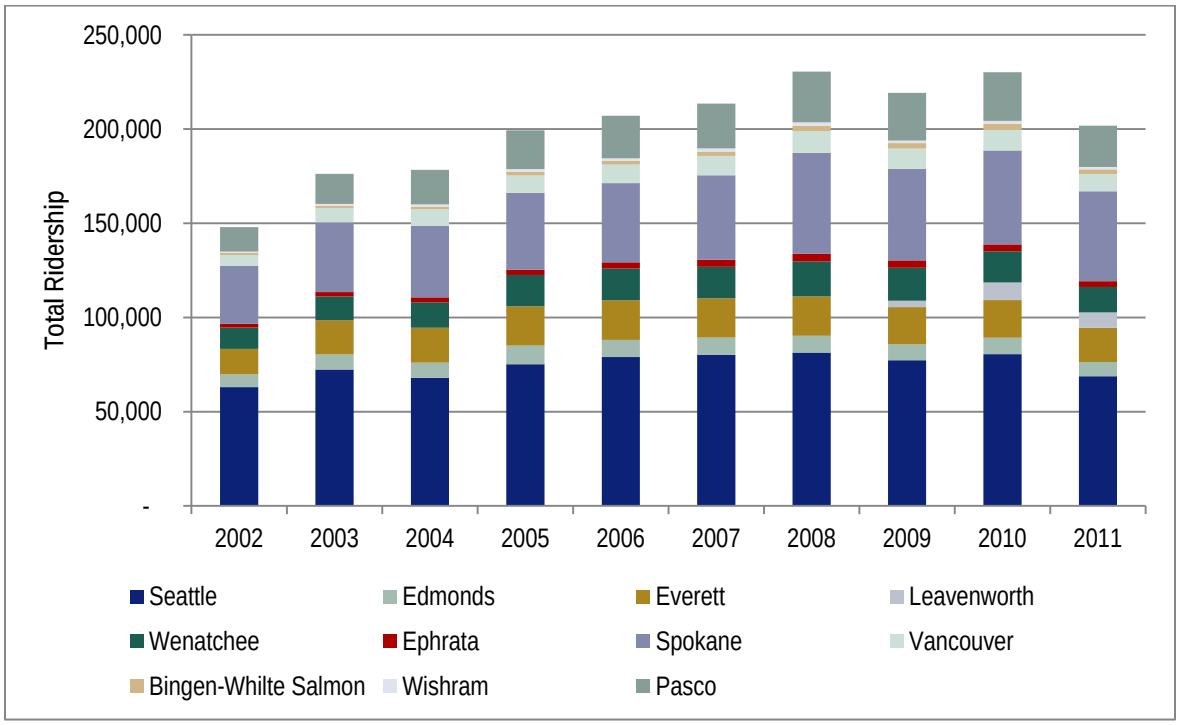
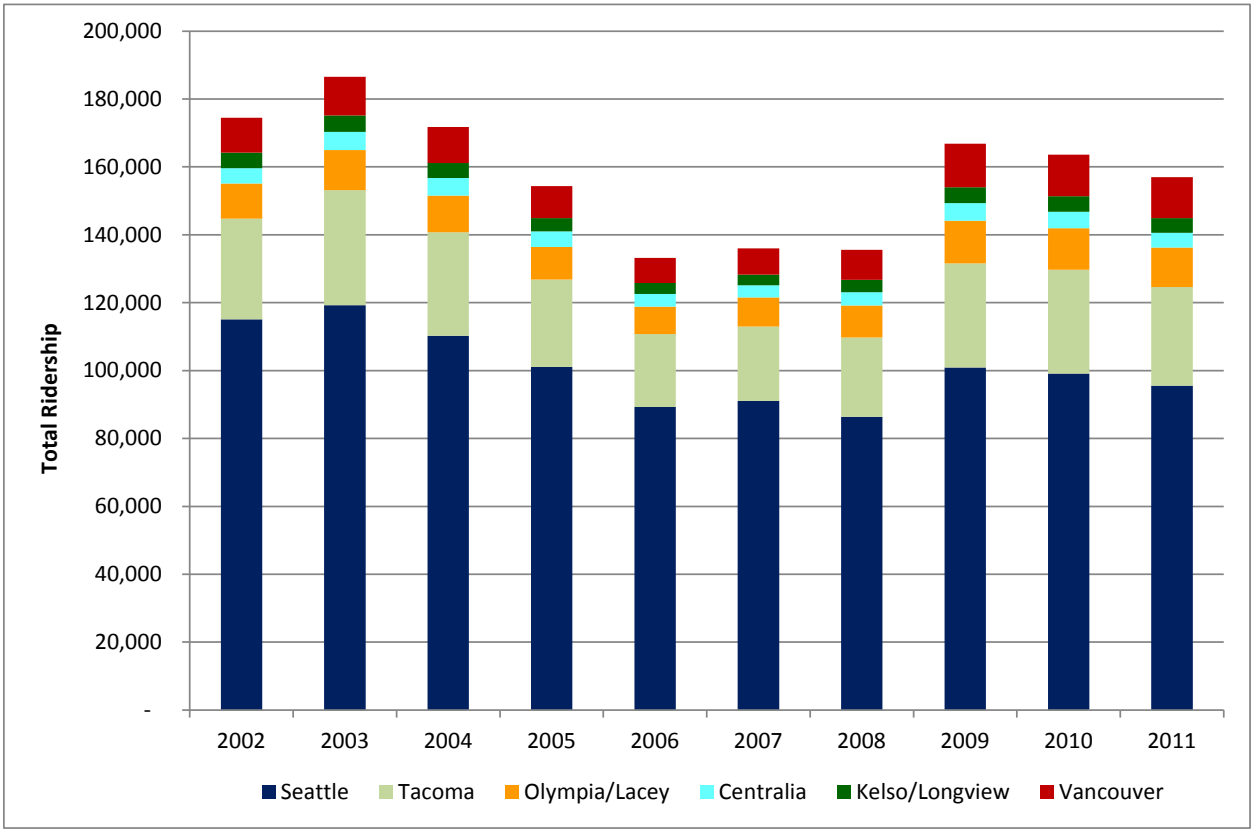


Figure 2.5 shows the Coast Starlight annual ridership per station per year in Washington for the same period. Between 2002 and 2011 annual ridership has been highest at the Seattle and Tacoma stations.

Figure 2.5 Coast Starlight Ridership at Washington Stations

2002 to 2011



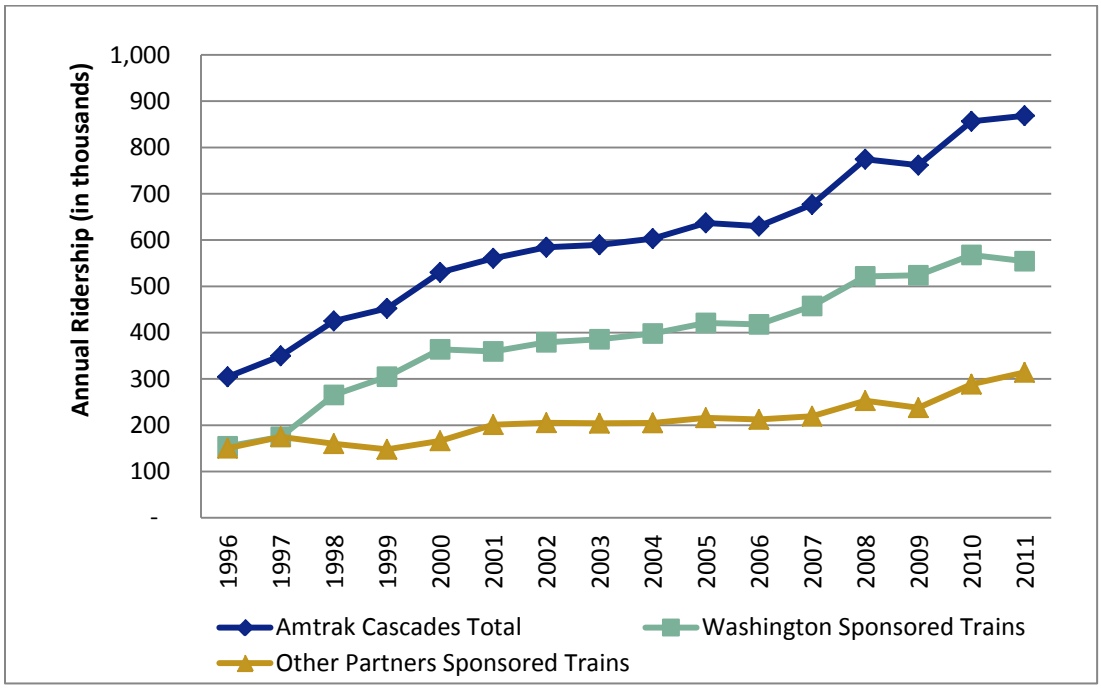
Intercity Rail – Amtrak Cascades

The Amtrak Cascades service extends 467 miles from Eugene, Oregon (OR) to Vancouver, British Columbia (B.C.). There are 11 daily trains: two operate between Vancouver, B.C. and Seattle; two operate between Vancouver, B.C. and Portland, OR; three operate between Seattle and Portland; three operate between Seattle and Eugene, OR; and one operates between Portland and Eugene.[2] The Amtrak Cascades follows the Pacific Northwest Rail Corridor (PNWRC), connecting some of the densest populations in Oregon and nine counties in Washington. Figure 2.6 shows the Amtrak Cascades ridership (by funding partner) from 1996 to 2011. Three historical ridership trend lines are included: one showing total ridership on all Amtrak Cascades trains, one showing ridership on Washington-sponsored trains, and one showing ridership on trains sponsored by other partners.

[2] WSDOT, 2006, *Washington State Long-Range Plan for Amtrak Cascades.*

Total ridership on Amtrak Cascades has nearly tripled since 1996, with significant growth in the late 1990s as new services and equipment were added. In 2011, the most recent year for which complete data are available, total ridership was almost 850,000.[3]

Figure 2.6 Amtrak Cascades Ridership by Funding Partner, 1996-2011



Source: WSDOT Rail Division (2012).

Table 2.1 lists quarterly data for all state-supported Amtrak Cascades trains. This table shows that ridership, ticket revenue and passenger miles all increase during the summer tourist season in the second and third quarters of each year. This table also shows steady growth in ticket revenue per passenger mile over time.

[3] This includes data for the entire Amtrak Cascades route; not just the state-supported trains.

Table 2.1 Amtrak Cascades State-Supported Quarterly Revenues, Ridership and Passenger Miles

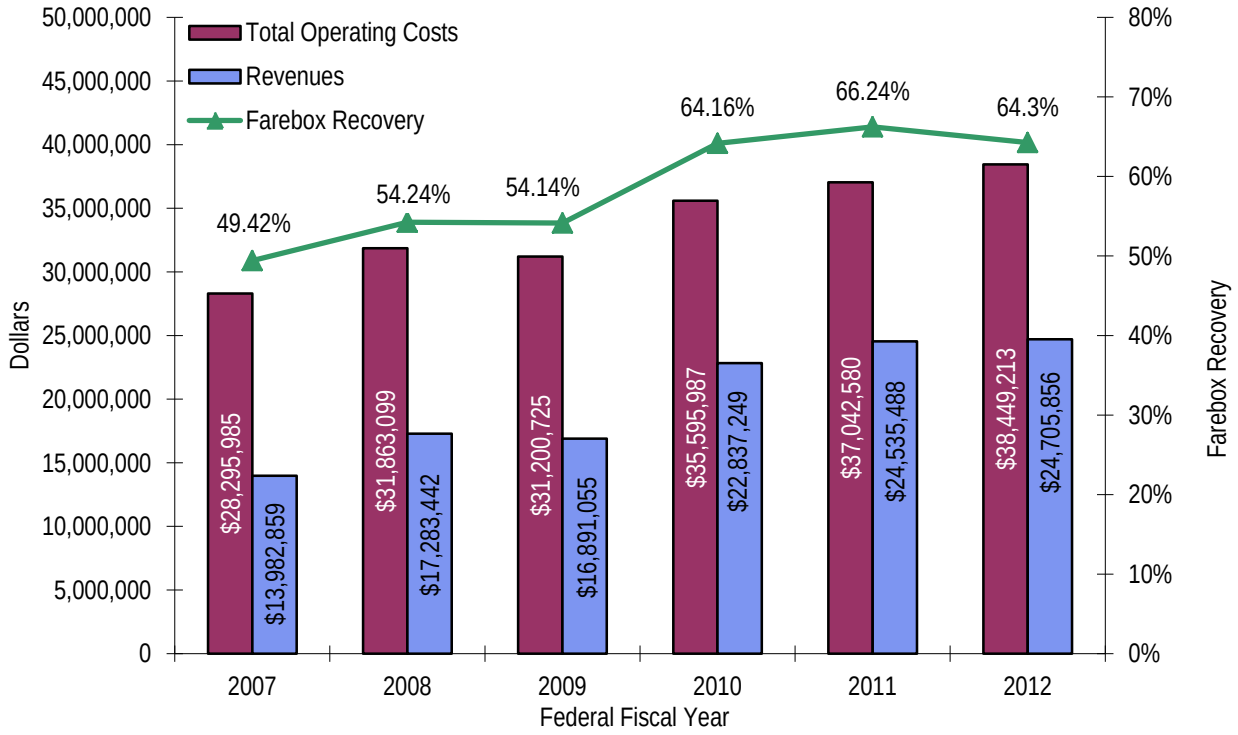
Year	Quarter	Ticket Revenues	Ridership	Passenger Miles	Ticket Revenue per Pass-Mile
2007	1st Qtr	$2,618,030	95,629	14,833,057	$0.18
	2nd Qtr	$3,272,337	124,871	19,030,593	$0.17
	3rd Qtr	$3,315,616	126,617	19,199,745	$0.17
	4th Qtr	$3,127,196	110,384	17,190,156	$0.18
2008	1st Qtr	$3,084,391	111,577	17,402,754	$0.18
	2nd Qtr	$3,683,262	137,716	21,088,683	$0.17
	3rd Qtr	$4,520,760	154,354	24,157,991	$0.19
	4th Qtr	$3,475,296	117,956	18,255,408	$0.19
2009	1st Qtr	$2,774,402	100,859	15,668,055	$0.18
	2nd Qtr	$3,540,114	129,791	19,865,422	$0.18
	3rd Qtr	$4,817,488	156,769	24,780,075	$0.19
	4th Qtr	$4,254,021	136,389	22,071,208	$0.19
2010	1st Qtr	$4,230,776	128,054	20,764,454	$0.20
	2nd Qtr	$5,207,269	149,270	23,847,970	$0.22
	3rd Qtr	$6,336,318	167,886	27,443,784	$0.23
	4th Qtr	$4,866,505	135,170	21,681,665	$0.22
2011	1st Qtr	$4,017,246	113,239	18,440,628	$0.22
	2nd Qtr	$5,801,979	160,398	25,902,989	$0.22
	3rd Qtr	$6,963,017	176,979	29,121,510	$0.24
	4th Qtr	$5,241,803	132,334	21,385,520	$0.25
2012	1st Qtr	$4,415,327	124,464	19,680,764	$0.22
	2nd Qtr	$5,906,934	154,015	23,630,050	$0.25
	3rd Qtr	$6,786,350	166,629	26,908,908	$0.25
	4th Qtr	$4,752,840	122,215	19,676,257	$0.24

Source: WSDOT Rail Division

Comparing passenger rail revenues to operating costs yields a farebox recovery ratio, a relative measure of how much the state-supported Amtrak Cascades service revenues compare to costs. This data is shown in Figure 2.7. The farebox recovery ratio has increased from 49 percent to 64 percent from 2007 to 2012. This measure compares favorably to California state-supported intercity passenger rail routes, which measure from 49 percent to 60 percent.

Figure 2.7 Amtrak Cascades Total Operating Cost, Revenue and Farebox Recovery Rate for Washington-Funded Trains

Federal FY 2007 – 2012



Source: WSDOT Rail Division - Based on financial billing data from Amtrak.

Note: Amtrak Cascades farebox recovery ratio for FFY2012 reached 64.3%, a drop from FFY2011. The total revenue increased 0.7% while ridership dropped 1.4% and cost increased 3.8%.

WSDOT also collects data by state-supported train Table 2.2 lists annual totals for each state-supported train for ridership, revenue and revenue per rider. Data on Trains 513 and 516 are disaggregated into 051310 and 051610 (for tickets for travel between Seattle and Portland), and 051320 and 051620 (for tickets beyond Seattle to Portland). The top three state-supported trains for ridership and revenue are 051320, 051620 and 050600, while a number of trains exceed 050600 in revenue per rider, including 051310, 051610 and 050710 (Seattle to Portland).

Table 2.2 Annual Train Statistics for Washington-Supported Trains

Train No.	050100	050600	050710	050800	051000	051310	051320	051610	051620	051700
Direction	SB	NB	SB	NB	NB	SB	SB	NB	NB	SB
City Pair	SEA-PDX	PDX-SEA	SEA-PDX	PDX-SEA	SEA-VAC	SEA-PDX	VAC-PDX	PDX-SEA	PDX-VAC	VAC-SEA
Time of Day	MORN	MID	AFT	EVE	MORN	MID	MORN	AFT	EVE	EVE
Ridership by State-Sponsored Train										
2007	43,392	71,855	50,425	52,103	42,435	43,060	36,185	47,241	33,304	37,501
2008	55,342	76,356	54,521	59,133	42,598	51,356	49,336	49,822	45,586	37,553
2009	53,130	74,680	55,275	52,993	47,217	47,852	56,286	45,400	51,791	39,184
2010	56,324	79,331	58,027	57,116	51,546	47,563	74,835	45,584	66,344	43,641
2011	60,507	76,790	56,265	56,050	54,744	46,972	75,181	45,534	67,076	43,831
2012	57,990	75,499	55,737	54,053	51,565	47,556	75,393	42,710	65,094	41,726
Revenue by State-Sponsored Train										
2007	$1,133,780	$1,923,096	$1,447,789	$1,485,775	$1,143,655	$1,147,677	$846,271	$1,362,578	$814,545	$1,028,013
2008	$1,516,874	$2,169,360	$1,636,255	$1,723,643	$1,189,602	$1,486,867	$1,293,753	$1,492,943	$1,201,503	$1,052,908
2009	$1,443,614	$2,147,979	$1,688,461	$1,535,100	$1,468,256	$1,403,109	$1,644,845	$1,375,686	$1,484,393	$1,194,582
2010	$1,673,463	$2,712,346	$2,083,469	$1,925,393	$1,924,492	$1,625,434	$2,984,058	$1,643,065	$2,586,756	$1,482,392
2011	$1,990,359	$2,784,944	$2,137,417	$2,002,483	$1,932,777	$1,757,966	$3,311,205	$1,751,025	$2,881,843	$1,474,026
2012	$1,891,590	$2,778,387	$2,139,752	$1,879,084	$1,830,650	$1,798,827	$3,555,956	$1,685,970	$2,934,846	$1,366,389
Revenue per Rider										
2007	$26.13	$26.76	$28.71	$28.52	$26.95	$26.65	$23.39	$28.84	$24.46	$27.41
2008	$27.41	$28.41	$30.01	$29.15	$27.93	$28.95	$26.22	$29.97	$26.36	$28.04
2009	$27.17	$28.76	$30.55	$28.97	$31.10	$29.32	$29.22	$30.30	$28.66	$30.49
2010	$29.71	$34.19	$35.91	$33.71	$37.34	$34.17	$39.88	$36.04	$38.99	$33.97
2011	$32.89	$36.27	$37.99	$35.73	$35.31	$37.43	$44.04	$38.46	$42.96	$33.63
2012	$32.62	$36.80	$38.39	$34.76	$35.50	$37.83	$47.17	$39.47	$45.09	$32.75

Source: WSDOT Rail Division

Note: Trains 050010 and 050910 operate in Washington, but are Amtrak-supported.

Quarterly data on train capacity was also available for 2011 and 2012, so in addition to data on ridership, revenue and revenue per rider, Table 2.3 includes capacity per train and ridership as a percentage of capacity. This quarterly train data shows similar seasonal increases during the second and third quarter as the annual totals. Seasonal ridership/capacity measures are high for trains 051000 and 051320, but year-round ridership/capacity is high for trains 050600 and 051320, which explains why those trains have the highest total annual ridership and revenues.

Table 2.3 Quarterly Washington-Sponsored Train Results

2011 and 2012

Train No.		050100	050600	050710	050800	051000	051310	051320	051610	051620	051700	
Direction		SB	NB	SB	NB	NB	SB	SB	NB	NB	SB	
City Pair		SEA-PDX	PDX-SEA	SEA-PDX	PDX-SEA	SEA-VAC	SEA-PDX	VAC-PDX	PDX-SEA	VAC-PDX	VAC-SEA	
Time		MORN	MID	AFT	EVE	MORN	MID	MORN	AFT	EVE	EVE	TOTALS
Ridership by State-Sponsored Train												
2011	1st Qtr	13,092	16,000	12,079	11,592	7,845	9,438	14,151	9,794	12,653	6,595	113,239
	2nd Qtr	16,359	20,209	15,220	15,180	16,642	12,389	20,662	12,663	18,920	12,154	160,398
	3rd Qtr	16,473	22,270	15,934	15,587	20,264	13,646	23,364	12,253	20,627	16,561	176,979
	4th Qtr	14,583	18,311	13,032	13,691	9,993	11,499	17,004	10,824	14,876	8,521	132,334
2012	1st Qtr	12,724	16,836	12,954	12,577	9,157	11,196	15,369	10,632	14,693	8,326	124,464
	2nd Qtr	15,983	20,173	14,507	14,692	15,322	12,400	20,572	10,992	17,882	11,492	154,015
	3rd Qtr	15,778	20,631	14,631	13,605	19,558	12,218	24,351	10,572	19,693	15,592	166,629
	4th Qtr	13,505	17,859	13,645	13,179	7,528	11,742	15,101	10,514	12,826	6,316	122,215
State-Sponsored Train Capacity												
2011	1st Qtr	24,380	24,402	24,391	24,247	22,273	24,294	24,380	24,413	24,380	22,298	239,458
	2nd Qtr	24,721	24,732	24,743	24,685	22,204	24,685	24,685	24,721	24,721	22,240	242,137
	3rd Qtr	25,001	24,968	24,979	24,962	22,448	24,962	25,023	25,023	25,023	22,509	244,898
	4th Qtr	25,001	25,001	25,001	25,001	22,448	25,001	25,012	25,001	25,012	22,448	244,926
2012	1st Qtr	24,679	24,668	24,657	24,585	21,689	24,585	24,635	24,657	24,635	21,689	240,479
	2nd Qtr	24,407	24,346	24,385	24,407	19,819	24,407	24,443	24,454	24,454	19,819	234,941
	3rd Qtr	24,812	24,812	24,807	24,848	21,398	24,848	24,848	24,837	24,837	21,398	241,445
	4th Qtr	24,901	24,951	24,883	24,805	20,459	24,805	24,876	24,901	24,901	20,448	239,930

State-Sponsored Train Ridership as a Percent of Capacity												
2011	1st Qtr	53.7%	65.6%	49.5%	47.8%	35.2%	38.8%	58.0%	40.1%	51.9%	29.6%	47.3%
	2nd Qtr	66.2%	81.7%	61.5%	61.5%	75.0%	50.2%	83.7%	51.2%	76.5%	54.6%	66.2%
	3rd Qtr	65.9%	89.2%	63.8%	62.4%	90.3%	54.7%	93.4%	49.0%	82.4%	73.6%	72.3%
	4th Qtr	58.3%	73.2%	52.1%	54.8%	44.5%	46.0%	68.0%	43.3%	59.5%	38.0%	54.0%
2012	1st Qtr	51.6%	68.3%	52.5%	51.2%	42.2%	45.5%	62.4%	43.1%	59.6%	38.4%	51.8%
	2nd Qtr	65.5%	82.9%	59.5%	60.2%	77.3%	50.8%	84.2%	44.9%	73.1%	58.0%	65.6%
	3rd Qtr	63.6%	83.1%	59.0%	54.8%	91.4%	49.2%	98.0%	42.6%	79.3%	72.9%	69.0%
	4th Qtr	54.2%	71.6%	54.8%	53.1%	36.8%	47.3%	60.7%	42.2%	51.5%	30.9%	50.9%
State-Sponsored Train Ticket Revenue												
2011	1st Qtr	$406,597	$541,129	$437,067	$410,321	$249,450	$337,526	$578,412	$357,289	$491,882	$207,573	$4,017,246
	2nd Qtr	$509,108	$708,565	$558,800	$514,365	$576,334	$449,848	$854,173	$473,511	$766,959	$390,316	$5,801,979
	3rd Qtr	$557,669	$829,565	$614,722	$563,368	$756,202	$528,277	$1,095,423	$484,747	$942,560	$590,484	$6,963,017
	4th Qtr	$516,985	$705,685	$526,828	$514,429	$350,791	$442,315	$783,197	$435,478	$680,442	$285,653	$5,241,803
2012	1st Qtr	$394,903	$576,781	$477,603	$438,792	$283,947	$385,454	$636,807	$392,982	$581,495	$246,563	$4,415,327
	2nd Qtr	$519,589	$737,903	$550,713	$507,362	$546,426	$462,788	$976,058	$437,139	$799,276	$369,680	$5,906,934
	3rd Qtr	$516,067	$783,985	$585,020	$474,035	$747,375	$490,214	$1,232,795	$436,959	$969,913	$549,987	$6,786,350
	4th Qtr	$461,031	$679,718	$526,416	$458,895	$252,902	$460,371	$710,296	$418,890	$584,162	$200,159	$4,752,840
State-Sponsored Train Ticket Revenue per Rider												
2011	1st Qtr	$31.06	$33.82	$36.18	$35.40	$31.80	$35.76	$40.87	$36.48	$38.87	$31.47	$35.48
	2nd Qtr	$31.12	$35.06	$36.71	$33.88	$34.63	$36.31	$41.34	$37.39	$40.54	$32.11	$36.17
	3rd Qtr	$33.85	$37.25	$38.58	$36.14	$37.32	$38.71	$46.89	$39.56	$45.70	$35.66	$39.34
	4th Qtr	$35.45	$38.54	$40.43	$37.57	$35.10	$38.47	$46.06	$40.23	$45.74	$33.52	$39.61
2012	1st Qtr	$31.04	$34.26	$36.87	$34.89	$31.01	$34.43	$41.43	$36.96	$39.58	$29.61	$35.47
	2nd Qtr	$32.51	$36.58	$37.96	$34.53	$35.66	$37.32	$47.45	$39.77	$44.70	$32.17	$38.35
	3rd Qtr	$32.71	$38.00	$39.98	$34.84	$38.21	$40.12	$50.63	$41.33	$49.25	$35.27	$40.73
	4th Qtr	$34.14	$38.06	$38.58	$34.82	$33.59	$39.21	$47.04	$39.84	$45.55	$31.69	$38.89

Source: WSDOT Rail Division

Note: Trains 050010 and 050910 operate in Washington, but are Amtrak-supported.

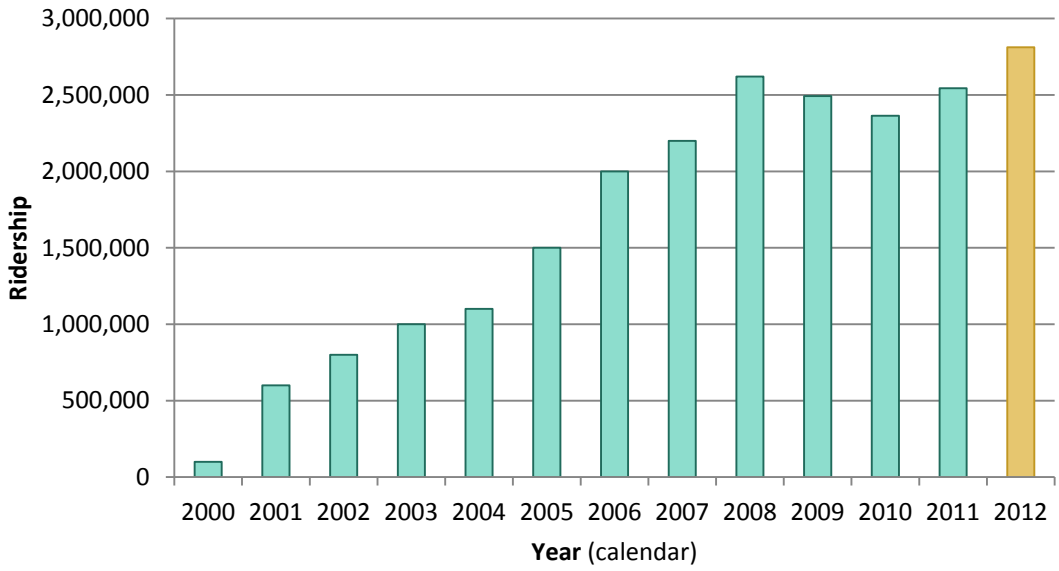
Commuter Rail – Sounder Service

The following discussion of Sounder Service is provided for additional context about rail transportation in Washington. It is a resource in order to consider the role of Sounder in commuter transportation.

Sounder Commuter Rail provides transportation between Everett, Seattle and Lakewood, a distance of about 82 miles. Service is divided into two routes—a North Line between Everett and Seattle, and a South Line between Lakewood and Seattle. Ridership numbers shown in Figure 2.8 and Figure 2.9 have been provided by Sound Transit.

Ridership has grown steadily from about 100,000 riders per year in 2000 (South Line only) to approximately 1 million people in 2003, when the North Line started operating. Total ridership was approximately 2.8 million passengers in 2012. According to Sound Transit, a slowly recovering economy and higher gasoline prices appear to be the main factors contributing to an increase in ridership.[4]

Figure 2.8 Sounder, Total Ridership



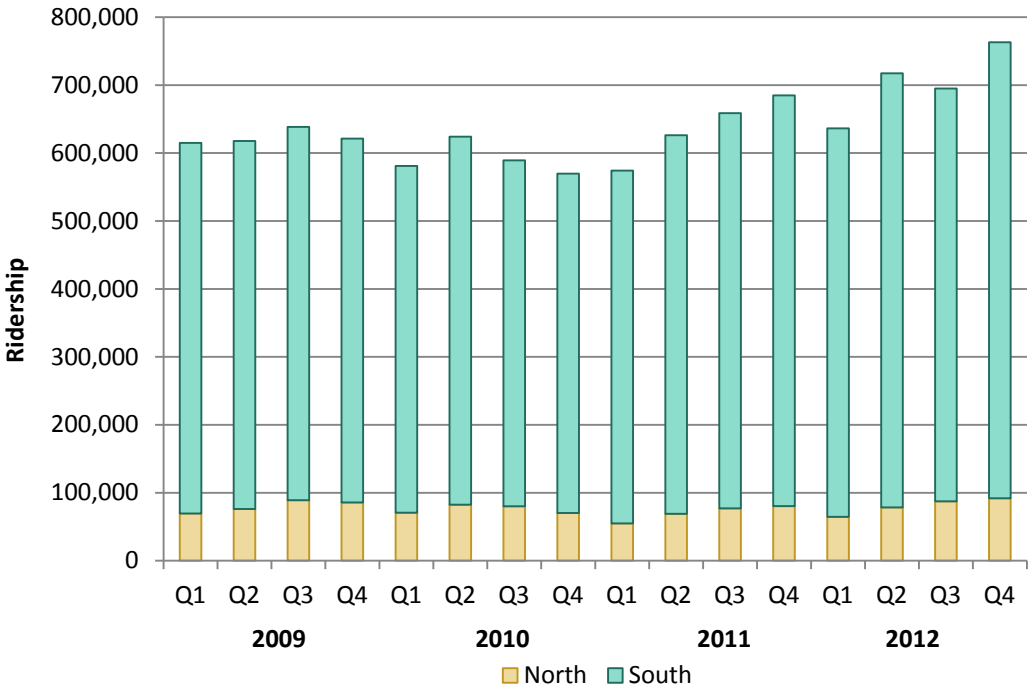
Source: Sound Transit

Note: 2012 data comes from both *Service Delivery Quarterly Performance Reports* and *Monthly Ridership Summaries* for October through December 2012

[4] Sound Transit, Quarterly Performance Report, Second Quarter 2012.

Figure 2.9 shows ridership by quarter from 2009 through the second quarter of 2012 and shows the distribution of ridership between the North and South Lines. As shown, ridership on the South Line accounts for 88 percent of all ridership on Sounder. The Sounder extension to Lakewood and South Tacoma did not start until October 8, 2012, so ridership levels from these stations are not reflected in third quarter totals.

Figure 2.9 Quarterly Ridership by Corridor



Source: Sound Transit.

Note: Boardings by corridor for 2012 are approximated based on historical ridership distributions and published data on total boardings. Data was not yet available at the corridor level.

Ridership Impacts

Beyond general economic conditions, demographics and other external factors, several specific issues have influenced ridership along these routes. These are:

- **Weather-Related Delays and Suspensions –** Amtrak Cascades experienced seven cancellations and 26 disruptions during the first quarter of 2013 due to landslides on the corridor between Seattle and Everett, which effects the Empire Builder and Sounder services, also. During the same period in 2012, there were eight cancellations and only four disruptions. Alternate transportation was provided so passengers reached their intended destination. When landslides occur, the BNSF Railway Company (BNSF) institutes a 48-hour moratorium on passenger rail service in the affected area.

WSDOT works closely with BNSF to determine the extent of the impact so it can deploy and communicate alternate bus service to our passengers.

Washington state is investing $16.1 million in federal high-speed rail funding to identify, design and construct slope stabilization needs along tracks between Seattle and Everett. Potential improvements under consideration include installing retaining walls, catchment systems, improving drainage systems and controlling erosion. Construction in at least one location will start in late summer 2013, with work starting on the remaining locations in 2014.

WSDOT is also leading an effort with Sound Transit, Amtrak, BNSF and adjacent local agencies to explore potential root causes of landslides through this particular area. These efforts will include sharing geotechnical, hydrological, historical slides and other data. However, it is recognized that the diverse topography, steep hillsides and historic slide patterns will continue to challenge these efforts to increase slope stabilization.[5]

- **Operational Reliability** – Operational reliability also impacts ridership and the economic performance of a service. The most common reasons affecting on-time performance include host-responsible delays that arise from freight train operations (congestion, breakdowns, etc.), speed restrictions due to track conditions, maintenance-related outages, signal problems and dispatching errors. Of lesser impact are delays under Amtrak's control, which include passenger incidents, late departures from stations and mechanical problems.[6]
- **Changes in Frequency –** The overriding factor that led to the Empire Builder's lower ridership between 1994 and 1996 was a reduction in frequency of service west of St. Paul, Minnesota. During that time, trains were operated four times per week instead of daily.[7]

2.2 TRAIN VOLUMES

Along with passenger rail ridership, a review of the current train volumes provides insight into rail demand across the state. Figure 2.10 shows average 2010 daily train volumes for both freight and passenger rail in Washington along the main routes. The map provides the actual number of trains that operate along each segment of the state's rail system. The volumes are segregated into daily freight trains and daily passenger trains. The daily passenger trains category

[5] www.wsdot.wa.gov/Projects/Rail/slidemanagement.

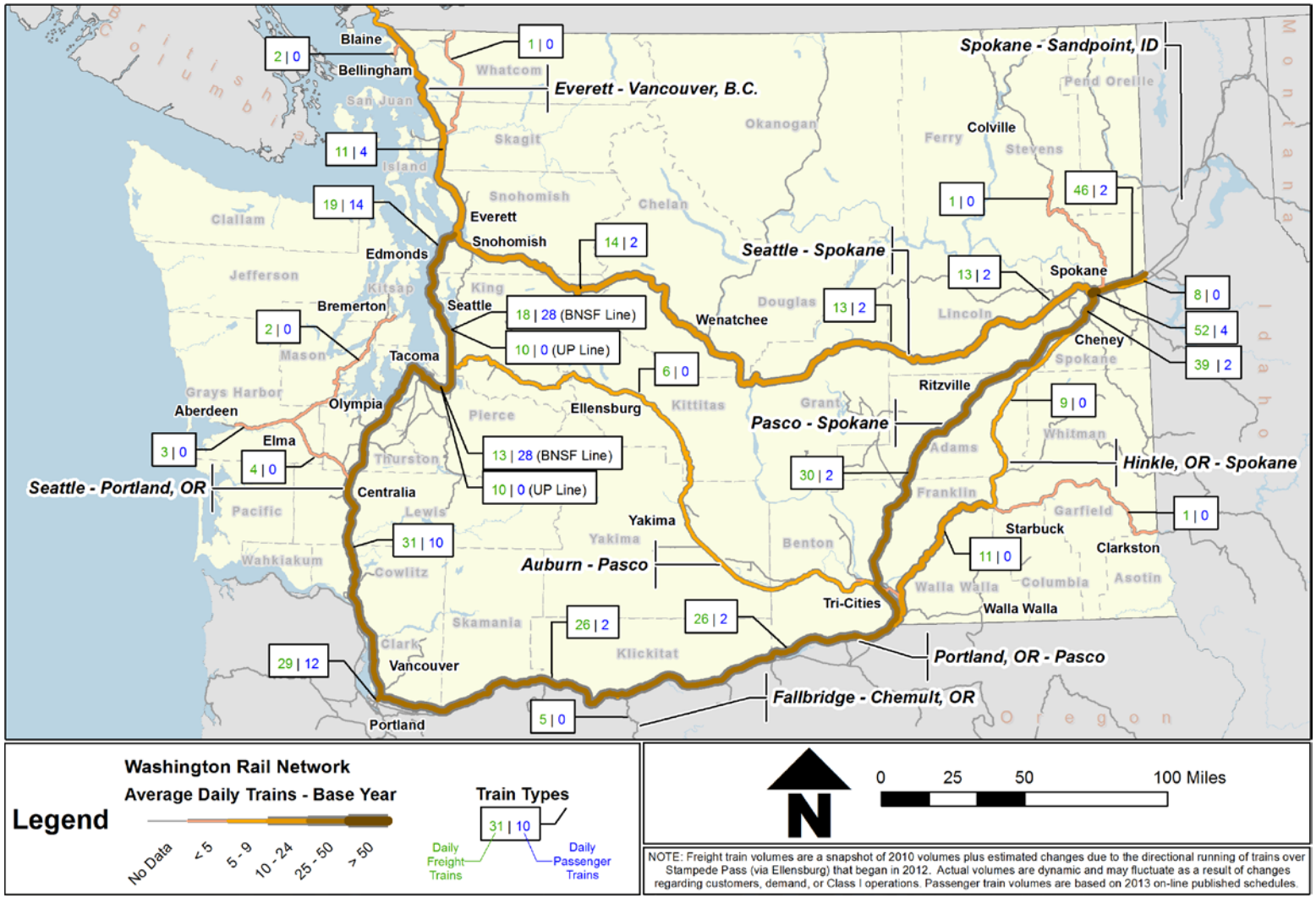
[6] Amtrak. (multiple dates in 2011 and 2012). Monthly Performance Reports.

[7] Great Northern Railway Historical Society. (2004). *75th Anniversary.* Accessed March 2013 from www.gnrhs.org/75th_anniversary.htm.

includes long-distance (Empire Builder and Coast Starlight), intercity (Amtrak Cascades), and commuter rail trains (Sounder).

This figure shows that the highest concentration of passenger rail services is located along the PNWRC. Within this corridor, passenger train volume is highest between Seattle and Tacoma because commuter, intercity and long-distance rail all operate on this segment. Considering freight and passenger rail services combined, the highest volumes are on the PNWRC and the segment between Spokane and Sandpoint, Idaho. This map serves as a basic planning tool when considering future service changes, because it illustrates how busy the state rail system is at various locations today and where there might be opportunities to add either freight or passenger rail service in the future.

Figure 2.10 Average 2010 Daily Train Volumes in Washington



Source: BNSF 2010 Train Counts Data for State of Washington; UP 2012 Q1 Train Counts Data for Spokane-Eastport, Idaho corridor; Cambridge Systematics' Estimation of 2010 Train Volumes using 2010 STB's Confidential Waybill Sample Data; and TransCAD model of Oak Ridge National Laboratory's (ORNL) Rail Network; Passenger train volumes from on-line schedules (2013).

3.0 Demographic, Employment and Modal Trends

Many factors drive passenger rail demand. First, it is important to look at the state's population trends. The size, location and density of a population in relation to its rail system is a key determinant of its success.

Economic indicators also influence passenger rail demand. Employment status and income level affect an individual's desire or ability to use passenger rail, which relates to demand. Looking more broadly, Gross State Product (GSP) [8] provides a rough measurement of Washington's economic output. The state's economic success is linked to the global economy as well as to individuals' economic success. Similar to the ridership/population comparisons, considering the state's economic indicators and ridership trends can show relationships between these factors, which can inform ridership forecasting assumptions and projections.

Finally, Washington state has a multimodal transportation network. Passenger rail is just one of many modes that people use to travel within and outside the state. The attractiveness of other modes with regard to price, convenience and travel time affects ridership demand. Automobile, bus and airplane travel time and costs along the Pacific Northwest Rail Corridor (PNWRC) are discussed in this section to provide context about the choices available to transportation users in Washington.

3.1 DEMOGRAPHIC TRENDS

Overall Population

Figure 3.1 shows the state's population trends between April 1, 1990 and April 1, 2010. During this period, the population grew from approximately 5 million people in 1990 to approximately 6.8 million in 2010. The population is still growing, and recorded an increase of about 50,000 people between April 2011 and April 2012.[9]

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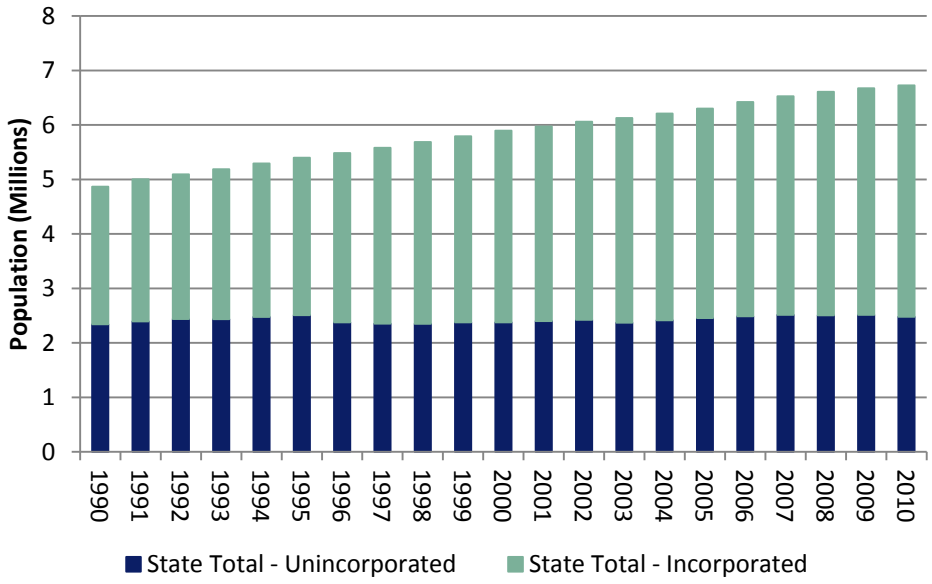
[8] GSP measures the economic output of a state. Gross Domestic Product (GDP) refers to the output of the entire United States.

[9] State of Washington Office of Financial Management. (September 2012.) *2012 Population Trends.* www.ofm.wa.gov/pop/april1/poptrends.pdf.

This population growth is a result of several factors, notably migration from other states and countries, increased life expectancy and the birth rate of the state's residents. In the 1990s, the average number of people moving to Washington was 64,500; in the 2000s, migration averaged about 45,000. Birth rates have also been declining for the past three years. Between April 2011 and April 2012, the birth rate hit its lowest point in more than 60 years at 12.4 births per 1,000 people.[10] Despite these slowing trends, overall population is still growing, though at a slower rate than during the 1990s.

Figure 3.1 Washington Population, 1990-2010



Source: State of Washington Office of Financial Management. Historical estimates of April 1 population and housing for the state, counties and cities: 1990-2010 (intercensal estimates).

Notes: Unincorporated areas are those that are not part of a city. The intercensal estimate methodology can be found here: www.ofm.wa.gov/pop/april1/hseries/ofm_april1_intercensal_estimates_methodology_1990-2000.pdf.

Population Distribution

Population patterns provide a deeper understanding of the state's transportation needs and provide support for the reasons the rail system has developed into its current network. Information about population centers is one important indicator. Seventy-eight percent of Washington residents live in the western part of the state, a pattern that has remained relatively constant over the last

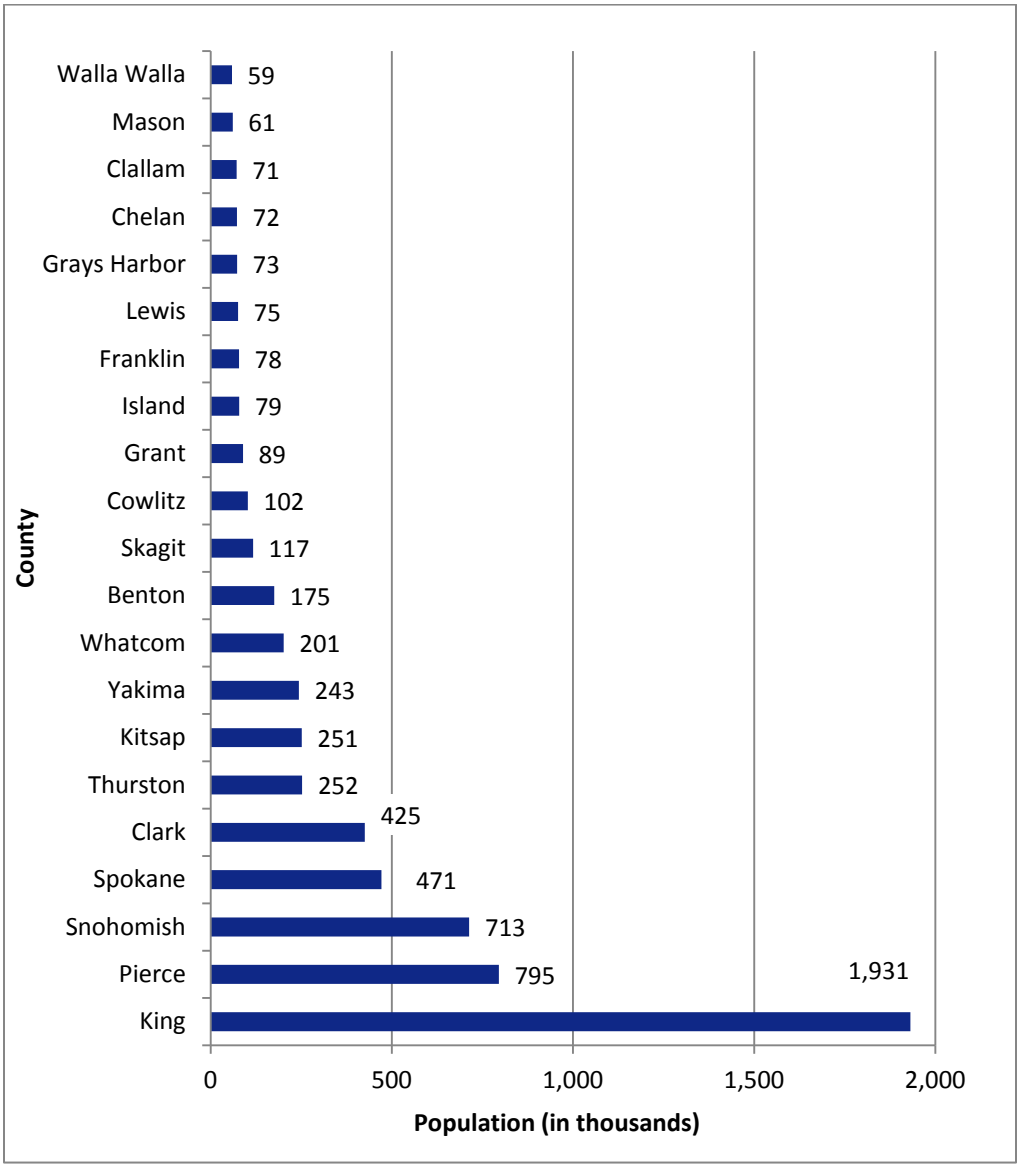
[10] Ibid.

20 years.[11] Given the high density of population in western Washington, it follows that passenger rail demand is high and growing along the PNWRC.

Figure 3.2 shows Washington's population in 2010 for counties with populations of 50,000 or greater. Of the 39 counties in Washington, 21 counties have a population of 50,000 or more. Of the 18 counties with a population less than 50,000, half of them have a population of less than 20,000. Figure 3.2 also shows that the state's population is primarily concentrated in five counties: King, Pierce, Snohomish, Spokane and Clark. This is not surprising given that these counties contain major metropolitan areas including: Seattle (King), Tacoma (Pierce), Everett (Snohomish), Spokane (Spokane) and Vancouver, WA (Clark). All but one of these counties is located in western Washington, which provides further support for the significant rail infrastructure in the western part of the state.

[11] Ibid.

Figure 3.2 Washington Population for Counties with Population of 50,000 or Higher (2010)



Source: State of Washington Office of Financial Management. Historical estimates of April 1 population and housing for the state, counties and cities: 1990-2010 (intercensal estimates).

Additionally, the state's growth is focused in metropolitan counties. Figure 3.3 shows the distribution of population change by county between 2011 and 2012. Seventy-six percent of Washington's population growth between 2011 and 2012 occurred in some of the largest metropolitan counties including King, Pierce, Snohomish, Clark, Spokane, Thurston, Whatcom and Yakima. King, Pierce, and Snohomish Counties, shown in the darkest color on the map, saw the largest growth in terms of the number of people added at 14,400 (0.74%); 5,900 (0.82%);

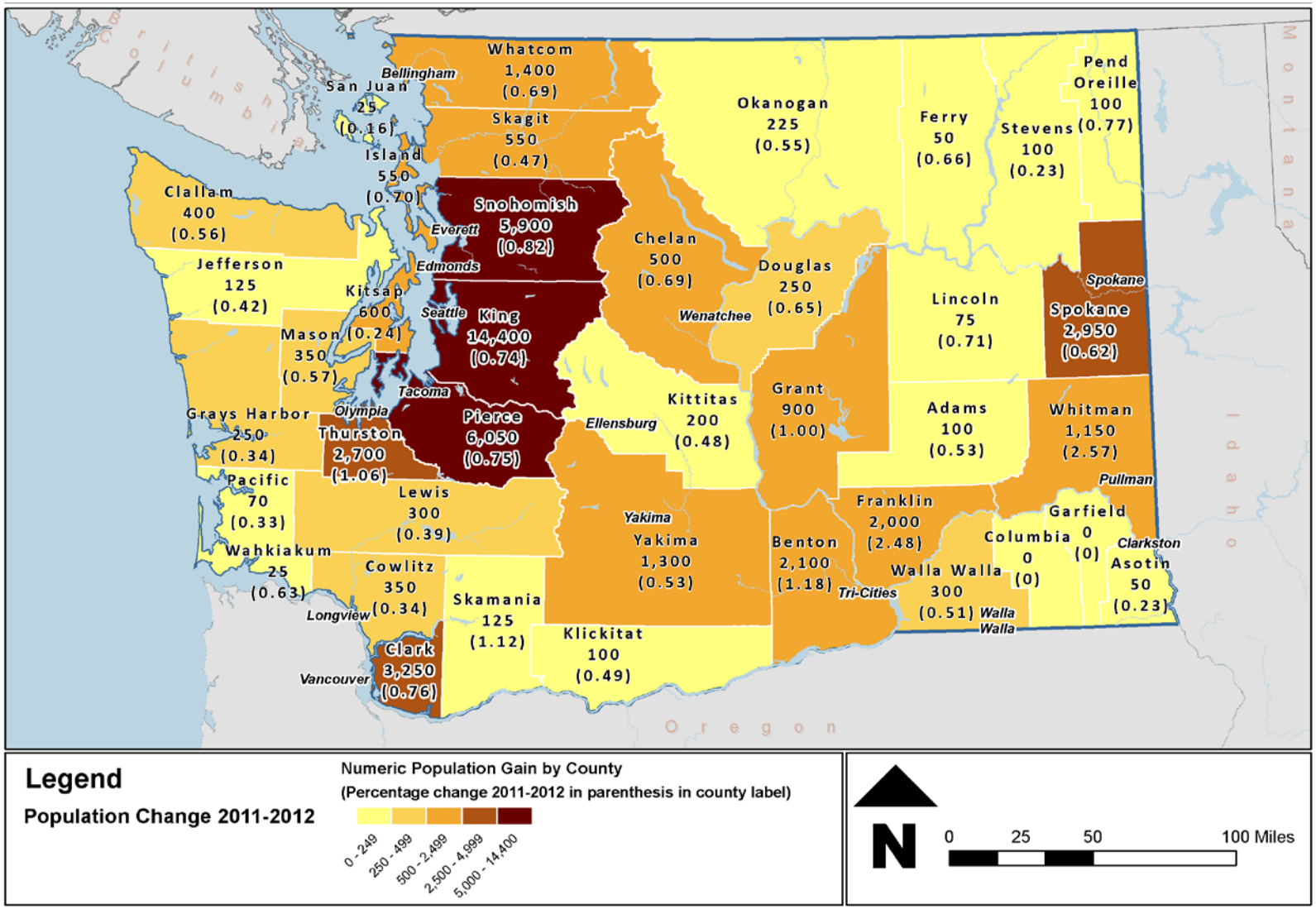
and 6,050 (0.75%) respectively.[12] However, some counties grew faster than these three counties in terms of growth rate (shown in percent change), as follows: Whitman (2.57%), Franklin (2.48%), Benton (1.18%), Skamania (1.12%), Thurston (1.06%) and Grant (1.00%).

The growth rate for the state between 2011 and 2012 was 0.74%, an increase of 49,870 people. The following ten counties grew faster than the state: Whitman, Franklin, Benton, Skamania, Thurston, Grant, Snohomish, Pend Oreille, Clark and Pierce.

Overall population change is happening in areas already served by passenger rail with the highest growth in and around King County.

[12] Ibid.

Figure 3.3 Distribution of Population Change by County, 2011-2012



Source: State of Washington Office of Financial Management (Forecasting Division). (September 2012.) *2012 Population Trends*.

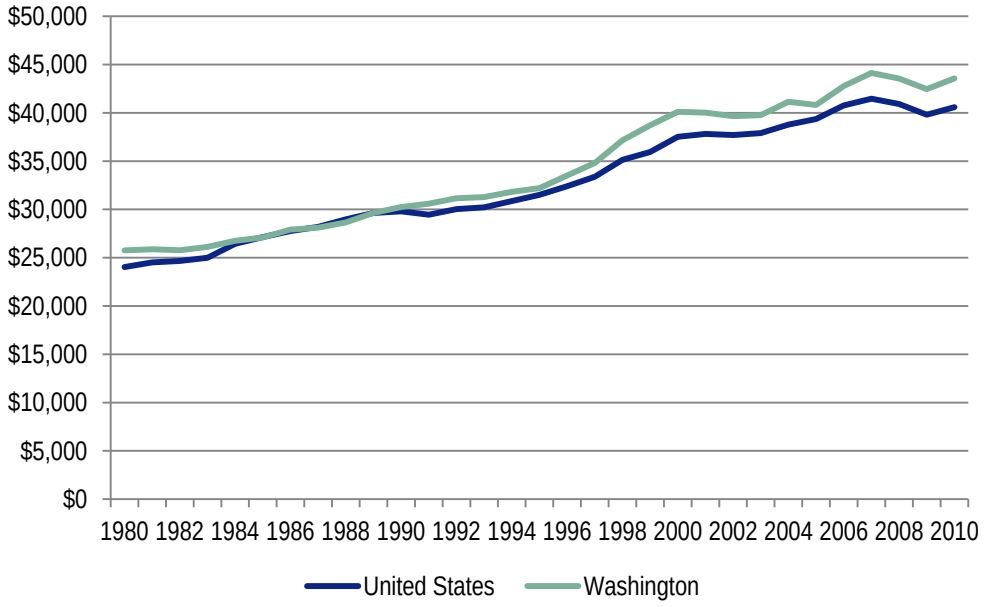
Note: These data are based on population estimates as of April 1, 2012, and were developed by Washington's Office of Financial Management.

3.2 EMPLOYMENT AND INCOME TRENDS

This section presents trend information about employment and income in Washington state. The information presented is at a macroencomic level for the purpose of understanding contributing environmental factors.

In 2011 Washington's per capita income was $44,294, which is higher than the national average of $41,663. Figure 3.4 shows that per capita income has been growing relatively steadily since 1980. There have been two periods of decline in per capita income (from 2000 to 2003, and from 2008 to 2009). Both periods can be associated with national recessions. Per capita is income shown in 2011 dollars.

Figure 3.4 Median Household Income, State of Washington, 1980-2011 (2011 Dollars)



Source: U.S. Census Bureau (2011).

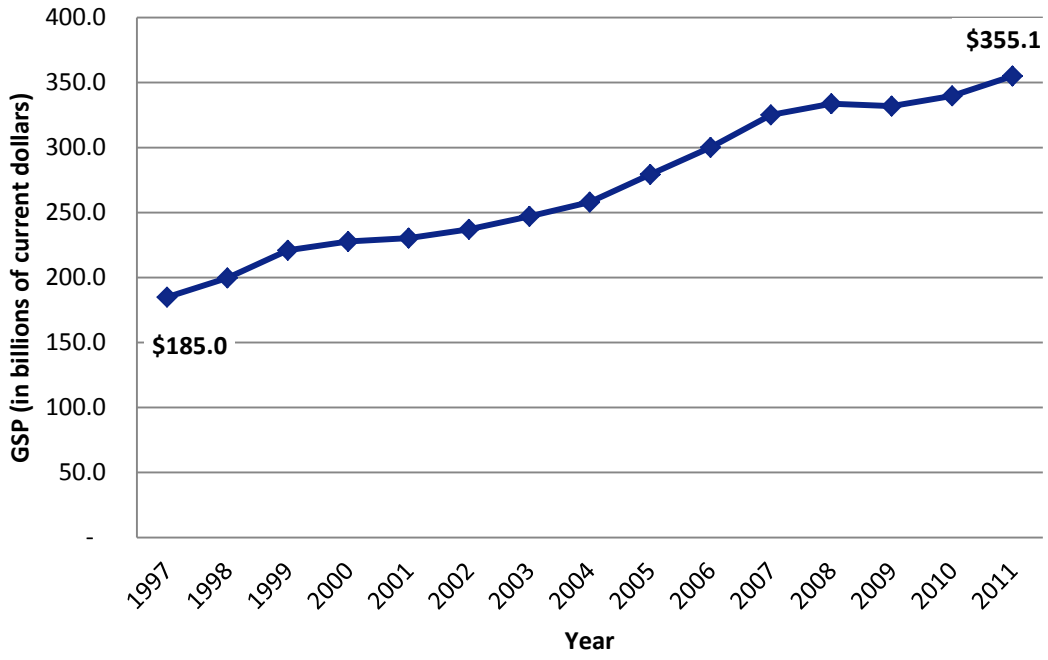
Notes: The 2010 household income figure is a preliminary estimate, based on the state personal income data published by the Bureau of Economic Analysis and the payroll data compiled by the state Employment Security Department.

The 2011 household income figure is also an estimate based on the Revenue Forecast Council's September 2011 forecast of state personal income.

Figure 3.5 displays Washington's GSP for aggregated public and private industry from 1997 to 2011. Despite one small dip in 2009, the GSP for all industries has been increasing steadily from 1997 to 2011. Industry GSP tends to be more correlated to freight rail demand, since industries produce goods and commodities carried by the freight rail system. Thus, more description about industry growth in Washington is provided in Technical Note 3a. It is included

here to show that, similar to household income, Washington GSP has grown fairly steadily since 1997.

Figure 3.5 Washington GSP, 1997-2011



Source: United States Bureau of Economic Analysis (2011).

3.3 ALTERNATIVE MODES

Another factor that dictates passenger rail demand is the availability, cost, reliability and travel times of alternate transportation modes. Table 3.1 provides sample travel times and costs for rail, auto and air travel between four major origins and destinations along the Amtrak Cascades route: Vancouver, British Columbia (B.C.); Seattle, Washington; Portland, Oregon (OR), and Eugene, OR. Trips between origin and destination pairs are only shown once. Exact air travel times may vary due to travel time to and from the airport and security delays, if any. Travel times assume 1.5 hours for transportation to and from the airport and time spent passing through security and checking in.

Table 3.1 Travel Times between Major Origins and Destinations Along the Amtrak Cascades Route by Mode

Destination	Mode[a,b,c,]	Travel Time [d, e]	Fare[e]
Between Seattle and:			
Vancouver, B.C.	Amtrak Cascades	4 hrs.	$29
	Greyhound bus	4 hrs. 0 mins. to 4 hrs. 10 mins.	$31.50
	Bolt Bus	4 hrs.	$5 -$25
	Automobile	2 hrs. 25 mins.	$80
	Airplane	2 hrs. 20 mins.	$174-$539
Portland, OR	Amtrak Cascades	3 hrs. 30 mins.	$24-$47
	Greyhound bus	3 hrs. 45 mins. to 4 hrs. 25 mins.	$43
	Bolt Bus	3 hrs. 15 mins.	$10-$29
	Automobile	2 hrs. 45 mins.	$98
	Airplane	2 hrs. 20 mins.	$82-$217
Eugene, OR	Amtrak Cascades	6 hrs. 15 mins. to 6 hrs. 30 mins.	$54
	Greyhound bus	7 hrs. 35 mins. to 8 hrs.	$53
	Automobile	4 hrs. 30 mins.	$160
	Airplane	2 hrs. 30 mins.	$148
Between Vancouver, B.C. and:			
Seattle – *Refer to first table entry labeled "Between Seattle and Vancouver, B.C."*			
Portland, OR	Amtrak Cascades	8 hrs. 15 mins.	$87
	Greyhound bus	8 hrs. 30 mins. to 9 hrs. 50 mins.	$80
	Bolt Bus	7 hrs.30 mins. To 8 hrs.	$27-$35
	Automobile	5 hrs. 5 mins.	$177
	Airplane	2 hrs. 45 mins.	$165-$499
Eugene, OR	Amtrak Cascades	10 hrs. 55 mins.	$96
	Greyhound bus	12 hrs. 20 mins. to 13 hrs. 25 mins.	$130
	Automobile	6 hrs. 50 mins.	$240
	Airplane	3 hrs. 15 to 5 hrs. 35 mins.	$371-$445
Between Portland, OR and:			
Eugene, OR	Amtrak Cascades	2 hrs. 35 mins.	$26
	Greyhound bus	2 hrs. 25 mins. to 3 hrs. 10 mins.	$31
	Automobile	1 hr 55 mins.	$63
	Airplane	2 hrs. 10 mins.	$197

Source:
[a] Cost information for Amtrak Cascades was estimated based on one-way prices shown on Amtrak's web site on December 20, 2012, for a Coach reserved ticket on a non-holiday Saturday: January 5, 2013.
[b] Greyhound Bus travel times and fares are based on one-way travel times for "standard fare" prices. These prices were found on Greyhound's web site on December 20, 2012 and December 26, 2012.
[c] Automobile travel times were calculated using Google Maps (https://maps.google.com/) on December 20, 2012. When Google provided multiple route options, the route with the shortest travel time was selected and no traffic was assumed. Because there is no "fare" for automobiles as for the other modes, information provided in the "fare" column includes fuel costs, which are based on the United States General Services Administration fuel rate updated January 1, 2013, which is $0.565 per mile. Origin/destination mileage information is based on the estimates provided by Google Maps.
[d] This time includes travel time in the air in addition to 1.5 hours to account for transportation to and from the airport and the security/screening process. Cost information assumes coach seats for each nonstop, one-way trip on January 5, 2013. The range of prices included is based on a flight search on www.kayak.com completed on December 20, 2012. The Vancouver, B.C. to Eugene, OR time and flight information is the only pair that assumes a one-stop flight as no nonstops were available using www.kayak.com.
[e] It is assumed that a trip between each origin and destination will take the same amount of time and will be the same cost in both directions. Times were rounded to the nearest 5 minutes.

Table 3.1 shows:

- The Seattle to Portland origin/destination pair shows the most similar travel times across the rail, bus, auto and air travel modes.
- Air travel is the quickest between many of the origins and destinations along the corridor including: Vancouver, B.C.-Portland, Seattle-Portland, and Seattle-Eugene, if available.
- On shorter segments (Vancouver, B.C.-Seattle and Portland-Eugene), auto travel is the same or faster than air travel.
- Assuming uncongested automobile travel, it is faster to travel between Seattle and Vancouver, B.C. or between Seattle and Portland by auto. However, congestion or wait times at the U.S./Canadian border could cause a trip on Amtrak Cascades to be faster.
- Bolt Bus has comparable travel times to Amtrak Cascades and Greyhound, and also offers lower fares in general.

Mode share in this corridor is also estimated to assess travel options available in the Amtrak Cascades travel markets and provides an indication of how travel demand is balanced across the entire multimodal transportation system.

Although there are no exact figures on the total number of intercity trips occurring along the I-5 corridor, available data summarized in Table 3.2 suggest the volume of travel in the corridor.

Table 3.2 Known Travel Statistics by Mode Along I-5 Corridor *2011*

Mode	Vancouver, B.C. to Seattle	Seattle to Portland
Rail[13]	77,000 passengers 2,200 departures and arrivals at SEA	233,000 passengers 4,400 departures and arrivals at SEA
Air[14]	371,000 passengers 4,277 departures from SEA	973,000 passengers 10,545 departures from SEA
Bus[15]	2,900 Bolt buses per year 2,200 Greyhound buses per year 1,460 Northwest Trailways buses per year	4,100 Bolt buses per year 2,300 Greyhound buses per year 1,460 Northwest Trailways buses per year

[13] Rail information from Washington State Department of Transportation (WSDOT) Ridership and Revenue Database.

[14] Air information from USDOT-T100, and 2011 Sea-Tac International Airport Activity Report.

[15] Bus information from boltbus.com, greyhound.com, and WSDOT Public Transportation website.

Mode	Vancouver, B.C. to Seattle	Seattle to Portland
Auto[16]	Maximum of 2.1 million vehicles per year, based on 5,700 AADT at MP 276.23. An alternative approach[17] suggests 1.2 million vehicles and 2.2 million travelers per year based on 52,000 AADT at MP 230.58 near Burlington. 5.8M auto crossings, U.S.-Canada	Maximum of 13.5 million vehicles per year based on 37,000 AADT at MP 039.90. An alternative approach[18] suggests 2.1 million vehicles and 3.2 million travelers per year based on 113,000 at MP 114.65 near Nisqually.

Washington state has estimated the share of existing trips using Amtrak Cascades and other modes (Table 3.3). As expected, motor vehicle travel is the dominant mode choice. Travel demand for rail and air is comparable, with slightly higher choice for air travel.

Table 3.3 Estimated Mode Share of Existing Trips Along I-5 Corridor

Mode	Vancouver, B.C. to Seattle and Seattle to Portland
Rail	7%
Air	12%
Bus	2%
Auto	79%

Source: WSDOT Rail Division

[16] Auto Annual Average Daily Traffic (AADT) information comes from WSDOT *TRIPS System Annual Traffic Report*; from Vancouver, B.C. to Seattle. There are also data from Whatcom Council of Governments, *International Mobility & Trade Corridor Project 2012 Resource Manual*. No direct data is available to measure number of vehicle trips between origin and destination in Washington. WSDOT measures traffic volumes at specific points along the corridor, and this data can be used to estimate a proxy value of traffic between hubs, such as Seattle to Vancouver, B.C., or Portland.

[17] The alternative approach is to use information from the *1992 High-Speed Ground Transportation Study* to estimate intercity travel relative to AADT at specific locations. Travel between Vancouver, B.C. and Seattle was 11.6 percent of all trips measured at Burlington (MP 230.58), while travel between Portland and Seattle was 7.9 percent of all trips measured at Nisqually. This assumes that travel patterns along the I-5 corridor have remained relatively unchanged since the study was conducted.

[18] Ibid.

4.0 Impacts of Freight and Passenger Rail

This section considers the impacts of passenger rail *and freight rail*. Freight and passenger rail play a major role in the transportation of people and goods within Washington state.[19] Combined, they bring benefits to Washington, including transportation accessibility, redundancy, mobility and economic development. On the other hand, as with any transportation mode, there are also negative consequences to rail transportation, including emissions that can contribute to poor air quality, safety concerns and impacts to communities located near rail infrastructure. Some of these impacts are described in this section.

4.1 TRANSPORTATION

Change in Traffic Volume

Passenger and freight trains provide options to vehicle and truck transportation. As passenger rail travel times, reliability and convenience become more comparable to auto travel, travelers may choose rail instead of auto travel and auto volumes along I-5 will decrease. This will in turn benefit highway travel fuel consumption and, in some bottleneck areas, reduce congestion-related idling, acceleration and deceleration. Enhancements to the Amtrak Cascades service—such as reducing the number of stops, increasing travel speeds and enhancing train amenities—could attract more discretionary travelers.

As this technical report also addresses the impacts of *all* rail, it is important to also consider the impacts of freight. Freight rail can also play a role in reducing traffic volume on parallel roadway facilities. In fact, one train can carry as much freight as several hundred trucks. For example, in 2011, 103 million tons of freight originated in, terminated in, or moved through Washington by rail. It would have taken approximately 5.7 million additional truck trips to move this amount of freight to/from and through the state.[20]

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[19] A profile of Washington's freight rail system, including its volumes and the types of commodities it carries, was the focus of Technical Note 3a.

[20] Association of American Railroads (AAR) Freight Railroads in Washington (2011), https://www.aar.org/keyissues/Documents/Railroads-States/Washington-2010.pdf.

Safety

Ensuring the safety and security of the rail network is crucial to attracting and maintaining passenger travelers and freight rail operators throughout the state. Passenger rail safety issues often involve incidents at grade crossings, (including motor vehicle/train accidents) and trespassing by pedestrians along rights of way. The Federal Railroad Administration's (FRA) Office of Safety Analysis maintains railroad safety data, which is summarized in the following sections. Information related to accidents and incidents, casualties, and highway-rail crossings will be discussed.

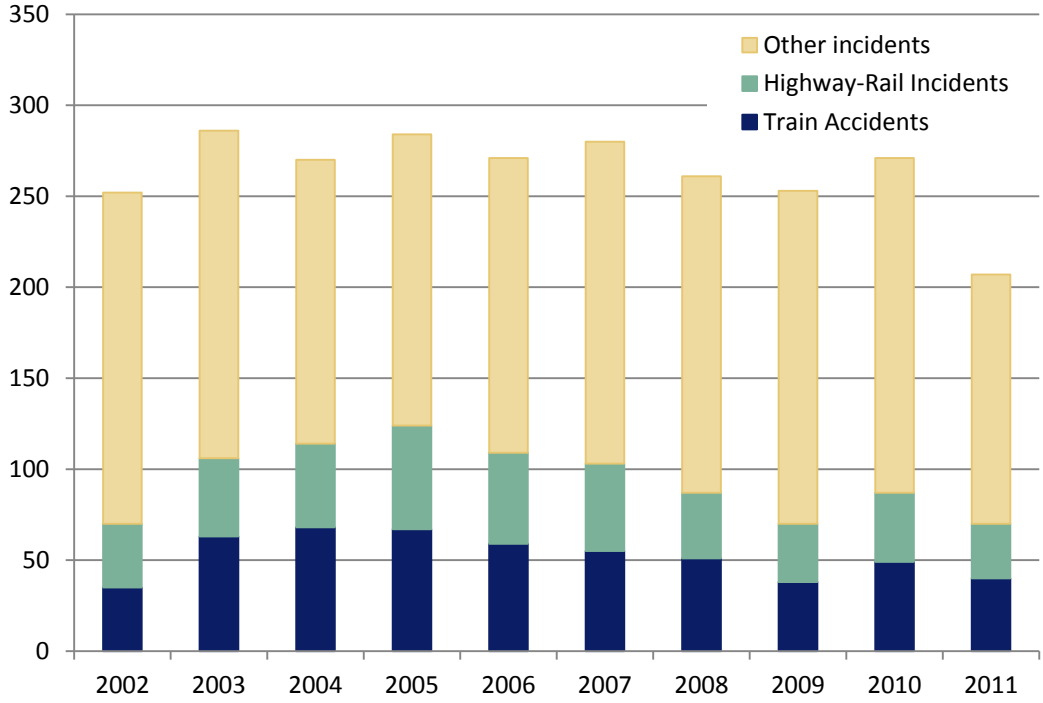
Incidents by Type

Figure 4.1 shows the total number of accidents and incidents occurring on rail lines statewide over the past 10 years. This is the sum of train accidents, highway-rail incidents, and other incidents. According to the FRA, train incidents are divided into three categories:

- **Train accidents** are defined as an event involving on-track rail equipment that results in monetary damage to the equipment and track above a certain threshold.
- **Highway rail incidents** are any impact between a rail and a highway user at a crossing site, regardless of severity. This includes public and private crossings.
- **Other incidents** are events other than train accidents or crossing incidents that caused physical harm to any person. Other events include such activities as getting on/off equipment, doing maintenance work, throwing switches, setting handbrakes, stumbling and tripping. *The vast majority of incidents in this category involve trespassers.*

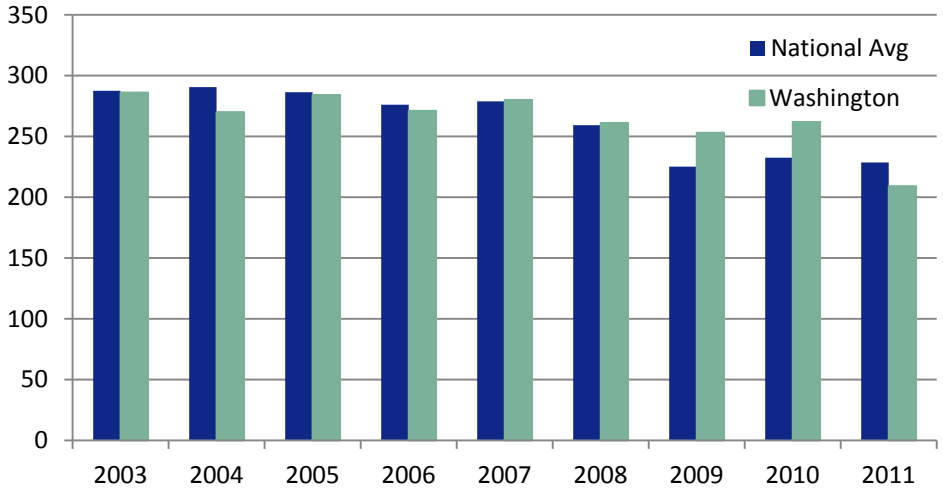
Overall in 2011, the state experienced 137 "other" incidents, 30 highway-rail incidents, and 40 train accidents (207 total train incidents). The trend in total train incidents between 2002 and 2011 has not shown any strong patterns, except for 2011, when incidents fell in excess of 20 percent of the average. Figure 4.1 shows total train incidents for Washington and Figure 4.2 shows the national average of train incidents for all 50 states (national average) from 2002 to 2011. This figure shows Washington's total train incidents generally trending in a similar pattern to national state averages and at a similar level.

Figure 4.1 Total Train Incidents in Washington State, 2002 to 2011



Source: FRA Office of Safety Analysis, 1.07 10-Year Accident/Incident Overview by Railroad/Region/State/County.

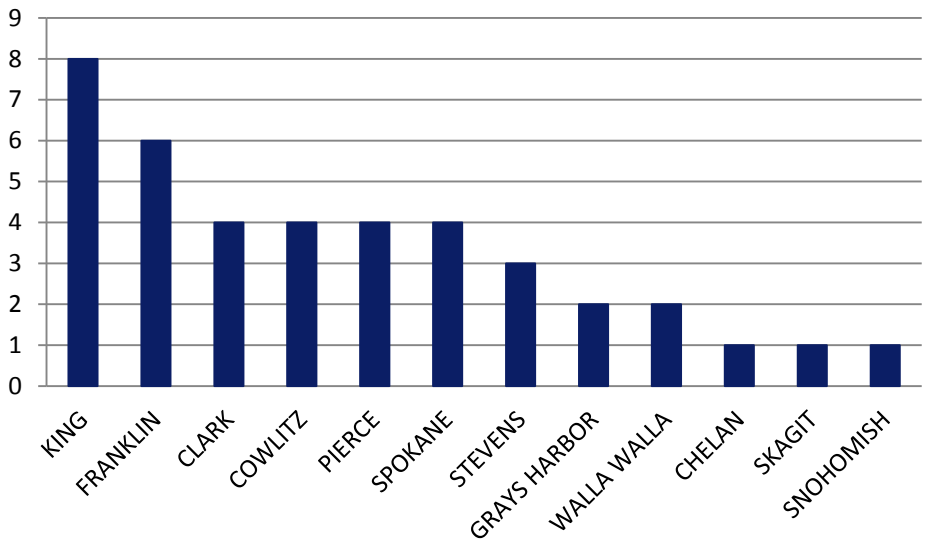
Figure 4.2 Total Train Incidents, Washington and National Average, 2002 to 2011



Source: FRA Office of Safety Analysis, 1.07 10-Year Accident/Incident Overview by Railroad/Region/State/County.

Figure 4.3 shows the location of train accidents by county for 2011. As shown, more train accidents in 2011 were located in King (8) and Franklin (6) Counties (35 percent of the total) than in other counties. Types of accidents include derailments, collisions, highway-rail impacts, obstructions, explosion-detonations, fires, etc. The majority of the train accidents over the last 10 years have been derailments (peaking at 78 percent of all accidents in 2007). Counties with more than two train accidents are located on the busier rail corridors in the state (in terms of total train frequencies).

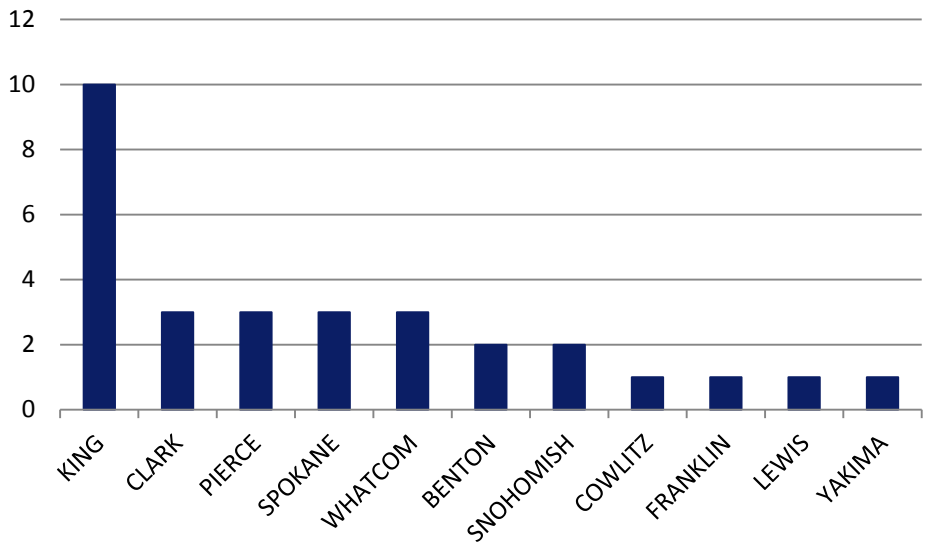
Figure 4.3 Train Accidents by County, 2011



Source: FRA Office of Safety Analysis, 2.01 Train Accidents.

In 2011 there were 32 highway-rail incidents, resulting in ten fatalities. Highway-rail incidents are of particular importance in a state rail planning effort, because highway-rail grade crossings represent the location for the most frequent interaction between the public and railroads. In addition, grade crossing improvement projects have been a federal priority for years under the Federal Highway Administration (FHWA) Section 130 Railway Highways Grade Crossing program (23 USC 130) that is managed by the Washington State Department of Transportation (WSDOT) in Washington, and are also often included in the long-term transportation improvement plans of cities and Metropolitan Planning Organizations (MPO). A higher number of highway-rail incidents occurred in King County (10 in 2011). Clark, Pierce, Spokane and Whatcom Counties recorded three each (Figure 4.4). This distribution towards higher population densities and train frequencies reflects the overall risk factors for highway-rail incidents—total levels of traffic (which matches relative county population) and overall rail traffic levels (many of the counties in Figure 4.4 are located along higher volume rail corridors).

Figure 4.4 Highway-Rail Incidents by County, 2011

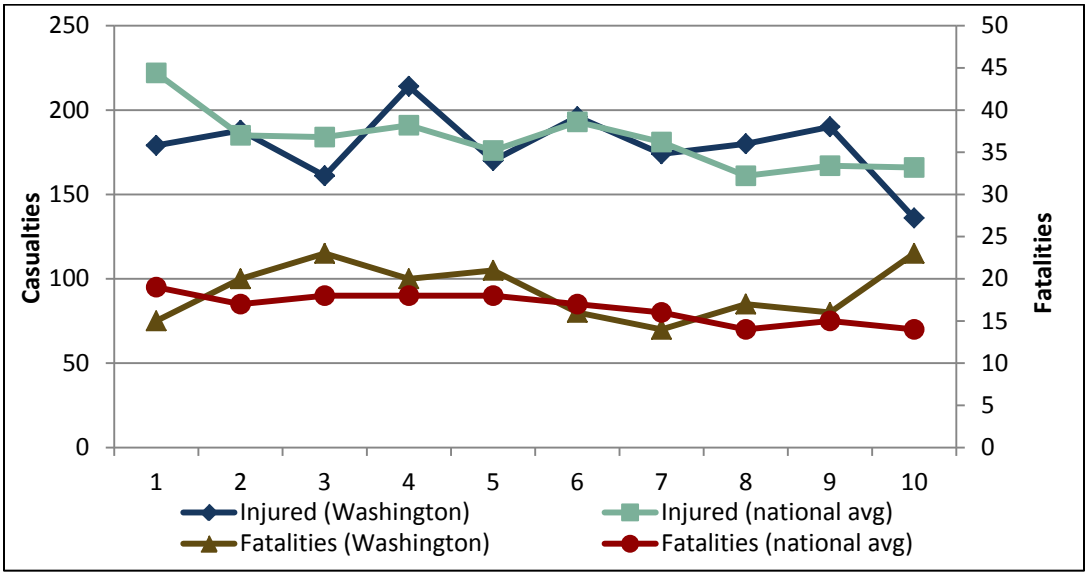


Source: FRA Office of Safety Analysis, 2.08 Highway-Rail Crossings.

Casualties

The FRA defines casualties as both injuries and deaths. While injuries remained relatively constant between 2002 and 2010, ranging from a high of 214 casualties in 2005 to 161 in 2004, the state experienced a decline in total injuries (136) in 2011, shown in Figure 4.5. Although one year of data does not make a trend, train fatalities increased from 2010 to 2011, from 16 to 23. Overall, Washington's train casualties are consistent and similar to national averages.

Figure 4.5 Train Casualties, Washington and National Average, 2002 to 2011



Source: FRA Office of Safety Analysis, 4.08 Casualty Summary Tables.

4.2 ECONOMIC

Passenger and freight rail services play a role in Washington state economic trends. Railroads provide value to the state through their services to shippers, employment of residents and support of its institutions. Rail supports many sectors of the state's economy, including manufacturing, agriculture, retail and wholesale trade, and construction. As highlighted in Technical Note 3a of this plan, these industries provided about 41 percent of the state's total Gross State Product (GSP) in 2010—or about $106 billion dollars. Additionally, employment and economic trends will have a direct effect on the rail network. By linking businesses to each other, freight railroads play a crucial role in sustaining the state's economy.

Two important links in this international trade system are the Ports of Seattle and Tacoma. Together, these ports comprise the third largest container load center in the nation, handling a combined 3.5 million 20-foot equivalent units (TEU) in 2011.[21] Several other deep-water ports are located on the coast (including Everett and Grays Harbor) and on the Columbia River (Vancouver, Washington). These ports, in coordination with the freight rail system, create an intermodal network that connects Washington industries to global markets and imports goods to support industries and residents in Washington state. Thus, Washington's freight system serves as a global gateway to international and national trade, with regional economies relying on the freight system. The global trade system is discussed in greater length in Technical Note 3a of this plan.

On the passenger side, in recent Congressional testimony, WSDOT has reported that the Amtrak Cascades service supports 1,500 annual direct and indirect jobs in the state. Further, Amtrak Cascades service attracts tourism spending of $131 million in direct tourist spending annually, which also results in $6.9 million annually in state tax revenues and $3.4 million in local tax revenues.[22] Amtrak also invests throughout the state, spending $19 million on goods and services in FY 2012 in Washington, primarily in Seattle and Spokane.[23][24] These economic impacts of passenger rail service, combined with

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[21] American Association of Port Authorities Annual Port Statistics: http://aapa.files.cms-plus.com/Statistics/NORTH%20AMERICA%20PORT%20CONTAINER%20TRAFFIC%20RANKING%202011.pdf

[22] Testimony of Paula E. Hammond, former Washington Secretary of Transportation, House Transportation and Infrastructure Committee, Subcommittee on Railroads, Pipelines and Hazardous Materials, March 5, 2013. http://transportation.house.gov/sites/republicans.transportation.house.gov/files/documents/2013-03-05--Hammond.pdf.

[23] Amtrak, *Amtrak Fact Sheet, Fiscal Year 2012, State of Washington*. www.amtrak.com/pdf/factsheets/WASHINGTON12.pdf.

the favorable utilization metrics from Section 2.1 (load factors, farebox recovery), have resulted from the Washington Legislature's long-term financial support for state-supported Amtrak Cascades trains and capital improvements to the corridor. As federal law has led to new terms for state operating support of corridor-length intercity passenger rail routes like the Amtrak Cascades, these same positive economic and usage trends should justify incremental increases in state operating support from Washington and Oregon alike.

Technical Note 4c: *Statewide Freight and Passenger Rail Needs and Opportunities* will outline overall freight and passenger rail system needs, which will also have similarly positive economic effects as those outlined in this section. Technical Note 6: *Institutional Framework and Funding Sources for Rail* will describe the institutional relationships and financial resources of the public and private sectors in considering investments to meet these rail needs. Public and private funding agreements for freight or passenger rail improvements will be informed by estimates of relative costs and benefits for the public and private parties involved in each project.

Employment

Investment in rail operations, projects and programs has a direct and positive effect on employment growth in several ways. Most importantly, it supports the operations of goods movement industries such as manufacturing, construction, warehousing and retail trade. As highlighted in Technical Note 3a of this plan, these industries employ more than 1.2 million people or 40 percent of the state's total employment.

In addition, the railroads themselves offer direct employment. According to information from the AAR, freight rail in Washington is responsible for 3,576 direct jobs, with nearly 11,000 railroad retirement beneficiaries.[25] In 2010 the national average freight railroad workers' earned wage was $73,000 with fringe benefits of $30,120.[26] According to AAR, the average wage and benefits for Washington freight rail employees is above the national average, at $110,380.[27] This average wage implies that total freight rail payroll in Washington is approximately $400 million annually. As per Railroad Retirement Board (RRB) statistics, the retirement and survivor benefits in Washington in 2011 were

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[24] The Amtrak investment includes modernizing and expanding the Seattle Maintenance Facility. This contract is with a firm in Bellevue.

[25] AAR Washington State Fact Sheet, www.aar.org/Railroads-States/Washington-2010.pdf.

[26] AAR, *The Economic Impact of America's Freight Railroads*, June 2012. www.aar.org/~/media/aar/Background-Papers/The-Economic-Impact-of-Freight.ashx.

[27] AAR Washington State Fact Sheet, www.aar.org/Railroads-States/Washington-2010.pdf.

$19 million, paid out to more than 14,100 individuals throughout the state.[28] This group of beneficiaries consists of retirees as well as spouses and survivors of deceased railroad employees. RRB numbers include Amtrak, plus freight railroad employees directly working on passenger-related activities, such as BNSF Railway's (BNSF) operation of Sounder Commuter rail.

On the passenger side, Amtrak employs 509 Washington residents with total wages of Amtrak employees living in Washington in FY 2012 of $34 million.[29]

In addition to their own employees, freight railroads also help sustain jobs that provide goods and services to railroads or are recipients of spending by the employees of railroads and their suppliers. Nationwide, each freight rail job supports 4.5 jobs elsewhere in the economy. Each $1 billion in new rail investment supports more than 17,000 jobs. The processes by which freight railroads select capital projects for these private investments, and how those investments can be influenced by public policies, will be discussed in Technical Note 6 as part of this State Rail Plan. Technical Notes 4c and 5 will also discuss overall rail needs for freight and passenger rail and how the public and private sectors will address those needs.

Property and Income Taxes

Railroads also pay an annual assessment on the property that they use for conducting business. In Washington, the Department of Revenue (DOR) collects property taxes from various public utility companies located in each county in Washington. The DOR recapitulates the actual and equalized property values of public utility companies. The breakdown of these property values for both BNSF and Union Pacific Railroad (UP) for the year 2011 is provided in Table 4.1.

Table 4.1 Property Values of Class I Railroads in Washington

Millions of Dollars, 2011

	Real Property		Personal Property		Real and Personal Property	
Companies	Actual	Equalized	Actual	Equalized	Actual	Equalized
BNSF	1,021	949	86	81	1,107	1,029
UP	147	137	09	08	155	145
Total All Public Utility Companies	3,405	3,162	15,490	14,653	18,895	17,815
Class I as percent of All PUCs	34%	34%	1%	1%	7%	7%

Source: Washington Department of Revenue, Recapitulations of Public Utility Companies, 2011.

[28] Railroad Retirement Board, *Table 7. – Retirement and Survivor Benefits in Current-Payment Status on September 30,2011, by class and State* www.rrb.gov/pdf/opa/AnnualRprt/Table7.pdf.

[29] Amtrak, *Amtrak Fact Sheet, Fiscal Year 2012, State of Washington*. www.amtrak.com/pdf/factsheets/WASHINGTON12.pdf.

The table shows that the real property value (both actual and equalized) for BNSF and UP was 34 percent of the total property values for all public utility companies. The personal property on the other hand is only one percent. Real and personal property values combined translated to a total actual taxable property value of nearly $19 billion for the Class I railroads.

Income from utility operations is taxed under the public utility tax. The DOR levies six different rates of tax, depending upon the specific utility activity. The current rate for railroads, including permanent surtaxes, is 1.9 percent. The DOR also reports the summary of excise tax returns on a quarterly basis by tax type. Freight falls under "Motor Transportation, Railroad, and Railroad Car" classification.

4.3 ENVIRONMENTAL

According to the U.S. Energy Information Administration, Washington state contributes 2.2 percent of total transportation sector energy consumption nationwide. The transportation sector consumes a significant amount of petroleum—604.2 trillion British thermal units (BTU) in 2010—throughout the state, with the majority (54 percent) being used for motor gasoline—328.6 trillion BTU in 2010.[30] Freight transportation consumes a significant amount of diesel (distillate fuel oil). In 2010, 114.6 trillion BTUs were used (equivalent to 19 percent of total energy consumption).

Petroleum and diesel consumption results in the emission of various pollutants, and, depending on the mode of transportation and specific fuel used, the types of pollutants produced differ. Specifically, trucks contribute most to nitrous oxides (NOx) and particulate matter (PM) emissions; marine vessels contribute mostly to sulfur dioxide pollution; whereas air cargo planes contribute to small amounts of pollution of NOx, PM and other pollutants as well.[31]

Rail operations produce a range of toxic pollutants including carbon monoxide (CO), NOx, volatile organic compounds, PM, and carbon dioxide. While in general rail is a more efficient mode in terms of fuel consumption (compared to passenger vehicles and trucks) for moving people and goods, its emission standards and technology do lag behind that of trucks.[32]

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[30] U.S. Energy Information Administration, *State Profile and Energy Estimates, Table CT7 Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2010, Washington.* www.eia.gov/beta/state/seds/data.cfm?incfile=sep_use/tra/use_tra_WA.html.

[31] www.ops.fhwa.dot.gov/publications/fhwahop10024/fhwahop10024.pdf.

[32] Ibid.

Regardless, rail uses substantially less fuel, per ton, as compared to trucks. In 2011, America's railroads, on average, moved each ton of freight an average of 469 miles on one gallon of fuel. (For the sake of comparison this is approximately the distance from Seattle to Boise, Idaho).[33] Rail fuel efficiency ranges from 156 to 512 ton-miles per gallon, while truck fuel efficiency ranges from 68 to 133 ton-miles per gallon.[34] Therefore, one of the main advantages of using rail as a transportation mode is reduced fuel consumption. Since the primary driver of emissions is fuel consumption, the reduced use of fuel associated with freight and passenger rail (as opposed to trucks or passenger vehicles) can lead to reduced greenhouse gas emissions (GHG), CO, NOx and PM. With train emission regulations becoming more strict every year, these benefits should continue to grow.

According to data from the Environmental Protection Agency (EPA), passenger rail is less polluting than other transportation modes, and less carbon-intensive than travel by car and air; see Figure 4.6. Additionally, freight rail is the least carbon-intensive of all freight modes; see Figure 4.7. WSDOT Rail Division also provided estimated annual carbon dioxide equivalent (CO2e) emissions by travel mode for October 2011 to September 2012 (based on approximately 130,000,000 passenger miles of travel). In this period the total short tons of the CO2e emissions by rail, car and air modes of transportation (78,598 short tons), 21 percent (16,790 short tons), can be attributed to rail transportation.

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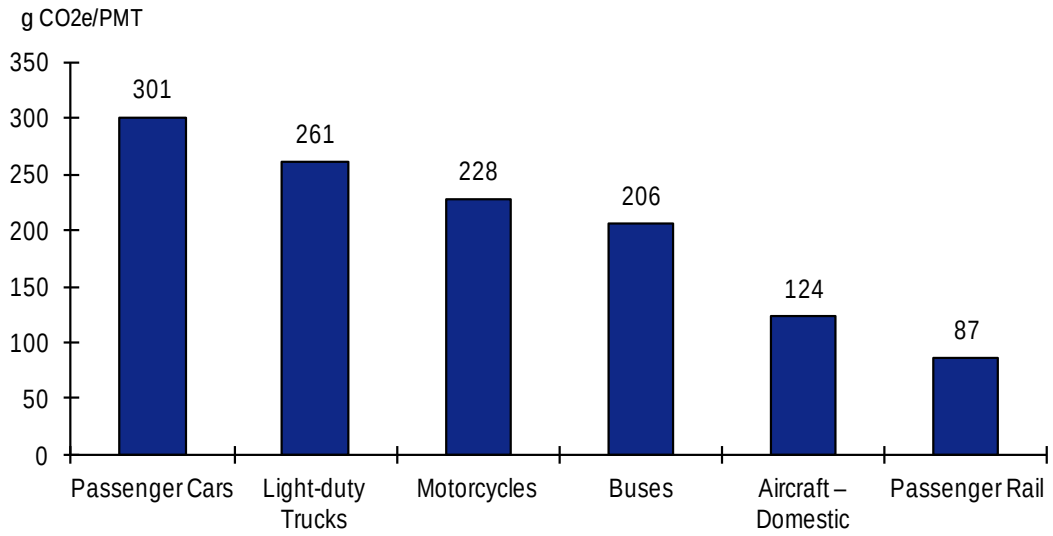
[33] Ibid.

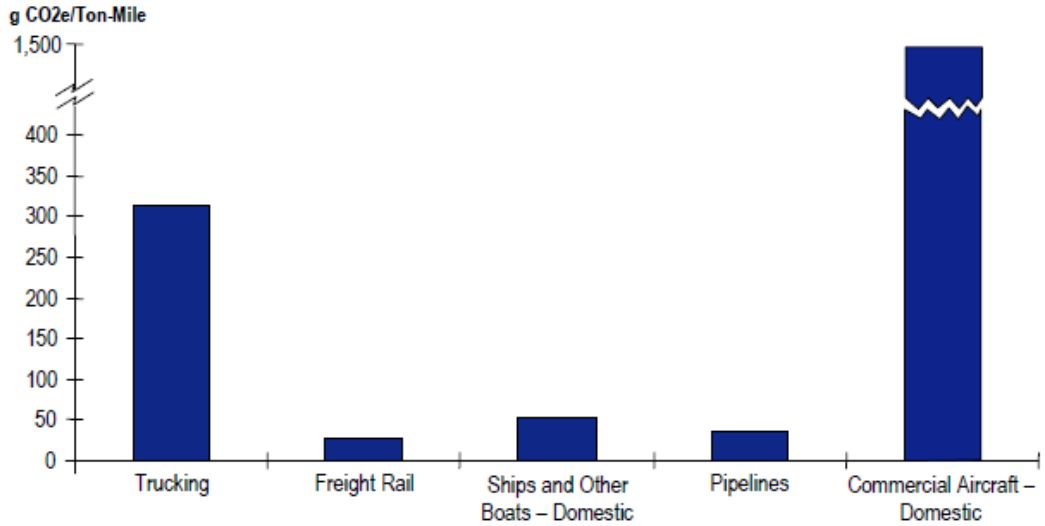
[34] ICF International, U.S. Department of Transportation, FRA, *Comparative Evaluation of Rail and Truck Fuel Efficiency on Competitive Corridors,* November 2009. www.ontrackamerica.org/files/Comparative_Evaluation_Rail_Truck_Fuel_Efficiency.pdf.

Figure 4.6 Greenhouse Gas (GHG) Emissions per Passenger-Mile by Passenger Transportation Mode, 2006



Source: U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 to 2006*, Bureau of Transportation Statistics, National Transportation Statistics, and U.S. Department of Energy, *Transportation Energy Data Book*.

Figure 4.7 GHG Emissions per Freight Ton-Mile by Freight Transportation Mode, 2006



Source: U.S. EPA, 2008, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 to 2006; and Bureau of Transportation Statistics, National Transportation Statistics.

Finally, state law requires air quality conformity in its statewide transportation planning activities. For example, Chapter 173-420 of the Washington Administrative Code outlines conformity of transportation activities to air

quality implementation plans.[35] The chapter sets forth minimum requirements for evaluating transportation plans, programs and projects for conformity with the purpose and intent of state implementation plans for air quality. Generally speaking, transportation plans shall include policies and provisions that promote the reduction of criteria pollutants and identify those aspects of the existing system whose modification offers the best opportunity for improving air quality.

4.4 LAND USE AND COMMUNITY IMPACTS

Passenger and freight rail throughout the state provide benefits extending beyond the mobility of people and goods. Localized community benefits of shifting traffic to rail from automobiles and trucks can include reduced braking and acceleration noise, reduced idling, enhanced safety and less traffic disruption. There are also disadvantages that must be considered: noise, rail crossing delay, connectivity, mobility and safety across the railroad tracks. The advantages and disadvantages accrue to users and nonusers of the rail system differently by type of user.

More specific land use-related impacts can similarly be discussed according to rail service type.

Passenger Rail

Rail transportation can help build important land use linkages within a state, whether it be between homes and place of employment, or between freight origins and destinations. In addition to linking different land uses, passenger rail investment has a tendency to concentrate growth and encourage urban renewal, historic preservation and city center planning.

Intercity and long-distance rail can help contribute to community livability, land use, safety and public health. Rail services that operate efficiently, comfortably and safely will enhance personal mobility and offer travelers a diversity of transportation options. Improving the convenience, frequency and reliability of rail travel through capital and operational improvements—such as double-tracking, station upgrades and grade separations—may also help cause a shift in travel from auto to rail. In addition to these benefits, users may enjoy reduced travel costs as compared to automobile ownership and travel.

Potential economic effects of the rail network on land use are discussed below. Other potential passenger rail impacts, including incompatible use concerns and safety, are profiled in the next section, Freight Rail.

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[35] Washington Administrative Code, Chapter 173-420, *Conformity of Transportation Activities to Air Quality Implementation Plans*. http://apps.leg.wa.gov/wac/default.aspx?cite=173-420&full=true.

No study exists that quantifies the economic benefits of the Empire Builder or Coast Starlight to Washington. However, Amtrak estimated the economic impact of Empire Builder in Montana to be nearly $14 million in annual economic benefits.[36] Additionally, a report from the Montana Department of Transportation estimates a number of economic benefits experienced by the state of Montana from Empire Builder. According to the study, direct spending by nonresident Amtrak users and Amtrak in Montana is conservatively estimated at between $5.3 and $5.7 million annually.[37] This direct spending results in additional spending, at retail establishments for example, creating a multiplier effect in the economy.

The WSDOT Rail Division provided information about the recent economic benefits of Amtrak Cascades service along the I-5 corridor. Overall between October 2012 and September 2013, it is estimated that the Amtrak Cascades service will create approximately $27.7 million in direct travel spending in Washington state. This spending will support 285 jobs over the course of the year. From October 2011 to September 2012, approximately $1.5 million state and local tax revenue was generated from Amtrak Cascades service in Washington.

Freight Rail

Freight rail has the opportunity to impact land use in both positive and negative ways. The *FHWA Freight and Land Use Handbook*[38] was developed to provide the tools and resources to properly assess the impacts of land use decisions on freight movements, as well as the impacts of freight development and growth on land use planning goals.

Freight rail throughout Washington helps link the state to both domestic and international markets. Shifting from truck to freight rail travel will reduce GHG emissions and provide public health benefits in communities located near rail lines and terminals. Enhancing freight rail movement through grade separation projects will improve safety and reduce congestion and the associated emissions from vehicle idling, reduce conflicts between trains and vehicle traffic within neighboring communities, and improve community connectivity by removing divisive at-grade tracks.

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[36] American Public Transportation Association, *Opportunity Cost of Inaction: High-Speed Rail and High Performance Passenger Rail in the United States*, July 2012.

[37] Montana Department of Transportation, Montana Department of Commerce, and Montana Department of Agriculture, *Analysis of the Economic Benefits of The Amtrak Empire Builder to Montana*, July 2003.

[38] *FHWA Freight and Land Use Handbook*, April 2012. Prepared by Cambridge Systematics.

Key considerations and issues related to freight rail service include:

Incompatible Land Uses

If the corridor around active service freight lines is not protected with zoning or other designations, the potential exists for incompatible uses, such as housing or commercial properties, to develop in a manner that is directly adjacent to the rail line. Though this is desirable in some cases, such as the development of new Tranist Oriented Developments, it can also cause undesirable effects, such as noise and light pollution, congestion and other problems, etc.

Coordinated growth management and land use regulations can help curb incompatible land uses. The Washington State Growth Management Act enacted in 1990 helped the state better coordinate growth management throughout the state through designating urban growth areas, coordinating zoning ordinances and so on. In addition, the Puget Sound Regional Council (PSRC) has also created an initiative aimed at preserving and enhancing existing areas of concentrated manufacturing and industrial activities. This initiative designated eight Manufacturing and Industrial Centers, including the Ports of Seattle and Tacoma, Boeing's plant, as well as other warehousing and large manufacturing centers. The clustering of all of these locations is particularly important, since the close proximity of manufacturing/industrial land uses to their markets means less time and money required to transport goods, as well as reduced impacts from freight transportation.[39]

Safety

As discussed in the *FHWA Freight and Land Use Handbook*, rail lines should be separated from pedestrian walkways and have adequate signage at grade crossings. Replacing at-grade crossings with above- or below-grade crossings can help reduce conflicts between freight and passenger rail with pedestrians, bicyclists, and motorists, where the volume of crossing traffic potentially justifies the large investment. An example of this is a pedestrian/bike bridge over a rail yard in Vancouver, Washington. Other important safety considerations include the presence of unauthorized persons near freight rail activities. Trespassers run the risk of being harmed if they are unfamiliar with potential hazards present at a freight rail facility. Finally, consideration should be given to developing a first responder plan in the event of a natural disaster or other threat associated with the freight rail system. Any plan should include communications, evacuation and incident management procedures.

[39] www.psrc.org/growth/centers/.

Community Impacts

Close proximity to freight rail can create many adverse effects for communities, including noise, air and light pollution and road/rail congestion. These conditions may result in negative public health and safety impacts, environmental impacts, and decline in property values along the rail corridor. Encroachment or getting too close to freight rail can occur in two ways. The first is when a city/community is built up around the existing rail infrastructure. In this case good zoning laws play a vital role in controlling what gets built and therefore control adverse effects.

The second way in which encroachment can arise is simply due to a rise in overall rail traffic in a community. As Section 2.2 of this technical note illustrates, the east to west lines from Spokane to Pasco to Portland already experience moderate daily freight train volumes (less than 35 daily trains). In many cases, rural cities grew around the freight rail line, and the rail line may bisect the towns. More frequent and longer trains can block at-grade highway-rail crossings, increasing the instances in which freight train traffic disrupts community life in towns along busy rail corridors. As freight rail traffic grows, strategies can be implemented to limit pollution at the source, or prevent the pollution from affecting citizens. Creating buffers, such as sound walls and berms, can reduce noise and light pollution and may be mandated in zoning codes for specific sites. Additionally, communities may choose to invest in implementing FRA approved Quiet Zones at crossings in communities where train horn noise is an issue. The supplemental safety measures employed at crossings within the Quiet Zone corridor represent a Context-Sensitive Solution aimed at making sure that transportation activities and projects are keeping with the context of a community's identity. Employing "Green Port" technologies through the use of "GenSet" locomotives in rail yards can also be used to control air pollution at these facilities.

Abandonments

Abandonments can also have both positive and negative impacts for a community. While abandoned rail lines can be converted for other uses such as public trails and bike paths, from an economic perspective it is a loss. Effects of abandonments include irreversible loss of the physical asset, worsened encroachment (further preventing re-building of future rail service), and adverse impact on the economy due to lack of connectivity for local industries. More topics on the specific needs and opportunities related to freight rail abandonment are explored in Technical Note 4c.