Leigh | Fisher

TECHNICAL MEMORANDUM No.4 FINAL

FORECASTS OF AVIATION ACTIVITY

Seattle-Tacoma International Airport

Prepared for

Port of Seattle
Seattle, Washington

September 2015

Sustainable Airport Master Plan
Seattle-Tacoma International Airport

Leigh | Fisher

TECHNICAL MEMORANDUM No.4 FINAL

FORECASTS OF AVIATION ACTIVITY

Seattle-Tacoma International Airport

Prepared for

Port of Seattle
Seattle, Washington

September 2015

CONTENTS

CONTENTS *(continued)*

CONTENTS *(continued)*

TABLES

FIGURES

Introduction

This technical memorandum presents forecasts of aviation activity in support of the Sustainable Airport Master Plan (SAMP) for Seattle-Tacoma International Airport (the Airport or SEA).

1.1 Objectives

The objectives of this memorandum are to present forecasts of aviation activity for enplaned passengers, air cargo, and aircraft operations, including passenger, all-cargo, general aviation, and military operations. Using calendar year 2014 as the base year, annual forecasts were prepared for four future demand years—2019, 2024, 2029, and 2034. Seattle-Tacoma International Airport records (based on data reported by the airlines) were used as the basis for the enplaned passenger, air cargo, and commercial airline aircraft operations forecasts. Federal Aviation Administration, Air Traffic Activity System (ATADS) data were used as the basis for the total aircraft operations forecasts.

The forecasts presented in this memorandum are "unconstrained" and, therefore, do not include specific assumptions about physical, regulatory, environmental or other impediments to aviation activity growth. The baseline unconstrained forecasts are the "preferred" forecasts recommended for Federal Aviation Administration (FAA) approval.

1.2 Approach

The SEA Sustainable Airport Master Plan (SAMP) forecasts were prepared using a collaborative process which included: (1) a review of previous forecasts prepared for the Airport, including the Part 150 forecasts prepared in 2010 and the FAA 2014 Terminal Area Forecasts (TAF) for the Airport; (2) the collection and analysis of data related to the key issues and trends affecting future aviation demand at SEA and the Seattle Region*; (3) input on future airline schedules and fleet mix obtained through a survey of the airlines serving SEA, (4) the development of statistical models to identify historical causal factors; and (5) coordination with representatives of the Airport and the FAA.

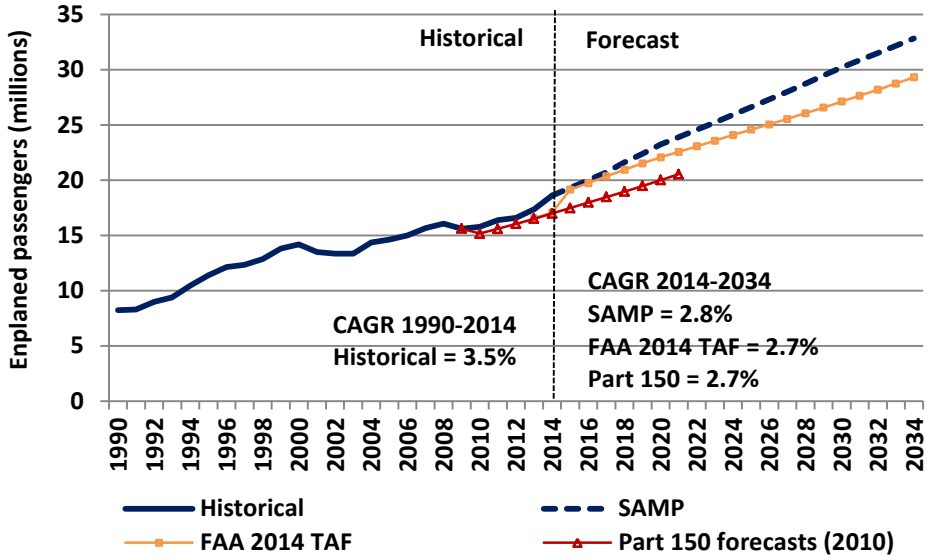
1.3 Enplaned Passengers

Figure 1-1 presents historical enplaned passengers for 1990 through 2014 and forecasts for 2015 through 2034, compared with the SEA Part 150 forecasts and the FAA 2014 TAF for the Airport. The SAMP enplaned passenger forecasts are based on 2014 data and are within 4.2% of the FAA 2014 TAF

*The Seattle Region, also referred to as the Airport service region in this report, includes a primary and secondary area. The primary area consists of 5 counties, including King, Kitsap, Pierce, Snohomish, and Thurston. The secondary area includes the adjacent counties and is defined by the location of and driving distance to other air carrier airports, as well as by the availability, price, and quality of airline service at those other airports.

in 2019 and 7.6% in 2024.* The enplaned passenger forecast growth rate of 2.8% per year between 2014 and 2034 is higher than the rate forecast by the FAA in its 2014 TAF for the Airport (an average of 2.7% per year) from Federal Fiscal Year (FFY) 2014 to FFY 2034.** A detailed comparison of the SAMP enplaned passenger forecasts and the FAA 2014 TAF is presented in Chapter 7.

Figure 1-1
Historical and Forecast Enplaned Passengers
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

CAGR = Compound annual growth rate

Source: Historical—Seattle-Tacoma International Airport records.
SEA Sustainable Master Plan (SAMP) Forecast: LeighFisher, based on available data through September 2014.
FAA 2014 TAF: U.S. Department of Transportation, Federal Aviation Administration, www.faa.gov, accessed January 2015.
Part 150 forecast: Landrum and Brown, July 2010.

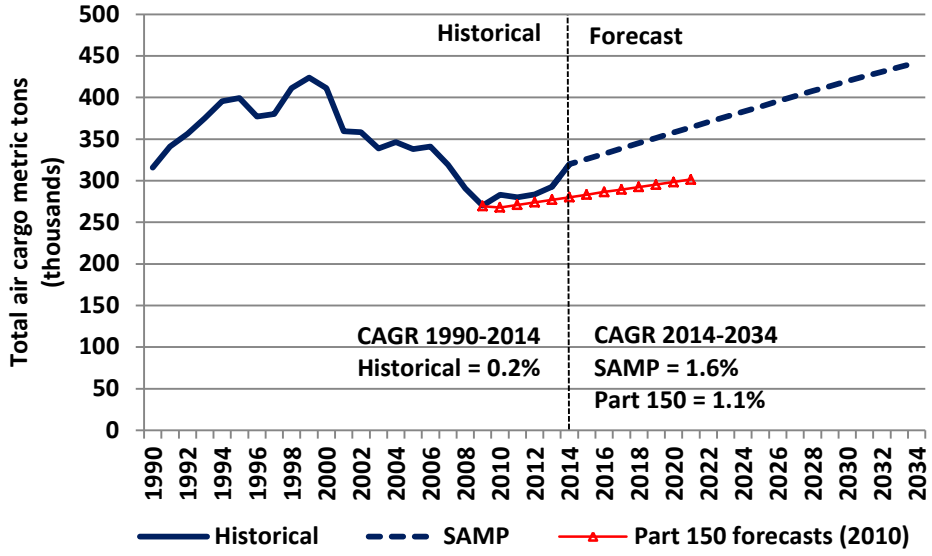
1.4 Air Cargo

Figure 1-2 presents historical air cargo (in metric tons) for 1990 through 2014 and forecasts for 2015 through 2034. (The FAA does not prepare cargo forecasts for individual airports as part of the TAF.) Since 2000, the cargo industry nationwide and at SEA has experienced significant changes related to: (1) air cargo security regulations by the FAA and Transportation Security Administration (TSA); (2) consolidation in the air cargo industry; (3) an increasing trend in the volume of cargo transported by truck; (4) the national and global economic recessions; (5) use of all-cargo carriers by the U.S. Postal Service to transport mail; and (6) increased use of mail substitutes (e.g., email). Total cargo (enplaned

*U.S. Department of Transportation, Federal Aviation Administration, *Forecasting Aviation Activity by Airport*, July 2001, and *Review and Approval of Aviation Forecasts*, June 2008, http://www.faa.gov.
**The Federal Fiscal Year begins on October 1 and ends on September 30.

and deplaned air freight and mail) is forecast to increase an average of 1.4% per year between 2014 and 2034 at the Airport as shown on Figure 1-2.

Figure 1-2
Historical and Forecast Air Cargo
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

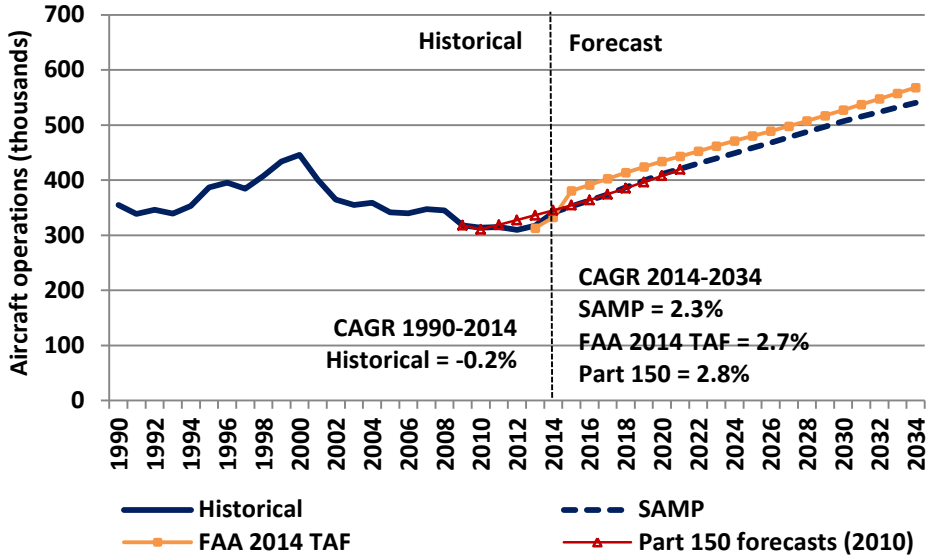
CAGR = Compound annual growth rate

Source: Historical—Seattle-Tacoma International Airport records.
SEA Sustainable Master Plan (SAMP) Forecast: LeighFisher, based on available data through September 2014.
Part 150 forecast: Landrum and Brown, July 2010.

1.5 Aircraft Operations

Figure 1-3 presents historical total aircraft operations for 1990 through 2014 and forecasts for 2015 through 2034, compared with the SEA Part 150 forecasts and the FAA 2014 TAF for the Airport. Total aircraft operations include air carrier, air taxi and commuter, general aviation, and military takeoffs and landings. The aircraft operations forecasts are based on 2014 data and are within 5.9% of the FAA 2013 TAF in 2019 and 4.8% in 2024. The forecast average growth rate in total aircraft operations of 2.3% per year between 2014 and 2034 is lower than the rate forecast by the FAA in its 2014 TAF for the Airport (an average of 2.7% per year) from FFY 2014 to FFY 2034. A detailed comparison of the SAMP aircraft operations forecasts and the FAA 2014 TAF is presented in Section 7.

Figure 1-3
Historical and Forecast Aircraft Operations
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

CAGR = Compound annual growth rate

Source: Historical—Seattle-Tacoma International Airport records.
SEA Sustainable Master Plan (SAMP) Forecast: LeighFisher, based on available data through September 2014.
FAA 2014 TAF: U.S. Department of Transportation, Federal Aviation Administration, www.faa.gov, accessed January 2015.
Part 150 forecast: Landrum and Brown, July 2010.

1.6 Airport Service Region

For the purposes of this study, the region served by the Airport includes a primary and secondary area. The primary area of the Airport service region is defined as the 5-county Puget Sound Regional Council Planning Area (the Seattle Primary Area) which includes the Seattle-Tacoma-Bellevue Metropolitan Statistical Area (MSA), the Olympia-Turnwater MSA, and the Bremerton-Silverdale MSA. The Seattle Primary Area includes the counties of King, Kitsap, Pierce, Snohomish, and Thurston with a combined population of 4.2 million in 2013, as shown in Table 1-1 and on Figure 1-4. Because economic growth and activity within the primary area stimulate a significant portion of passenger demand at the Airport, statistics for these 5 counties were used to evaluate aviation activity trends at the Airport.

The secondary area served by the Airport, which includes many of the counties surrounding the 5-county primary area, is defined by the location of and driving distance to other air carrier airports, as well as by the availability, price, and quality of airline service at those other airports. Portland International Airport, a large-hub airport with an average of 258 daily departures in July 2014, is located approximately 161 road miles south of SEA. Vancouver International Airport, a Canadian airport with an average of 341 daily departures in July 2014, is located approximately 155 road miles northwest of SEA.

The airports located in Bellingham, King County (Boeing Field), Wenatchee (Pangborn), and Yakima are small and non-hub airports with an average of 14, 11, 3, and 3 daily departures, respectively, in July 2014. The airports in Friday Harbor and Port Angeles are non-primary airports providing limited commercial service.

Table 1-1
Seattle Primary Area Population in 2013
Seattle-Tacoma International Airport

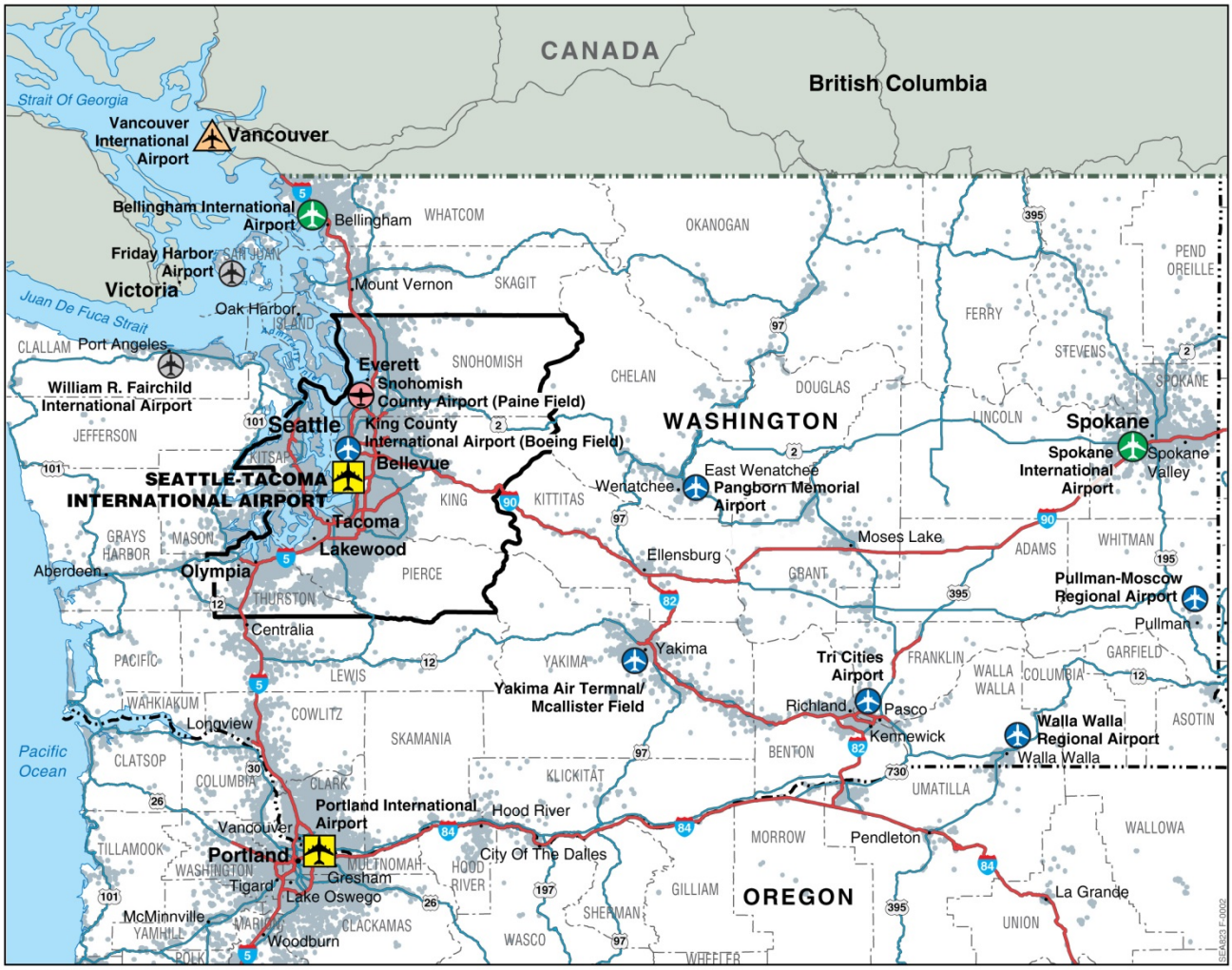
County	Population	Percent of total
King	2,044,449	49.5%
Snohomish	745,913	18.1
Pierce	819,743	19.9
Thurston	262,388	6.4
Kitsap	253,968	6.2
Total	4,126,461	100.0%

Source: U.S. Department of Commerce, Bureau of the Census, www.census.gov, accessed August 2014.

1.7 Airport Role

The role of an airport is important in evaluating the domestic and international components of aviation activity and preparing forecasts. Seattle-Tacoma International Airport has an important role in the global, national, State, and local air transportation systems and is the 15th busiest airport in the United States, in terms of total passengers (enplaned plus deplaned). The importance of the Airport is reflected in its large origin-destination (O&D) passenger base, its role as the primary connecting hub in Alaska's system, and its role as the West Coast gateway and hub for Delta Air Lines.

Figure 1-4
Airport Service Region
Seattle-Tacoma International Airport



LEGEND

- Airport service region
- Population density: 1 dot equals 100 people
- Large hub airport
- Small hub airport
- Nonhub airport
- Non-primary airport (less than 10,000 enplaned passengers)
- General aviation airport
- Canadian airport
- International boundary
- State boundary
- County boundary
- Interstate highways
- Other major U.S. roads

Source: U.S. Census Bureau, 2010 Census data.

N

25 0 25 50
Graphic scale in miles

Road miles from Seattle to:

Bellingham	89
Billings	818
Boise	504
Calgary	704
Edmonton	789
Eugene	271
Great Falls	643
Idaho Falls	787
Missoula	477
Pangborn	155
Port Angeles	137
Portland	161
Prince George	558
Pullman	285
Salt Lake City	841
Spokane	279
Tri-Cities	208
Vancouver	141
Walla Walla	261
Yakima	142

1.7.1 Airport's Role as an Origin-Destination Airport

The Airport's large O&D passenger base is related to the strength of the Airport service region's economy and supports the continued service development by Alaska, Delta, and other airlines at the Airport. The flights of 12.9 million passengers originated in the Seattle Primary Area in 2013 (i.e., these originating passengers did not connect with another flight at the Airport).

1.7.2 Airport's Role as a Connecting Hub

The Airport serves as an important connecting hub in the route systems of both Alaska and Delta. In 2014, the Airport accounts for an estimated 31% of the total scheduled departing seats in Alaska Airlines' system, making it Alaska's busiest airport. Alaska accounted for 74% of all passengers connecting at the Airport in 2013. The Airport is the eighth busiest airport in Delta's system in 2014, in terms of total scheduled departing seats. Between 2013 and 2014, Delta added nearly 1 million scheduled departing seats at the Airport. Delta accounted for 12% of all passengers connecting at the Airport in 2013.

1.7.3 Airport's Role as an International Gateway

The Airport's role as a developing international gateway is related to the strength of the Seattle Primary Area economy and the location of global companies and strong international communities of interest in the Seattle Primary Area. In addition, the level of international service provided at the Airport is supported by shorter flight times to Asian destinations compared with other West Coast gateways, the increasing presence of SkyTeam members at SEA, and the cost advantages of Delta's Pacific gateway at Seattle compared with Asian gateways.

In 2014, the Airport accounted for 5% of international scheduled departing seats from U.S. airports to countries in Asia. Delta accounts for approximately 51% of seats to Asian destinations and 47% of seats to European destinations at the Airport in 2014. Delta is the principal U.S. airline in the SkyTeam Alliance which currently has 20 full members with service to 177 countries in Africa, the Americas, Asia, Europe, and the Pacific.

Economic Basis for Aviation Demand

The economy of the Seattle Primary Area is an important determinant of long-term passenger and cargo demand at the Airport.

2.1 Socioeconomic Trends

Generally, regions with large populations, high levels of employment, and high average per capita incomes will generate strong demand for airline travel. The demographics and economy of the region—as measured by changes in population, employment, and per capita income—as well as airline service and airfares—are typically the most important factors affecting origin-destination (O&D) passenger demand. In 2013, approximately 74% of the Airport's passengers were O&D passengers; the remaining 26% were connecting passengers.

The following sections present a discussion of the economic basis for airline traffic at the Airport—the historical population, nonagricultural employment, and per capita income of the Seattle Primary Area, comparative unemployment rates, and tourism. Also provided is a summary of the economic outlook for world regions, the United States, Washington, and the Seattle Primary Area.

2.1.1 Population

Historically, population in the Seattle Primary Area and the State increased faster than in the nation. From 1990 to 2013, population in the Seattle Primary Area and Washington increased an average of 1.5% and 1.6% per year, respectively, while population in the nation increased an average of 1.0% per year, as shown in Table 2-1. Population growth in Seattle Primary Area is projected by the Puget Sound Regional Council (PSRC) to increase an average of 1.0% per year between 2013 and 2034, compared with forecast increases of 1.3% per year than in the State and 1.0% per year in the nation.

2.1.2 Employment

From 1990 to 2013, nonagricultural employment in the Seattle Primary Area and the State increased an average of 1.4% per year, faster than for the nation (an average of 1.0% per year), as shown in Table 2-1. Since the end of the recession in 2009, nonagricultural employment in the Seattle Primary Area increased an average of 2.2% per year between 2010 and 2013, faster than growth in the State and nation with an average increases 1.7% and 1.5% per year, respectively. Nonagricultural employment in the Seattle Primary Area is projected by the PSRC to increase an average of 1.4% per year between 2013 and 2034, compared with forecast increases of 1.6% per year than in the State and 1.3% per year in the nation.

Table 2-1
Historical And Projected Socioeconomic Data
Seattle-Tacoma International Airport

	Population (thousands)			Nonagricultural employment (thousands)			Per capita income (2005 dollars)		
	Seattle Primary Area	State of Washington	United States	Seattle Primary Area	State of Washington	United States	Seattle Primary Area	State of Washington	United States
Historical									
1990	2,910	4,867	248,710	1,435	2,148	109,527	33,441	30,121	29,264
2000	3,493	5,894	281,425	1,826	2,745	132,019	42,839	37,274	34,690
2010	3,954	6,725	308,746	1,851	2,837	130,275	42,996	38,107	35,955
2011	4,008	6,821	311,583	1,879	2,873	131,842	43,578	38,693	36,754
2012	4,066	6,895	313,874	1,920	2,922	134,104	44,389	40,026	37,598
2013	4,126	6,971	316,129	1,971	2,987	136,368	n.a.	40,004	37,529
Projected									
2018	4,370	7,471	332,206	2,169	3,231	145,807	53,210	42,150	39,593
2023	4,598	7,976	348,610	2,325	3,492	155,898	60,459	45,275	42,528
2028	4,818	8,484	365,642	2,447	3,773	166,688	67,633	48,955	45,985
2034	5,096	9,091	386,444	2,660	4,138	180,626	74,798	53,223	49,994
	Compound annual percent increase (decrease)								
Historical									
1990-2000	1.8%	1.9%	1.2%	2.4%	0.0%	1.9%	2.7%	2.2%	1.7%
2000-2013	1.3	1.3	0.9	0.6	0.7	0.2	0.3 *(a)*	0.5	0.6
1990-2013	1.5	1.6	1.0	1.4	1.4	1.0	1.3 *(a)*	1.2	1.1
Projected									
2013-2018	1.2	1.4	1.0	1.9	1.6	1.3	3.1 *(a)*	1.1	1.1
2018-2023	1.0	1.3	1.0	1.4	1.6	1.3	2.6	1.4	1.4
2023-2028	0.9	1.2	1.0	1.0	1.6	1.3	2.3	1.6	1.6
2028-2034	0.9	1.2	0.9	1.4	1.5	1.3	2.0	1.7	1.7
2013-2034	1.0	1.3	1.0	1.4	1.6	1.3	2.5 *(a)*	1.5	1.5

Note: The Seattle Primary Area includes King, Kitsap, Pierce, Snohomish, and Thurston counties.

(a) Represents the increase from 2012.

Sources: *Historical*—U.S. Department of Commerce, Bureau of the Census, www.census.gov, U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, U.S. Department of Commerce, Bureau of Economic Analysis, www.bea.gov, accessed August 2014. Adjusted to constant 2005 dollars using the U.S. Department of Labor, Consumer Price Index for Urban Consumers (1982-84 = 100), www.bls.gov. Historical growth rates for income are through 2012, the latest year available.
Seattle Region Forecast—Puget Sound Regional Council, *2012 Regional Macroeconomic Forecast*, July 2013, www.psrc.org.
U.S. and Washington Forecast --and Woods & Poole Economics, Inc., *The Complete Economic and Demographic Data Source*, 2013.

2.1.3 Income

From 1990 to 2012 (the most recent year available), per capita personal income in the Seattle Primary Area increased an average of 1.3% per year, faster than that for the State (an average of 1.2% per year) and the nation (an average of 1.1% per year), as shown in Table 2-1. Since 2000, the growth in per capita income has slowed. In 2012, per capita income in the Seattle Primary Area was $44,389 (in 2000 dollars), 10.9% higher than that for the State ($40,026) and 18.1% higher than the nation ($37,598). Per capita personal income in the Seattle Primary Area is projected by the PSRC to increase an average of 2.5% per year between 2012 and 2034.

2.1.4 Unemployment Rates

In addition to the employment trends discussed earlier, the unemployment rate is also indicative of general economic conditions. Table 2-2 shows comparative annual unemployment rates in the Seattle Primary Area, the State, and the nation as a whole for 2000 through 2013. Unemployment rates in the Seattle Primary Area have generally followed but remained lower than State and national trends since 2005.

Table 2-2
Comparative Unemployment Rates
Seattle-Tacoma International Airport

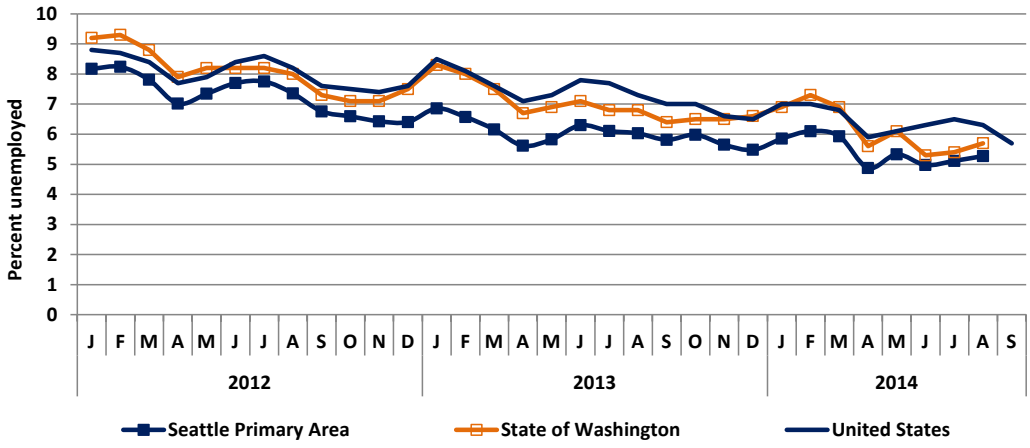
	Seattle Primary Area	State of Washington	United States
2000	4.4%	5.0%	4.0%
2001	5.5	6.2	4.7
2002	6.7	7.3	5.8
2003	6.8	7.4	6.0
2004	5.7	6.2	5.5
2005	5.0	5.5	5.1
2006	4.5	5.0	4.6
2007	4.0	4.5	4.6
2008	4.9	5.5	5.8
2009	8.9	9.3	9.3
2010	9.5	9.9	9.6
2011	8.7	9.2	8.9
2012	7.3	8.1	8.1
2013	6.0	7.0	7.4

Note: Unemployment rates are not seasonally adjusted.

Source: U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, accessed September 2014.

Since the end of the recession in June 2009, monthly unemployment rates in the Seattle Primary Area, the State of Washington, and the United States have decreased, as shown on Figure 2-1. In August 2014, the unemployment rate (unadjusted) for the Seattle Primary Area was 5.3%, lower than the State (5.7%) and the nation (6.3%).

Figure 2-1
Monthly Unemployment Trends
Seattle-Tacoma International Airport



Note: Unemployment rates are not seasonally adjusted.

Source: U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, accessed September 2014.

2.1.5 Nonagricultural Employment by Sector

Figure 2-2 shows a comparative distribution of nonagricultural employment by industry sector for the Seattle Primary Area in 2000 and in 2013, and for the State and the nation in 2013.

- *Business Services.* Business services in the Seattle Primary Area accounted for the largest share of nonagricultural employment, with 22.6% in 2000 and 23.0% in 2013. From 2000 to 2013, the Seattle Primary Area's employment in business services increased an average of 0.7% per year, with the strongest growth in professional, business, finance, and information services.*

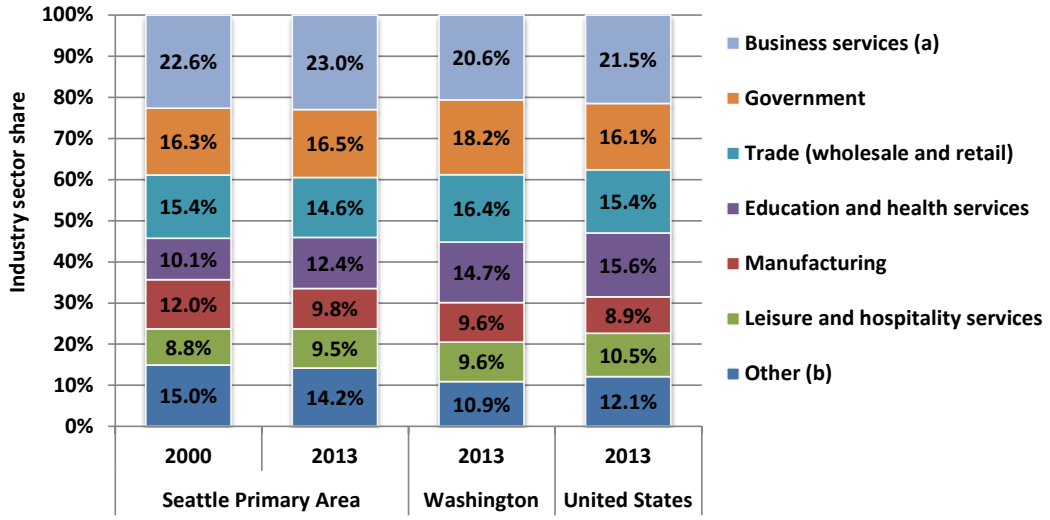
- *Government.* Employment by federal, state and local government agencies** accounted for the second largest share of nonagricultural employment and increased an average of 0.7% per year between 2000 and 2013. The share of government employment in the Seattle Primary Area increased from 16.3% in 2000 to 16.5% in 2013.

- *Trade.* Trade is comprised of wholesale and retail trade. From 2000 to 2013, the Seattle Primary Area's employment in trade increased an average of 0.2% per year, reflecting growth in retail trade. The share of trade employment in the Seattle Primary Area decreased from 15.4% in 2000 to 14.6% in 2013.

*Information services includes traditional, Internet, and software publishing; the motion picture and sound recording industries; the broadcasting industries; the telecommunications industries; Web search portals, data processing industries; and the information services industries.

**As reported by the U.S. Department of Labor, Bureau of Labor Statistics, government employment includes only civilian employees.

Figure 2-2
Comparative Distribution of Nonagricultural Employment
Seattle-Tacoma International Airport



(a) Includes professional and business services, finance and information.
(b) Includes mining, construction, transportation and public utilities.

Source: U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, accessed September 2014.

- *Education and Health Services.* Employment in education and health services in the Seattle Primary Area increased an average of 2.2% per year between 2000 and 2013 and was the fastest growing industry sector. The share of education and health services employment in the Seattle Primary Area increased from 10.1% in 2000 to 12.4% in 2013.

- *Manufacturing.* Manufacturing employment in the Seattle Primary Area decreased an average of 1.0% per year between 2000 and 2013 and experienced the largest employment losses of any industry sector. The manufacturing sectors in Washington and the nation also experienced job losses between 2000 and 2013, decreasing an average of 1.1% and 2.8% per year, respectively, during that period. The share of manufacturing employment in the Seattle Primary Area decreased from 12.0% in 2000 to 9.8% in 2013.

- *Leisure and Hospitality Services.* The Seattle Primary Area's employment in leisure and hospitality services increased an average of 1.3% per year between 2000 and 2013. The share of leisure and hospitality services in the Seattle Primary Area increased from 8.8% in 2000 to 9.5% in 2013.

- *Other Activities.* Other employment in the Seattle Primary Area increased an average of 0.2% per year between 2000 and 2013. The share of other employment in the Seattle Primary Area decreased from 15.0% in 2000 to 14.2% in 2013.

2.1.6 Industry Clusters

The economy of the Seattle Primary Area is driven by companies that export goods and services nationally and globally, bringing in new investment and jobs that support economic growth as well as air service development. Companies that make up industry clusters, also referred to as the "traded sector," tend to *cluster* because they draw competitive advantage from their proximity to competitors, to a skilled workforce, to specialized suppliers, and to a shared base of sophisticated knowledge about their industry.

The Economic Development Council of Seattle and King County (EDC) identified eight industry clusters in Seattle Primary Area.

- *Aerospace*. Approximately 480 aerospace companies are located in King County and directly support approximately 47,000 jobs (48% of all aerospace jobs in the State of Washington), according to the EDC. Boeing Commercial Airplanes, headquartered in Renton, Washington 12 miles south of downtown Seattle, is the largest aerospace company in the Seattle Primary Area. Other major aerospace companies include Aim Aerospace, Esterline Technologies Corporation, Honeywell Aerospace, Hexel Corporation, and Aerojet Rocketdyne.

- *Maritime*. According to a 2013 economic impact study, the maritime industry cluster contributed $30 billion to the State of Washington's economy in 2012.* The largest concentration of maritime activities (as of 2012) is within the Central Puget Sound region, with 41% of all direct maritime employment located in King County, 24% in Kitsap County, and 8% in Pierce County. The maritime cluster is comprised of five core sectors: (1) passenger water transportation; (2) boat and ship building, repair, and maintenance; (3) maritime logistics and shipping; (4) fishing and seafood products; and (5) maritime support services. Companies in the maritime cluster range from owner-operated boatbuilding firms to Fortune 500 global logistics companies such as Expeditors International headquartered in Seattle. Other major maritime employers include the Port of Seattle, Holland America Line (a subsidiary of Carnival Corporation headquartered in Seattle), and the Puget Sound Naval Shipyard.

- *Clean Tech*. According to a 2011 Brookings Study, the number of clean tech jobs in the Seattle MSA increased an average of 5.3% per year between 2003 and 2010, from 21,760 to 31,340.** Seattle's clean tech cluster is diversified, including jobs in renewable energy services, green architecture, smart grid, and forestry products. Leading clean tech companies include Imperium Renewables, Propel Biofuels, Powerit Solutions, and Infinia.

*Economic Development Council of Seattle and King County , *Washington State Maritime Industry Cluster, Economic Impact Study*, November 2013, www.edc-seaking.org.

**The Brookings Institution, Metropolitan Policy Program, *Sizing the Clean Economy, A National and Regional Green Jobs Assessment,* 2011, www.brookings.edu/metro.

- *Financial Services*. The Seattle Primary Area accounted for half of financial services cluster jobs in the State of Washington in 2010, according to a 2011 study of the Washington financial services industry cluster.* Major investment companies headquartered in Seattle include Russell Investment Company, Parametric Portfolio Associates, and Milliman Inc.

- *Global Trade & Investment*. The Seattle Primary Area is a major West Coast center of global trade, reflecting its proximity to Asia and Alaska, deep-water port, international gateway at the Airport, and role in export manufacturing. Of the 100 largest U.S. metropolitan areas, the Seattle Primary Area ranked sixth for exports and twelfth for output in 2012, according to a 2013 Brookings Study.**

- *Life Sciences & Health Care*. According to the EDC, King County in the Seattle Primary Area is home to 160 life science companies that together employ 22,000 people. The Seattle Primary Area is home to the University of Washington Medicine, the Fred Hutchison Cancer Research Center, and the Bill and Melinda Gates Foundation.

- *Information Technology*. The information technology cluster in the Seattle Primary Area includes software development and publishing, interactive media development and technologies, Radio Frequency Identification, and wireless technologies and applications. The Seattle Primary Area is home to Microsoft, Amazon, Expedia, as well as engineering and operations for Google, Facebook, Intel, Hewlett Packard, Oracle, Yahoo!, and Adobe.

- *Fashion*. The fashion industry cluster in the Seattle Primary Area includes apparel design, textile and apparel manufacturers, apparel wholesalers and apparel corporate headquarters. Nordstrom, REI, Eddie Bauer, and Filson have grown from local Seattle businesses to worldwide brands. The Seattle Primary Area is also home to design and retail programs at Washington State University, Seattle Pacific University, and University of Washington.

*enterpriseSeattle, *Washington State Financial Services Cluster Study*, 2011, www, edc-seaking.org. enterpriseSeattle, founded in 1971, is an economic development partnership with the mission of building a competitive, world class economy in King County.

**The Brookings Institution, *Export Nation 2013: U.S. Growth Post Recession*, September 2013, www.brookings.edu.

2.1.7 Major Employers

Table 2-3 lists the major employers in King County in 2013. The Boeing Company was the largest employer in King County in 2013, with 85,000 employees, reflecting importance of the aerospace cluster to the Seattle Primary Area.

Table 2-3
Major Employers in King County
Seattle-Tacoma International Airport

Rank	Company	Number of employees
1	The Boeing Company	85,000
2	Microsoft	41,664
3	University of Washington	29,800
4	Providence Health and Services	20,240
5	Amazon	15,000 *(a)*
6	King County Government	12,993
7	United States Postal Service	11,914
8	Starbucks	10,837
9	City of Seattle	10,479
10	Nordstrom Inc.	9,281
11	Costco Wholesale Corporation	8,912
12	Swedish	8,586
13	Group Health Cooperative	7,833
14	Alaska Air Group	6,667
15	Seattle Public Schools	5,696
16	Virginia Mason Medical Center	5,611
17	United Parcel Service	5,554

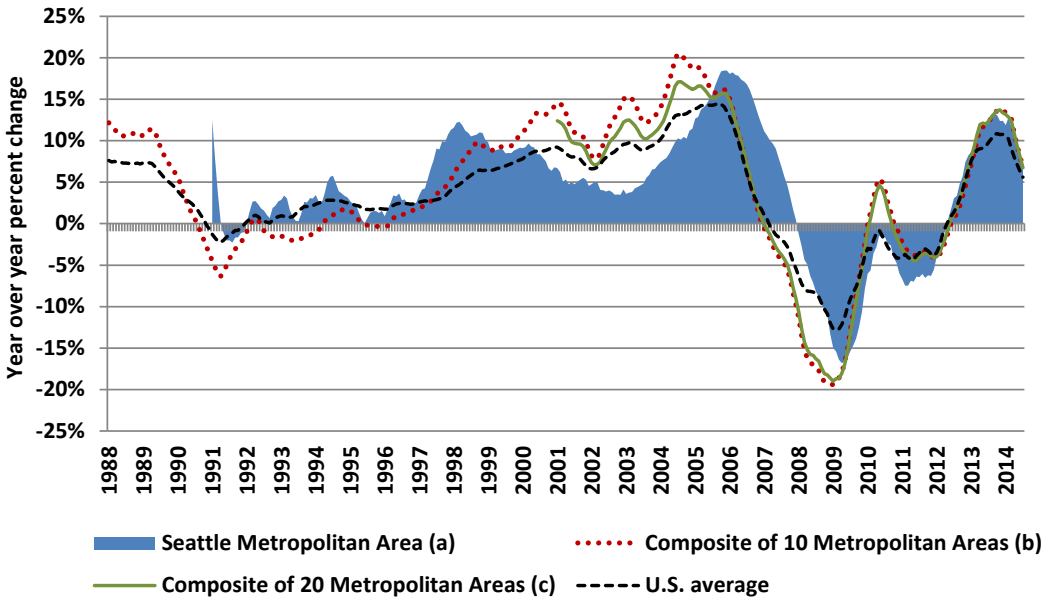
(a) Amazon does not disclose their regional employment numbers. Estimated based on published sources.

Source: Puget Sound Business Journal Book of Lists 2014, as reported by the Economic Development Council of Seattle and King County, www.edc-seaking.org, accessed October 2014.

2.1.8 Regional Housing Market

Figure 2-3 presents the percent change in home prices for Seattle and composites for 10 and 20 selected metropolitan areas from January 1988 through July 2014, based on the Standard & Poor's/Case-Shiller Home Price Index. Home prices in Seattle reached peak levels in 2006 and began to decrease following the start of the economic recession In December 2007 and continued to decrease through April 2012, generally following national trends. Since April 2012, housing prices in the Seattle regional housing market have increased each month, with slower but continued growth since February 2014.

Figure 2-3
Percent Change in Home Prices
Seattle and Selected Metropolitan Areas



Note: Data begins in 1990 for Seattle and in 2011 for the composite of 20 metropolitan areas.

(a) Includes data for the Seattle MSA.
(b) Includes Boston, Chicago, Denver, Las Vegas, Los Angeles, Miami, New York, San Diego, San Francisco, and Washington, D.C.
(c) Includes Atlanta, Charlotte, Cleveland, Dallas, Detroit, Minneapolis, Phoenix, Portland, Seattle, and Tampa in addition to the areas mentioned above.

Source: Standard & Poors/Case-Shiller Home Price Indices, www.standardandpoors.com, accessed October 2014.

2.1.9 Tourism

Tourism represents an increasingly important source of economic activity in the Seattle Primary Area. Seattle points of interest include the Space Needle, Chihuly Garden and Glass, the Seattle waterfront, Pioneer Square, Pike Place Market, the Seattle Aquarium, and numerous museums and parks. According to Visit Seattle, visitor spending in Seattle and King County increased an average of 4.8% per year between 2003 and 2013, from $3.77 billion to $6.00 billion, as shown in Table 2-4. In 2013, an estimated 18.6 million overnight visitors traveled to Seattle and King County, according to a study conducted for Visit Seattle.*

International tourism accounts for an increasing share of total visitors to the Seattle Primary Area, with approximately 20% of visitors coming from other countries. Canada accounts for the largest share of international visitors to Seattle, with 58.0%, followed by China and the United Kingdom, each with 4.7%, Japan with 4.6%, and Australia with 3.5%.

The Seattle Primary Area is an increasingly popular location for meetings and conventions. According to Visit Seattle, more than 300 conventions representing $1.6 billion in economic impact in the past

*Visit Seattle is a private, nonprofit marketing organization serving Seattle and King County with a goal to enhance employment opportunities and the economic prosperity of the region.

5 years could not be accommodated due to the lack of convention space and dates. The Washington State Convention Center (WSCC) is the smallest big-city convention center on the West Coast and ranks 55th in size nationally. As a result, the development of a nearby WSCC sister convention facility in close proximity to a new private hotel development is being planned, with construction estimated to start in 2017.

Table 2-4
Tourism Statistics
Seattle-Tacoma International Airport

	Overnight visitors (millions)	Visitor expenditures (billions)	Cruise ship passengers	Cruise ship vessels
2003	8.50	$3.77	344,922	99
2004	8.73	3.97	562,308	148
2005	9.10	4.33	686,978	169
2006	9.41	4.75	751,074	196
2007	9.49	5.16	780,593	190
2008	9.34	5.14	886,039	210
2009	8.80	6.90	875,433	218
2010	9.50	5.50	931,698	223
2011	9.90	5.90	885,949	195
2012	10.20	5.90	934,900	202
2013	18.60	6.00	870,994	187
	Compound annual percent increase			
2003-2013	8.1%	4.8%	9.7%	6.6%

Sources: Visit Seattle, *Annual Economic Impacts of Travel: Seattle and King County, Washington,* compiled by Dean Runyan Associates for Visit Seattle, www.visitseattle.org. Port of Seattle, *2014 Cruise Ship Fact Sheet*, www.portofseattle.org, accessed October 2014.

The Seattle Primary Area is home to two downtown cruise terminals—Bell Street Cruise Terminal at Pier 66 and Smith Cove Cruise Terminal at Terminal 91, which together handled 870,994 cruise ship passengers in 2013, as shown in Table 2-4. Seven major cruise lines offer cruises to Alaska from Seattle, including Carnival, Celebrity Cruises, Holland America Line, Norwegian Cruise Line, Princess Cruises, Oceania Cruises and Royal Caribbean. According to the Port of Seattle, the Seattle cruise industry generates more than 3,900 jobs and $372 million in annual business revenue.

2.2 Economic Outlook

The economic outlook for the United States, the State of Washington, and the Seattle Primary Area forms a basis for anticipated growth in airline traffic at the Airport. Economic activity in the Seattle Primary Area and the State is directly linked to the production of goods and services in the world and the rest of the United States. Both airline travel and the movement of cargo through the Airport depend on the economic linkages between and among the regional, State, national, and global economies. The economic and other assumptions underlying the forecasts of enplaned passengers are based on a

review of global, national, State, and regional economic outlooks as well as an analysis of historical socioeconomic trends and airline traffic trends, as presented in the chapter titled "Historical Passenger Airline Traffic."

2.2.1 Global Economy

Globalization of the world economy has created linkages between national economies that relate not only to trade but also to air travel. The Seattle Primary Area and the State have strong linkages to the global economy through a number of industry sectors and the five world regions that are currently served at the Airport. The economic growth of these world regions, in terms of Gross Domestic Product (GDP), is directly related to the growth in air travel. Projections of GDP for the world regions are shown in Table 2-5. Continued growth in the economies of the world regions most closely aligned with the Seattle economy and airline service at the Airport are expected to contribute to continued growth in passenger traffic at the Airport.

2.2.2 U.S. Economy

The U.S. economy has grown at a slow-to-moderate pace since the 2008-2009 economic recession. The Congressional Budget Office (CBO) forecasts stronger economic growth in 2014 than in 2013, with GDP increasing 3.1% compared with 2.1% in 2013. Thereafter, the CBO projects economic growth of 3.4% percent in 2015 and 2016 and 2.7% in 2017, before settling into a longer-term 2.2% rate of growth through 2019. The long-term GDP forecasts presented in Table 2-4 prepared by Global Insight are for an average annual growth rate of 2.5% between 2013 and 2034.

Table 2-5
Historical and Projected GDP Growth by World Region
Seattle-Tacoma International Airport

	Average annual percent increase (decrease) in GDP (constant U.S. dollars)		
	Historical		Forecast
World region	1990-2000	2000-2013	2013-2034
Asia	n.a.	4.3%	4.3%
Canada	1.9%	1.9	2.4
Europe (a)	(1.2) *(a)*	0.9	1.5
Latin America	3.6	3.1	4.0
Mexico	1.5	2.7 *(b)*	3.7
Middle East/Africa	n.a.	1.9	2.4
United States	3.4	1.8	2.5
World	1.8	2.5	3.2

n.a. = not available

(a) Data are for the countries that have adopted the Euro.
(b) Percent change between 1991 and 2000.

Source: Global Insight as reported in U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecasts, Fiscal Years 2014-2034*, March 2014.

2.2.3 Washington Economy

In September 2014, the Washington State Economic and Revenue Forecast Council completed county-level projections of economic variables through 2019.* Strong economic growth is forecast for the State of Washington between 2013 and 2019, including:

- Nonagricultural employment growth of 1.7% per year
- Per capita income growth, in constant dollars, of 2.6% per year
- Housing unit (authorized by building permit) growth of 5.0% per year

Long-term economic forecasts for the State of Washington are presented in Table 2-1.

2.2.4 Seattle Economy

In July 2013, the PSRC completed its long-range regional economic forecast through 2040.** PSRC's forecasts are used for land-use and transportation planning. According to the PSRC, strong economic growth is forecast for the Seattle Primary Area between 2013 and 2034, including:

- Population growth of 1.0% per year
- Nonagricultural employment growth of 1.4% per year
- Per capita income growth, in constant dollars, of 2.5% per year

A favorable long-term economic outlook for the Seattle Primary Area is supported by its growing population, well-educated work force, high per capita income, diverse local economy, popularity as a domestic and international tourist destination.

2.2.6 Economic Basis for Forecast Aviation Demand

The economic outlook for world regions, the United States, the State of Washington, and the Seattle Primary Area form a basis for anticipated growth in aviation demand at the Airport. Employment and income projections for the Seattle Primary Area and the State of Washington are for strong economic growth, particularly in aerospace, manufacturing, trade, professional and health care services, education, leisure and hospitality services. Factors expected to contribute to economic growth in the Seattle Primary Area and associated increases in airline travel include: (1) the diversity in the economic base, which lessens its vulnerability to weaknesses in particular industry sectors, (2) growth in the existing and emerging Seattle industry sectors described earlier, (3) an educated labor force able to support the development of knowledge-based and service industries, and (4) continued reinvestment to support the development of tourism, conventions, and other businesses. This outlook is reflected in the aviation demand forecasts presented in Chapter 6, "Aviation Demand Forecasts."

*Washington State Economic and Revenue Forecast Council, *Final September 2014 Economic Forecast*, www.erfc.wa.gov.
**Puget Sound Regional Council, *2012 Regional Macroeconomic Forecast*, July 2013, www.psrc.org.

Historical Passenger Airline Traffic

A review of passenger airline activity at the Airport provides the foundation for the forecasts.

3.1 Airlines Serving Seattle-Tacoma International Airport

The Airport is served by 27 passenger airlines, including 5 mainline airlines, 4 regional affiliates of which one is associated with more than one mainline airline, 5 low-cost carriers, and 13 foreign-flag airlines, as shown in Table 3-1.

Table 3-1
Airlines Serving Seattle-Tacoma International Airport
Seattle-Tacoma International Airport

Mainline	Regional airlines (affiliation)	Low cost carriers	Foreign-flag airlines
Alaska Airlines	Compass Airlines (Delta)	Frontier Airlines *(a)*	Air Canada
American Airlines *(b)*	Horizon Air (Alaska)	JetBlue Airways	All Nippon Airways
Delta Air Lines *(c)*	Kenmore Air	Southwest Airlines *(d)*	Asiana Airlines
Hawaiian Airlines	Skywest Airlines (Alaska, Delta, United)	Sun Country Airlines	British Airways
United Airlines *(e)*		Virgin America	Condor Flugdienst
			Emirates
			EVA Air
			Hainan Airlines
			Icelandair
			Korean Air
			Lufthansa Airlines
			Air Canada
			All Nippon Airways

(a) Frontier was acquired by Indigo Partners LLC in December 2013 and restructured its airfares in 2014 to that of an "ultra" LCC, i.e., a low cost airline with a simplified fare structure and a la carte pricing.
(b) American completed its merger with US Airways on December 9, 2013.
(c) Delta completed its merger with Northwest on October 29, 2008.
(d) Southwest completed its merger with AirTran on May 2, 2011.
(e) United completed its merger with Continental on October 1, 2010.

Sources: Seattle-Tacoma International Airport records and OAG Worldwide Aviation Ltd, OAG Analyser database, accessed August 2014.

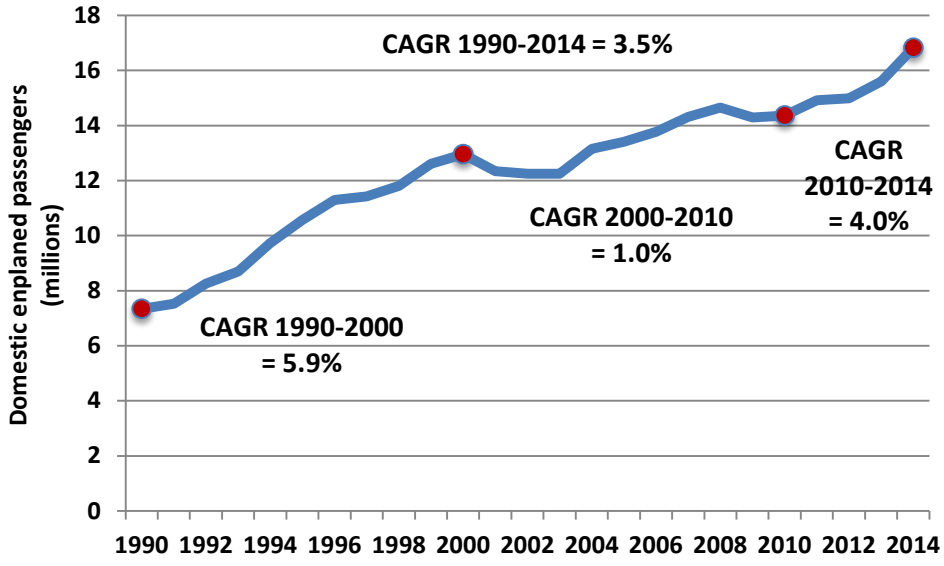
3.2 Enplaned Passengers

As shown in Table 3-2, the number of enplaned passengers at the Airport increased an average of 3.5% per year between 1990 and 2014, exceeding growth in the nation as a whole during this period (an average increase of 2.1% per year). SEA experienced the strongest growth between 1990 and 2000, an average increase of 5.6% per year, reflecting the expansion of service by Alaska and Horizon Airlines and the introduction of service by Southwest Airlines in 1994. Between 2000 and 2010, the period including the 2001 recession and the 2008-2009 recession, the number of passengers at the Airport increased an average increase of 1.1% per year, compared with an average increase of 0.6% per year in the nation as a whole. Between 2010 and 2014, the number of passengers enplaned at the Airport increased an average of 4.4% per year, exceeding the national rate during this period (an average increase of 1.7% per year) and SEA's long-term growth rate between 1990 and 2014.

3.2.1 Domestic Passengers

Since 1990, domestic passengers have accounted for at least 90% of total enplaned passengers at the Airport and have driven overall growth. As shown on Figure 3-1, the compound annual growth rate for domestic enplaned passengers at SEA is 3.5% between 1990 and 2014, with faster growth between 1990 and 2000 (an average increase of 5.9% per year). Domestic passenger growth slowed between 2000 and 2010 (an average increase of 1.0% per year), but exceeded long-term growth rates between 2010 and 2014 (an average increase of 4.0% per year).

Figure 3-1
Historical Trend Analysis – Domestic Enplaned Passengers
Seattle-Tacoma International Airport



CAGR = Compound annual growth rate

Source: Seattle-Tacoma International Airport records.

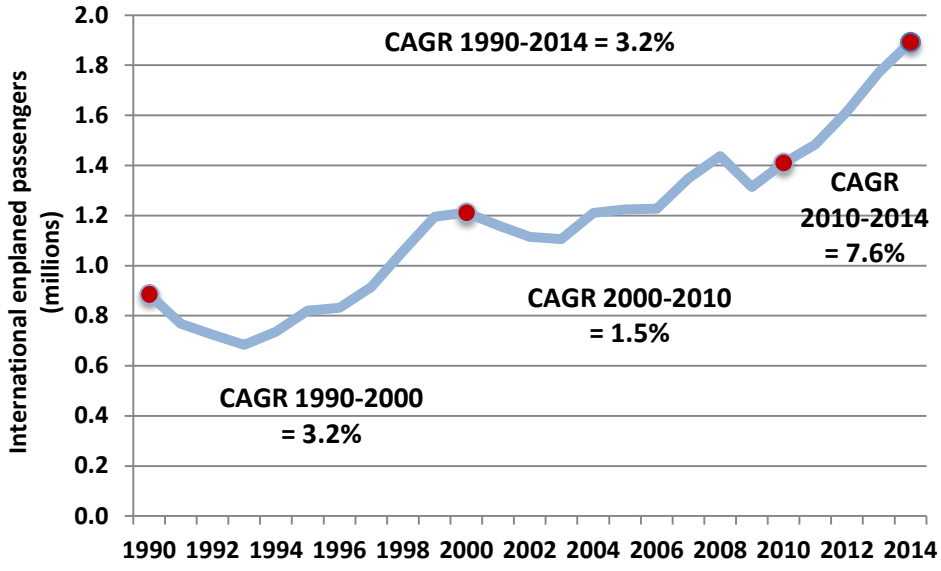
As shown in Table 3-2, enplaned passengers traveling from SEA to destinations in the contiguous United States increased an average of 3.6% per year between 1990 and 2014, accounting for approximately 89.0% of total domestic enplaned passengers during this period. The State of Alaska accounted for 7.0% of total domestic enplaned passengers at the Airport between 1990 and 2014, with average annual growth of 2.7% per year during this period. Enplaned passengers traveling from SEA to Hawaii increased an average of _4.1% per year between 1990 and 2014, accounting for approximately 4.0% of total domestic enplaned passengers during this period.

3.2.2 International Passengers

Since 1990, international passengers have accounted for about 10% of total enplaned passengers at the Airport. As shown on Figure 3-2, the compound annual growth rate for international enplaned passengers at SEA is 3.2% between 1990 and 2014, with faster growth between 2010 and 2014 (an average increase of 7.6% per year), reflecting the development of the Airport as Delta's West Coast gateway and continued growth in foreign-flag airline service.

Between 1990 and 2014, the numbers of passengers traveling from Seattle to Europe experienced the strongest growth (an average increase of 5.2% per year), followed by Asia (an average increase of 3.3% per year), as shown in Table 3-2. The number of SEA international passengers to Canada and Mexico increased an average of 2.0% and 2.7% per year, respectively, between 1990 and 2014.

Figure 3-2
Historical Trend Analysis – International Enplaned Passengers
Seattle-Tacoma International Airport



CAGR = Compound annual growth rate

Source: Seattle-Tacoma International Airport records.

Table 3-2
Historical Enplaned Passengers by Region
Seattle-Tacoma International Airport

	Domestic				International						
Year	Alaska	Hawaii	Contiguous United States	Total	Asia	Canada	Europe	Mexico	Other	Total	Total
1990	640,765	255,955	6,444,380	7,341,100	341,670	342,970	143,799	55,589	792	884,820	8,225,920
1991	695,814	229,426	6,601,200	7,526,440	287,368	321,341	116,665	42,279	--	767,653	8,294,093
1992	898,424	282,545	7,073,234	8,254,203	223,018	315,872	135,997	49,563	87	724,537	8,978,740
1993	1,005,815	280,242	7,414,260	8,700,317	172,867	311,958	157,401	42,022	--	684,248	9,384,565
1994	1,070,352	255,151	8,410,095	9,735,598	180,031	341,887	167,441	46,193	--	735,552	10,471,150
1995	939,374	278,022	9,353,276	10,570,672	261,614	331,984	172,531	53,720	--	819,849	11,390,521
1996	822,183	245,055	10,234,302	11,301,540	305,925	276,239	182,115	55,702	11,466	831,447	12,132,987
1997	810,286	256,847	10,359,882	11,427,015	344,618	315,644	171,396	67,104	15,614	914,376	12,341,391
1998	872,444	282,696	10,655,070	11,810,210	346,433	401,243	223,609	69,406	17,086	1,057,777	12,867,987
1999	869,710	328,651	11,408,016	12,606,377	395,057	431,174	271,308	82,630	15,590	1,195,759	13,802,136
2000	877,177	323,786	11,761,615	12,962,578	394,436	463,400	253,885	90,758	8,695	1,211,174	14,173,752
2001	836,948	298,631	11,208,990	12,344,569	344,801	470,008	237,483	98,524	10,595	1,161,411	13,505,980
2002	886,259	313,387	11,047,539	12,247,185	297,307	462,076	243,795	99,487	12,464	1,115,129	13,362,314
2003	883,454	295,183	11,071,518	12,250,155	284,405	457,690	245,846	105,070	12,501	1,105,512	13,355,667
2004	983,246	250,599	11,919,777	13,153,622	362,941	470,129	258,508	97,990	21,052	1,210,620	14,364,242
2005	962,454	263,011	12,182,508	13,407,973	381,661	453,158	268,021	104,838	16,486	1,224,164	14,632,137
2006	1,036,194	342,474	12,385,420	13,764,088	391,346	431,075	277,776	126,362	--	1,226,559	14,990,647
2007	1,077,959	439,348	12,796,072	14,313,379	402,993	492,934	305,244	146,330	355	1,347,856	15,661,235
2008	1,099,727	401,521	13,146,235	14,647,483	358,840	528,766	401,821	140,395	7,634	1,437,456	16,084,939
2009	1,062,802	577,027	12,656,357	14,296,186	348,332	476,315	365,638	120,333	3,394	1,314,012	15,610,198
2010	1,042,948	595,697	12,724,936	14,363,581	462,780	494,712	358,405	93,767	103	1,409,767	15,773,348
2011	1,090,239	570,440	13,253,152	14,913,831	502,274	482,535	400,073	98,413	362	1,483,657	16,397,488
2012	1,110,666	597,103	13,275,177	14,982,946	611,033	494,211	405,105	103,732	297	1,614,378	16,597,324
2013	1,129,145	629,346	13,845,638	15,604,129	716,264	523,882	429,100	102,793	--	1,772,039	17,376,168
2014	1,220,044	675,295	14,928,877	16,824,216	752,779	548,023	485,703	105,894	--	1,892,399	18,716,615
	Compound annual percent increase (decrease)										
1990-2000	3.2%	2.4%	6.2%	5.9%	1.4%	3.1%	5.8%	5.0%	27.1%	3.2%	5.6%
2000-2010	1.7	6.3	0.8	1.0	1.6	0.7	3.5	0.3	(35.8)	1.5	1.1
2010-2014	4.0	3.2	4.1	4.0	12.9	2.6	7.9	3.1	--	7.6	4.4
1990-2014	2.7	4.1	3.6	3.5	3.3	2.0	5.2	2.7	--	3.2	3.5

Source: Seattle-Tacoma International Airport records.

3.2.3 Enplaned Passengers by Airline Type

As shown in Table 3-3, low cost carriers experienced the strongest growth in enplaned passengers at the Airport between 1990 and 2014 (an average of 24.3% per year), reflecting the initiation of scheduled service by Southwest Airlines in 1994, Frontier in 1996, Sun Country in 1999, jetBlue in 2001, and Virgin America in 2008. Regional airlines also experienced strong growth between 1990 and 2014 (an average of 6.3% per year), largely reflecting the expansion of service by Horizon. Foreign-flag and mainline airlines increased an average of 3.5% and 2.4%, respectively, between 1990 and 2014.

3.2.4 Originating and Connecting Passengers

Table 3-4 presents the estimated distribution of enplaned passengers between those originating their air journeys at the Airport and those connecting between flights. Between 2000 and estimated 2014, the number of connecting passengers increased an average of 2.6% per year, compared with an average increase of 1.8% per year in originating passengers during the same period. Strong growth in the number of connecting passengers at the Airport between 2010 and estimated 2014 (an average increase of 5.6% per year) reflects the continued expansion of Alaska's hub and the development of Delta's hub at the Airport.

3.2.4.1 Domestic Connecting Passengers

Domestic connecting passengers or passengers connecting to domestic flights at the Airport consist of (1) passengers connecting from a domestic flight to another domestic flight (domestic-domestic) and (2) passengers connecting from an international flight to a domestic flight (international-domestic). Domestic-domestic connections accounted for 82% of all domestic connecting passengers at the Airport in 2013; international-domestic connections accounted for the remaining 18%, as shown on Figure 3-3.

The number of domestic connecting passengers at an airport is influenced by the route networks of the existing airlines. Alaska Airlines accounted for 77% of all domestic connecting passengers at the Airport in 2013, reflecting the role of the Airport as a primary connecting hub in Alaska's system. Delta Air Lines accounted for 10% of all domestic connecting passengers at the Airport in 2013, reflecting the initial development of the Airport as an international gateway and West Coast connecting hub in Delta's system.

3.2.4.2 International Connecting Passengers

International connecting passengers or passengers connecting to international flights at the Airport consist of (1) passengers connecting from a domestic flight to another international flight (domestic-international) and (2) passengers connecting from an international flight to another international flight (international-international). Domestic-international connections accounted for 87% of all international connecting passengers at the Airport in 2013; international-international connections accounted for the remaining 13% as shown on Figure 3-4.

Table 3-3
Historical Enplaned Passengers by Airline Type
Seattle-Tacoma International Airport

Year	Mainline airlines	Regional airlines	Low cost carriers	Foreign-flag airlines	Charter airlines	Total	Percent increase (decrease)
1990	7,113,988	724,130	12,601	347,694	27,507	8,225,920	--%
1991	7,107,714	824,326	11,839	292,262	57,952	8,294,093	0.8
1992	7,411,521	1,041,897	74,741	253,378	197,203	8,978,740	8.3
1993	7,356,522	1,281,854	505,743	217,941	22,505	9,384,565	4.5
1994	8,149,600	1,465,255	577,662	258,801	19,832	10,471,150	11.6
1995	8,758,623	1,467,376	805,046	335,398	24,078	11,390,521	8.8
1996	9,272,191	1,448,919	1,013,076	362,855	35,946	12,132,987	6.5
1997	9,496,261	1,429,834	984,084	382,446	48,766	12,341,391	1.7
1998	9,760,124	1,732,045	914,551	400,989	60,278	12,867,987	4.3
1999	10,194,477	2,043,599	1,136,410	379,417	48,233	13,802,136	7.3
2000	10,238,968	2,134,896	1,399,832	354,278	45,778	14,173,752	2.7
2001	9,777,015	1,957,840	1,406,270	328,259	36,596	13,505,980	(4.7)
2002	9,709,960	1,830,899	1,379,542	348,162	93,751	13,362,314	(1.1)
2003	9,730,445	1,845,577	1,415,408	338,994	25,243	13,355,667	0.0
2004	10,442,106	1,914,155	1,562,844	401,097	44,040	14,364,242	7.6
2005	10,698,352	1,871,965	1,558,627	424,722	78,471	14,632,137	1.9
2006	10,884,927	1,910,189	1,684,967	449,857	60,707	14,990,647	2.5
2007	11,029,477	2,235,212	1,817,708	523,055	55,783	15,661,235	4.5
2008	10,813,573	2,462,046	2,171,753	603,346	34,221	16,084,939	2.7
2009	10,391,866	2,384,878	2,243,858	573,711	15,885	15,610,198	(3.0)
2010	10,382,612	2,507,165	2,272,733	581,939	28,899	15,773,348	1.0
2011	10,705,549	2,590,659	2,452,775	616,761	31,744	16,397,488	4.0
2012	10,882,041	2,610,250	2,385,437	683,557	36,039	16,597,324	1.2
2013	11,562,032	2,674,364	2,379,308	723,335	37,129	17,376,168	4.7
2014	12,457,530	3,114,926	2,321,638	786,821	35,700	18,716,615	7.7
	Compound annual percent increase (decrease)						
1990-2000	3.7%	10.2%	86.4%	1.4%	8.5%	6.0%	
2000-2010	0.1	4.6	6.3	3.2	1.4	2.4	
2010-2014	4.7	5.6	0.5	7.8	5.4	4.4	
1990-2014	2.4	6.3	24.3	3.5	1.1	3.5	

Note: See Table 3-1 for a listing of airlines by type.

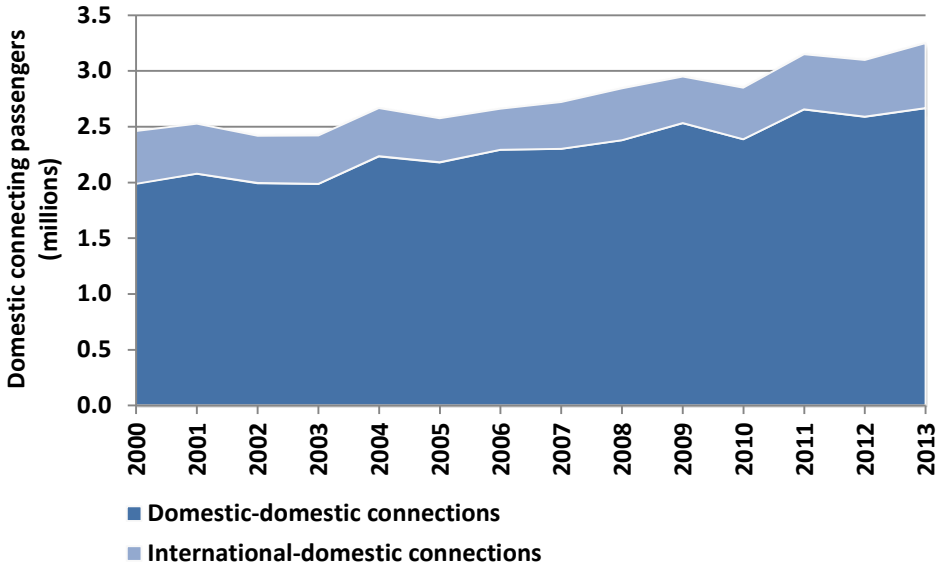
Source: Seattle-Tacoma International Airport records.

Table 3-4
Originating and Connecting Passengers
Seattle-Tacoma International Airport

Year	Originating *(a)*			Connecting *(b)*			Enplaned passengers *(c)*			Percent of total	
	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Originating	Connecting
2000	10,158,148	598,374	10,756,522	2,804,430	612,800	3,417,230	12,962,578	1,211,174	14,173,752	75.9%	24.1%
2001	9,446,739	560,811	10,007,550	2,897,830	600,600	3,498,430	12,344,569	1,161,411	13,505,980	74.1	25.9
2002	9,424,175	579,349	10,003,524	2,823,010	535,780	3,358,790	12,247,185	1,115,129	13,362,314	74.9	25.1
2003	9,342,045	575,702	9,917,747	2,908,110	529,810	3,437,920	12,250,155	1,105,512	13,355,667	74.3	25.7
2004	10,036,302	716,560	10,752,862	3,117,320	494,060	3,611,380	13,153,622	1,210,620	14,364,242	74.9	25.1
2005	10,409,563	730,534	11,140,097	2,998,410	493,630	3,492,040	13,407,973	1,224,164	14,632,137	76.1	23.9
2006	10,627,538	746,219	11,373,757	3,136,550	480,340	3,616,890	13,764,088	1,226,559	14,990,647	75.9	24.1
2007	11,097,999	813,376	11,911,375	3,215,380	534,480	3,749,860	14,313,379	1,347,856	15,661,235	76.1	23.9
2008	11,214,933	833,866	12,048,799	3,432,550	603,590	4,036,140	14,647,483	1,437,456	16,084,939	74.9	25.1
2009	10,780,546	766,982	11,547,528	3,515,640	547,030	4,062,670	14,296,186	1,314,012	15,610,198	74.0	26.0
2010	10,988,451	822,927	11,811,378	3,375,130	586,840	3,961,970	14,363,581	1,409,767	15,773,348	74.9	25.1
2011	11,257,181	888,557	12,145,738	3,656,650	595,100	4,251,750	14,913,831	1,483,657	16,397,488	74.1	25.9
2012	11,366,446	1,007,858	12,374,304	3,616,500	606,520	4,223,020	14,982,946	1,614,378	16,597,324	74.6	25.4
2013	11,798,559	1,081,519	12,880,078	3,805,570	690,520	4,496,090	15,604,129	1,772,039	17,376,168	74.1	25.9
2014	12,666,055	1,124,217	13,790,271	4,158,161	768,182	4,926,344	16,824,216	1,892,399	18,716,615	73.7	26.3
	Compound annual percent increase										
2000-2010	0.8%	3.2%	0.9%	1.9%	(0.4%)	1.5%	1.0%	1.5%	1.1%		
2010-2014	3.6	8.1	3.9	5.4	7.0	5.6	4.0	7.6	4.4		
2000-2014	1.6	4.6	1.8	2.9	1.6	2.6	1.9	3.2	2.0		

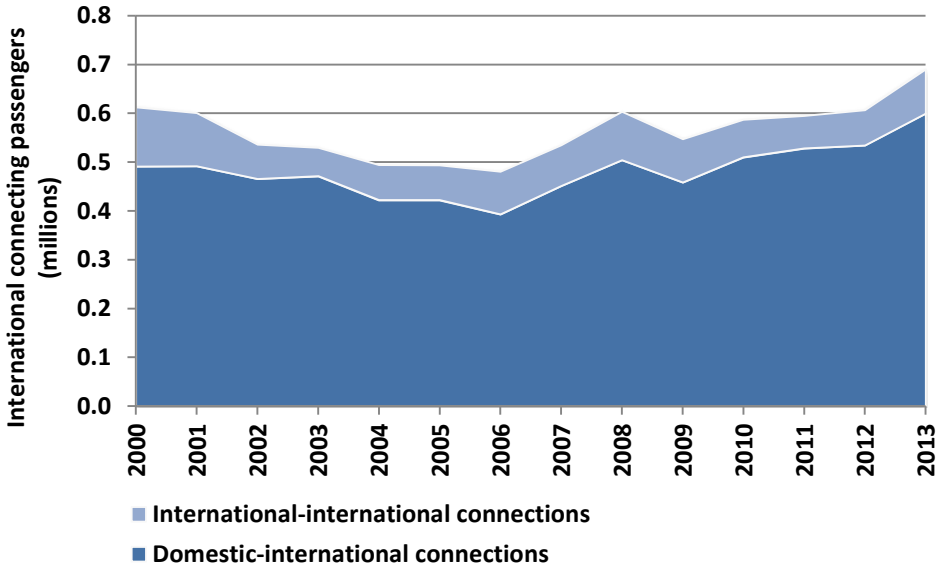
(a) Calculated by subtracting connecting passengers from total enplaned passengers. Includes domestic and international O&D passengers traveling on U.S. and foreign-flag airlines as well as any passengers making connections between two international flights and non-revenue passengers.
(b) U.S. Department of Transportation, *Origin Destination Survey of Airline Passenger Traffic, Domestic,* online database, accessed September 2014. Data for 2014 are estimated.
(c) Seattle-Tacoma International Airport records.

Figure 3-3
Domestic Connecting Passengers
Seattle-Tacoma International Airport



Source: U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, DOT Analyser online database, accessed October 2014.

Figure 3-4
International Connecting Passengers
Seattle-Tacoma International Airport



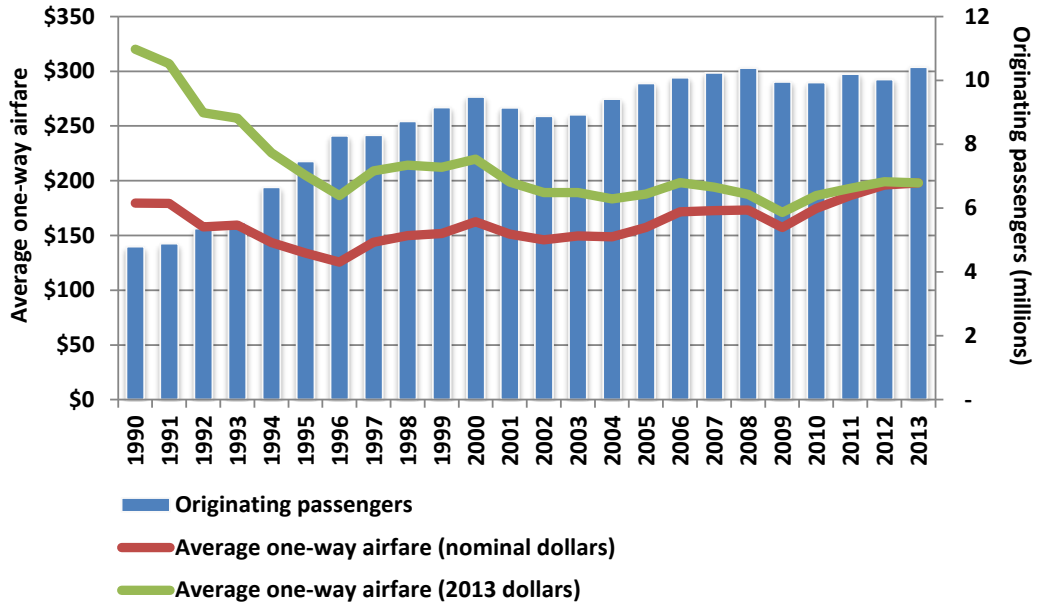
Source: U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, DOT Analyser online database, accessed October 2014.

The number of international connecting passengers at an airport is influenced by the geographical location of an airport to international regions, the level of airline service, and route networks of the existing airlines. Alaska Airlines accounted for 61% of all international connecting passengers at the Airport in 2013, reflecting the role of the Airport as a primary connecting hub in Alaska's system. Delta Air Lines accounted for 21% of all international connecting passengers at the Airport in 2013, reflecting the initial development of the Airport as an international gateway and West Coast connecting hub in Delta's system.

3.2.5 Domestic Originating Passengers and Airfares

O&D passenger demand is affected by the demographics and economy of the region served by the airport as well as airline service and airfares. From 1990 to 2013, the number of domestic originating passengers at SEA increased an average of 3.4% per year while nominal average airfares increased slightly (an average increase of 0.4% per year), as shown on Figure 3-5.

Figure 3-5
Domestic Originating Passengers and Airfares
Seattle-Tacoma International Airport



Source: U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, DOT Analyser online database, accessed October 2014. The U.S. Department of Labor Consumer Price Index for All Urban Consumers was used to calculate one-way airfares in 2013 dollars.

3.3 Airline Market Shares

The market shares for the passenger airlines serving the Airport are shown in Table 3-5 and Figure 3-6. In 2014, Alaska Airlines had the largest market share of enplaned passengers (38.8%) at the Airport, followed by Delta Air Lines (15.6%), Horizon (12.8%), United Airlines (8.3%), Southwest Airlines (8.0%), and American Airlines (6.7%).

Table 3-5
Airline Market Shares of Enplaned Passengers
Seattle-Tacoma International Airport

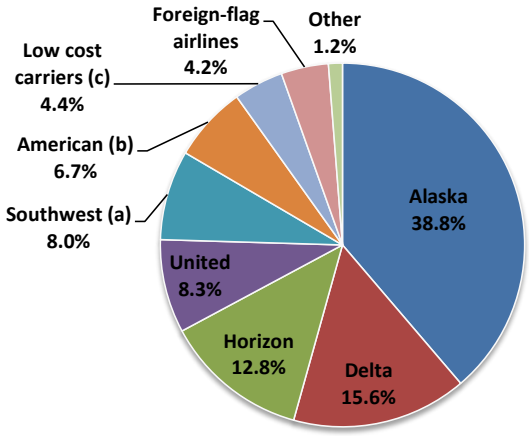
Airline	2010	2011	2012	2013	2014
Alaska	5,529,138	5,883,252	6,051,964	6,611,569	7,255,506
Horizon	2,216,764	2,308,414	2,343,579	2,375,386	2,402,239
Delta	1,877,680	1,891,782	1,911,144	2,103,619	2,912,159
United	1,913,569	1,849,468	1,783,441	1,702,959	1,555,285
Southwest *(a)*	1,497,601	1,582,905	1,477,779	1,482,430	1,493,989
American *(b)*	1,137,311	1,167,599	1,222,628	1,265,485	1,252,582
Low cost carriers *(c)*	737,568	843,677	907,658	896,878	826,865
Foreign-flag airlines	581,939	616,761	683,557	723,335	786,821
Other	281,778	253,630	215,574	214,507	231,169
Total	15,773,348	16,397,488	16,597,324	17,376,168	18,716,615
	Percent of total				
Alaska	35.1%	35.9%	36.5%	38.0%	38.8%
Horizon	14.1	14.1	14.1	13.7	12.8
Delta	11.9	11.5	11.5	12.1	15.6
United	12.1	11.3	10.7	9.8	8.3
Southwest *(a)*	9.5	9.7	8.9	8.5	8.0
American *(b)*	7.2	7.1	7.4	7.3	6.7
Low cost carriers *(c)*	4.7	5.1	5.5	5.2	4.4
Foreign-flag airlines	3.7	3.8	4.1	4.2	4.2
Other	1.8	1.5	1.3	1.2	1.2
	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Includes regional affiliates.

(a) Includes AirTran.
(b) Includes US Airways.
(c) Includes Allegiant, Frontier, jetBlue, Sun Country, and Virgin America.

Source: Seattle-Tacoma International Airport records.

Figure 3-6
Airline Shares of Enplaned passengers In 2014
Seattle-Tacoma International Airport



Note: Includes regional affiliates.

(a) Includes AirTran.
(b) Includes US Airways.
(c) Includes Allegiant, Frontier, jetBlue, Sun Country, and Virgin America.

Source: Seattle-Tacoma International Airport records.

3.4 Origin-Destination Markets and Airline Service

In 2013, approximately 74% of the Airport's passengers were O&D passengers; the remaining 26% were connecting passengers. This section presents a summary of the busiest domestic and international O&D markets at SEA as well as the airline service provided to each market.

3.4.1 Domestic Origin-Destination Markets and Airline Service

For the 12-month period ended September 2013, the top 25 domestic passenger markets at SEA accounted for 71.7% of the total domestic O&D passengers, as shown in Table 3-6. The Los Angeles area is the largest O&D market with 11.6% of domestic O&D passengers, followed by San Francisco with 9.7%, New York (4.2%), Las Vegas (4.2%), and Phoenix (3.7%).

In July 2014, each of the top 25 domestic passenger markets had daily nonstop service at the Airport, as shown in Table 3-6 and on Figure 3-7. The Airport had an average of 485 daily domestic scheduled flights in July 2014, including 387 to the top 25 domestic passenger markets.

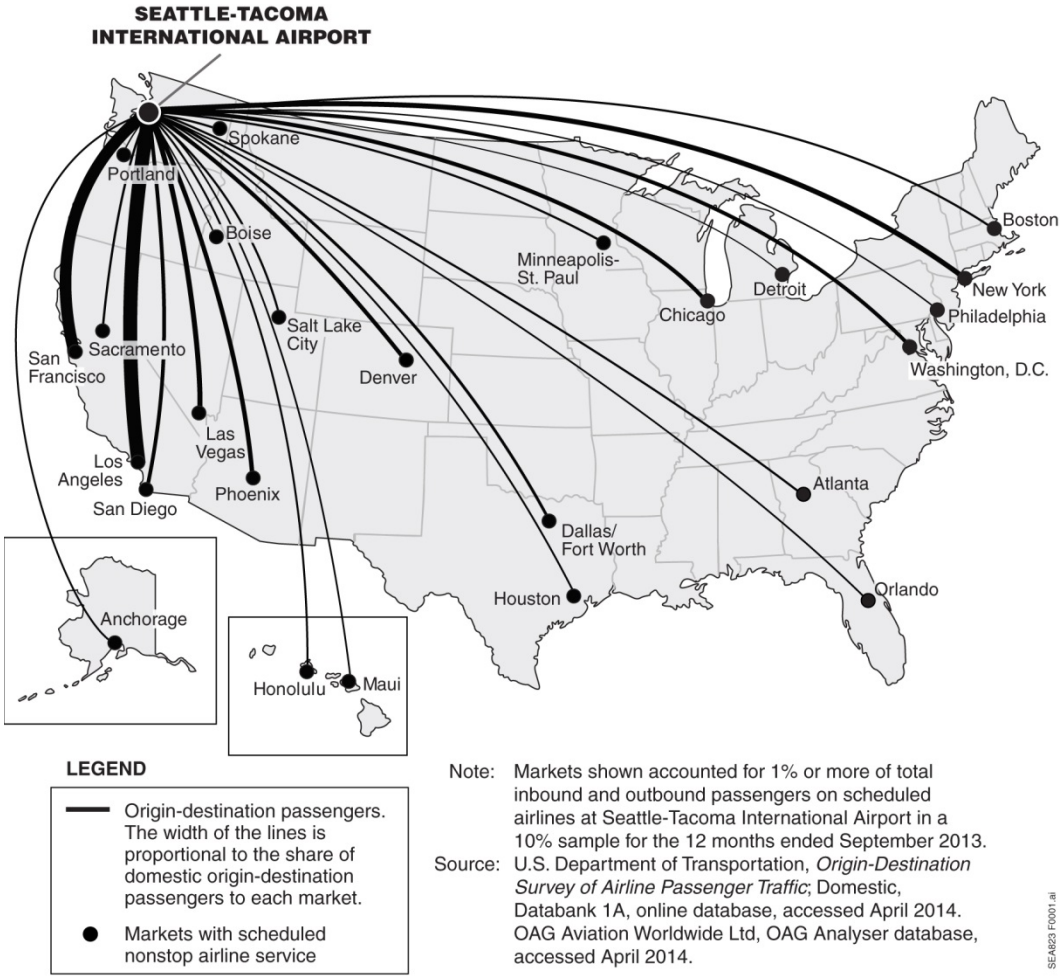
Table 3-6
Domestic Passenger Origin-Destination Patterns and Airline Service
Seattle-Tacoma International Airport

2013 Rank	Origin-destination market	Air miles from SEA	Percent of domestic O&D passengers *(a)*	Average daily nonstop scheduled departures *(b)*
1	Los Angeles *(c)*	937	11.6%	48
2	San Francisco *(d)*	672	9.7	58
3	New York *(e)*	867	4.2	12
4	Las Vegas	2,402	4.2	21
5	Phoenix	1,107	3.7	15
6	Denver	1,024	3.3	19
7	Chicago *(f)*	1,733	3.3	20
8	Washington D.C. *(g)*	2,335	3.1	7
9	San Diego	1,050	3.1	16
10	Dallas/Fort Worth *(h)*	1,660	2.4	13
11	Sacramento	605	1.9	10
12	Minneapolis	1,399	1.8	11
13	Boston	2,496	1.8	6
14	Atlanta	2,182	1.8	10
15	Spokane	224	1.8	17
16	Salt Lake City	689	1.8	11
17	Honolulu	2,677	1.7	4
18	Anchorage	1,448	1.6	25
19	Houston *(i)*	2,554	1.5	9
20	Orlando	2,640	1.4	1
21	Maui	1,874	1.4	3
22	Boise	399	1.2	10
23	Philadelphia	2,378	1.2	5
24	Portland	129	1.1	31
25	Detroit	1,927	1.0	5
	Cities listed		71.7%	387
	Other cities		28.3%	98 *(j)*
	All cities		100.0%	485

(a) Data are for October 2012 through September 2013.
(b) Data are for July 2014.
(c) Los Angeles, Burbank, Long Beach, Ontario, and Orange County airports.
(d) San Francisco, Oakland, and San Jose airports.
(e) LaGuardia, John F. Kennedy International, and Newark Liberty International.
(f) O'Hare and Midway airports.
(g) Reagan, Dulles, and Baltimore Thurgood Marshall.
(h) Dallas/Fort Worth International Airport and Love Field.
(i) George Bush Intercontinental and William P. Hobby airports.
(j) An additional 53 average daily departures are provided from Seattle to international destinations.

Sources: U.S. Department of Transportation, *Origin Destination Survey of Airline Passenger Traffic, Domestic*, online database and OAG Aviation Worldwide Ltd, OAG Analyser database, accessed September 2014.

Figure 3-7
Domestic Origin-Destination Patterns in 2013
Seattle-Tacoma International Airport



3.4.2 International Origin-Destination Markets and Airline Service

In 2013, the top 25 international passenger markets at SEA accounted for 58.1% of the total international O&D passenger bookings*, as shown in Table 3-7. Tokyo, Japan is the largest O&D market with 6.1% of international O&D passenger bookings, followed by London in the United Kingdom with 5.0%, Seoul, Korea (4.0%), San Jose Cabo, Mexico (3.7%), and Toronto, Canada (3.2%).

*As defined by the International Air Transport Association (IATA), a passenger airline "booking", equivalent to the term "reservation", means the allotment in advance of seating accommodation for a passenger. IATA, *Passenger Glossary of Terms*, www.iata.org

Table 3-7
International Passenger Origin-Destination Patterns and Airline Service
Seattle-Tacoma International Airport

2013 Rank	Origin-destination market	Country	Air miles from SEA	Percent of international O&D bookings *(a)*	Average daily nonstop scheduled departures *(b)*
1	Tokyo *(c)*	Japan	4,763	6.1%	3
2	London *(d)*	United Kingdom	4,791	5.0	3
3	Seoul *(e)*	Korea	5,209	4.0	3
4	San Jose Cabo	Mexico	1,820	3.7	--
5	Toronto (f)	Canada	2,057	3.2	2
6	Beijing	China	5,399	3.1	2
7	Vancouver	Canada	127	2.8	18
8	Puerto Vallarta	Mexico	2,083	2.7	--
9	Calgary	Canada	451	2.5	5
10	Cancun	Mexico	2,687	2.2	--
11	Taipei (g)	Chinese Taipei	6,070	2.0	1
12	Manila	Philippines	6,660	2.0	--
13	Paris (h)	France	5,007	1.8	1
14	Mexico City (i)	Mexico	2,337	1.7	--
15	Shanghai (j)	China	5,716	1.7	1
16	Frankfurt	Germany	5,009	1.7	2
17	Edmonton	Canada	558	1.6	3
18	Guadalajara	Mexico	2,145	1.5	--
19	Hong Kong	Hong Kong	6,497	1.4	1
20	Delhi	India	7,055	1.4	--
21	Ho Chi Minh City	Viet Nam	7,425	1.3	--
22	Amsterdam	Netherlands	4,877	1.3	2
23	Victoria	Canada	97	1.2	4
24	Osaka (k)	Japan	5,008	1.1	--
25	Montreal	Canada	2,280	1.1	--
	Cities listed			58.1	51
	Other cities			42.0	2
	All cities			100.0%	53

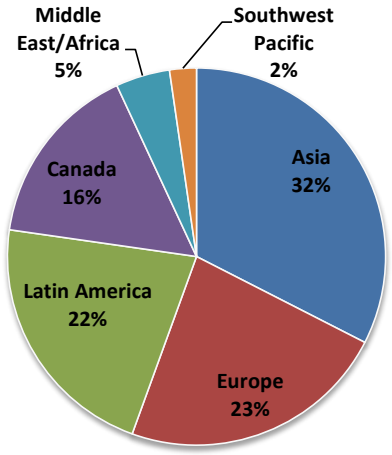
(a) Data are for calendar year 2013.
(b) Data are for July 2014.
(c) Tokyo Narita International and Tokyo Haneda airports.
(d) London Heathrow, London Gatwick, London City, and London Stansted airports.
(e) Seoul Incheon and Seoul Gimpo international airports.
(f) Toronto Lester B Pearson International, Toronto Kitchener/Waterloo Regional, and Toronto City Centre airports.
(g) Taipei Taiwan Taoyuan International and Taipei Songshan airports.
(h) Paris Charles de Gaulle and Paris Orly airports.
(i) Mexico City Juarez International and Mexico City Toluca airports.
(j) Shanghai Pudong and Shanghai Hongqiao international airports.
(k) Osaka Kansai International, Osaka Itami International, and Osaka Kobe airports.

Sources: OAG Aviation Worldwide Ltd, OAG Traffic Analyser (passenger bookings) and OAG Analyser database, accessed October 2014. Bookings data were used to represent international origin-destination patterns because the U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, does not include data for foreign-flag airlines and is therefore incomplete.

Of the top 25 international passenger markets, 15 had daily nonstop service at the Airport in July 2014, as shown in Table 3-7. The Airport had an average of 53 daily international scheduled flights in July 2014, including 51 to the top 25 international passenger markets.

As shown on Figure 3-8, Asia accounted for the largest share of SEA passenger airline bookings in 2013, with 32%, followed by Europe (23%), Latin America (22%), Canada (16%), Middle East/Africa (5%), and the South Pacific (2%).

Figure 3-8
International Origin-Destination Passenger Bookings by Region in 2013
Seattle-Tacoma International Airport



Source: OAG Aviation Worldwide Ltd, OAG Traffic Analyser (passenger bookings), accessed October 2014.

3.5 Airline Service at Alternate Airports

The effective boundary of the region served by the Airport is defined by the availability of airline service at surrounding airports. The extent to which the Airport is successful in competing with these other airports for passengers depends, among other factors, on the level of service (i.e., flight frequency and timing, number of stops, type of aircraft, level of onboard service) and airline fares. In addition to level of service and price, competition for international travelers is characterized by the funneling of passengers to international flights at gateway airports such as the Airport.

Portland International Airport is the closest U.S. airport to SEA, located approximately 161 road miles south, with an average of 258 domestic and international daily departures in July 2014, as shown in Table 3-8. Vancouver International Airport, located approximately 155 road miles northwest of SEA in Canada, had an average of 341 domestic and international daily departures in July 2014. The West Coast gateway airports located in Los Angeles (LAX) and San Francisco compete with SEA for international passengers, with an average of 151 and 82 international daily departures, respectively, in July 2014.

Table 3-8
Airline Service at Alternate Airports
Seattle-Tacoma International Airport

Region	Average daily scheduled nonstop departures				
	Seattle	Los Angeles	Portland	San Francisco	Vancouver
United States	455	719	247	506	82
Other regions					
Asia	10	31	1	22	18
Europe	8	22	1	16	10
Latin America	--	53	--	15	2
Canada	33	29	9	26	227
Middle East/Africa	1	3	--	1	--
Southwest Pacific	--	14	--	2	2
Subtotal—Other regions	53	151	11	82	259
Total departures	508	870	258	588	341

Source: OAG Aviation Worldwide Ltd, OAG Analyser database, accessed October 2014.

3.6 Monthly Passenger Airline Traffic

Trends in monthly airline traffic, including enplaned passengers and enplaned passenger load factor are presented in the following sections.

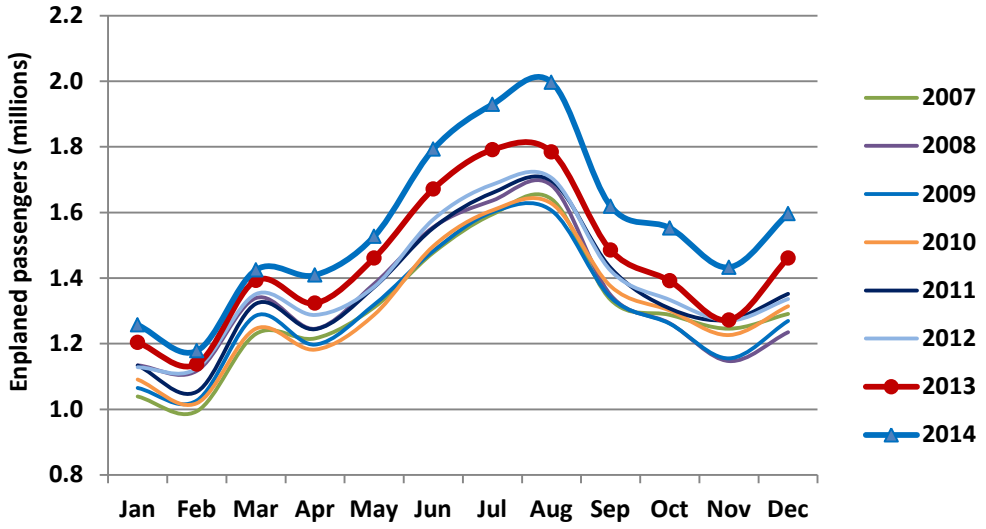
3.6.1 Monthly Enplaned Passengers

Figure 3-9 presents monthly enplaned passenger data for the Airport for January 2007 through December 2014. The monthly data show the seasonal variation in enplaned passenger traffic, with peak levels occurring in July and August and the lowest monthly activity occurring from November through February.

3.6.2 Monthly Enplaned Passenger Load Factors

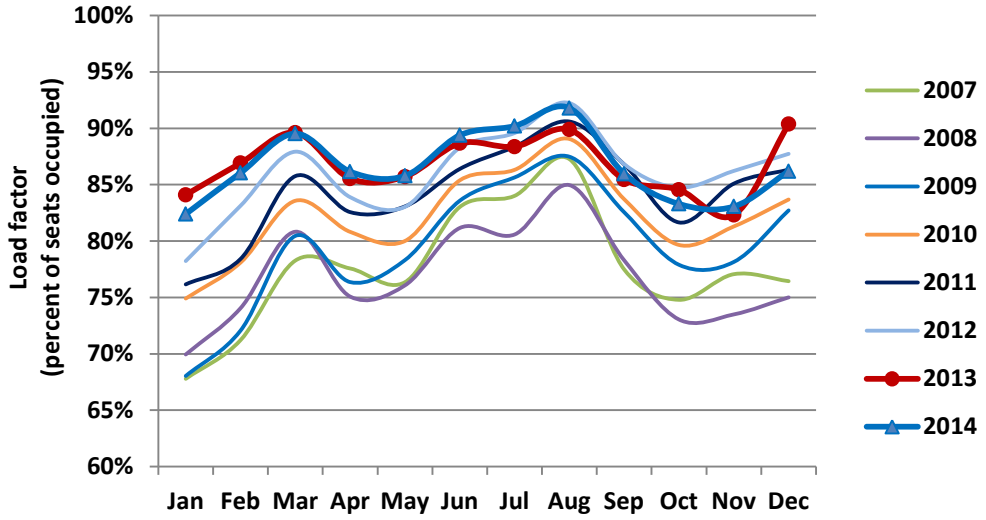
As shown on Figure 3-10, enplaned passenger load factors at SEA ranged from a low of 67.8% in January 2007 to a high of 92.2% during August 2012. Load factors at the Airport in recent years have averaged about 86% to 87% on an annual basis.

Figure 3-9
Monthly Enplaned Passengers
Seattle-Tacoma International Airport



Source: Seattle-Tacoma International Airport records.

Figure 3-10
Monthly Enplaned Passenger Load Factors
Seattle-Tacoma International Airport



Source: Seattle-Tacoma International Airport records and OAG Aviation Worldwide Ltd, OAG Analyser database, accessed October 2014.

Historical Air Cargo

A review of air cargo activity at the Airport provides the foundation for the forecasts.

4.1 All-Cargo Airlines Serving Seattle-Tacoma International Airport

The Airport is served by 14 all-cargo airlines, including 3 integrated airlines, 2 regional airlines, and 9 airlines that operate freighter aircraft, as shown in Table 4-1.

Table 4-1
All-Cargo Airlines Serving Seattle-Tacoma International Airport
Seattle-Tacoma International Airport

Integrated airlines	Regional airlines (feeders)	Freighters
ABX Air	Airpac Airlines	Air Transport International
FedEx	Empire Airlines	Asiana Airlines *(a)*
United Parcel Service		Cargolux
		China Cargo Airlines
		Eva Airlines *(a)*
		Kalitta Air
		Korean Air *(a)*
		Nippon Cargo Airlines
		USA Jet Airlines

(a) Operates passenger and freighter aircraft at the Airport.

Source: Seattle-Tacoma International Airport records.

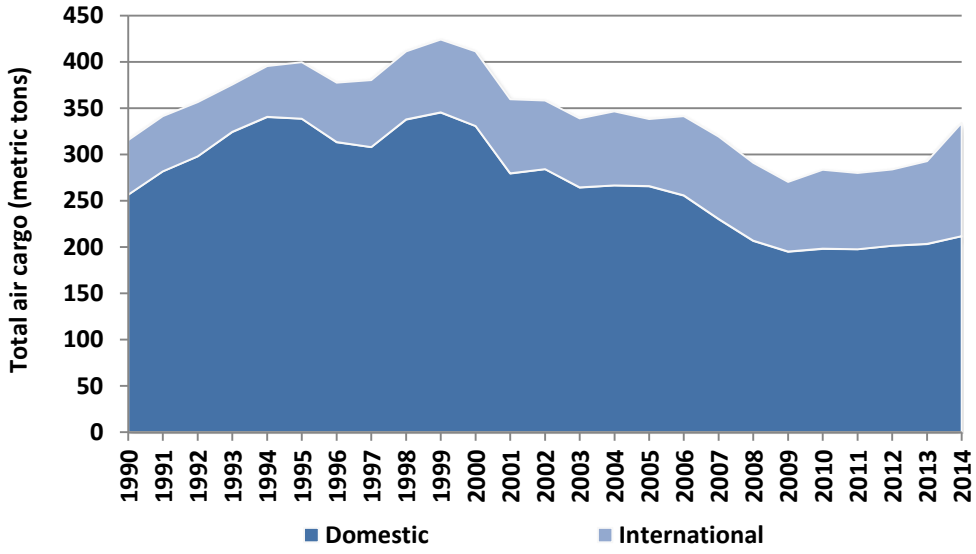
4.2 Air Cargo

As shown on Figure 4-1 and in Table 4-2, total air cargo (freight and mail) at the Airport increased from 315,572 metric tons in 1990 to a peak of 424,002 in 1999 and then decreased to 333,926 metric tons in 2014, for an average decrease of 0.2% per year between 1990 and 2014.

4.2.1 Domestic Air Cargo

In 2014, domestic air cargo accounted for 63% of total air cargo at the Airport, down from 81% in 1990. As shown in Table 4-2, domestic air cargo increased from 256,556 metric tons in 1990 to a peak of 345,2294 in 1999 (an average increase of 3.4% between 1990 and 1999). From 1999 to 2010, domestic air cargo at the Airport decreased an average of 4.9% per year. Since 2010, domestic air cargo has experienced slow growth—an average of 1.7% per year between 2010 and 2014.

Figure 4-1
Historical Air Cargo by Sector
Seattle-Tacoma International Airport



Source: Seattle-Tacoma International Airport records.

4.2.2 International Air Cargo

Between 1990 and 2014, international air cargo at the Airport increased an average of 3.1% per year, as shown in Table 4-2. International air cargo growth slowed between 1999 and 2010 (an average increase of 0.7% per year), reflecting the effects of two economic recessions during this period. Since 2010, international air cargo at the Airport has increased at a faster rate—an average increase of 19.5% per year, reflecting the expansion of international service by passenger airlines such as Delta Air Lines and increased activity by all-cargo airlines such as Cargolux and China Airlines.

4.2.3 Air Cargo by Airline Type

As shown in Table 4-3, integrated cargo airlines such as FedEx experienced the strongest growth in domestic air cargo at the Airport between 1990 and 2014 (an average of 9.2% per year). Passenger airlines experienced strong growth in international air cargo between 1990 and 2014 (an average of 4.1% per year), reflecting the expansion of international service by Delta and foreign-flag airlines.

Table 4-2
Historical Air Cargo by Sector
Seattle-Tacoma International Airport

	Domestic			International			Total		
Year	Air freight	Air mail	Total	Air freight	Air mail	Total	Air freight	Air mail	Total
1990	186,105	70,451	256,556	59,016	--	59,016	245,121	70,451	315,572
1991	208,819	72,984	281,803	59,395	--	59,395	268,214	72,984	341,198
1992	225,750	72,191	297,941	58,502	--	58,502	284,252	72,191	356,443
1993	246,294	78,049	324,343	51,037	--	51,037	297,331	78,049	375,380
1994	265,077	75,487	340,564	54,957	--	54,957	320,034	75,487	395,521
1995	248,794	89,822	338,616	60,882	--	60,882	309,676	89,822	399,498
1996	222,016	91,350	313,366	63,956	--	63,956	285,971	91,350	377,322
1997	208,840	99,114	307,955	72,312	--	72,312	281,152	99,114	380,267
1998	221,143	116,605	337,748	73,033	611	73,644	294,176	117,216	411,392
1999	226,014	119,280	345,294	74,623	4,085	78,708	300,637	123,366	424,002
2000	236,553	94,198	330,751	75,570	4,908	80,477	312,122	99,106	411,228
2001	218,627	60,796	279,422	75,780	4,353	80,133	294,407	65,149	359,556
2002	215,575	68,609	284,184	71,060	3,014	74,074	286,635	71,623	358,258
2003	205,892	58,498	264,390	73,668	892	74,560	279,559	59,391	338,950
2004	205,369	61,266	266,635	79,837	119	79,956	285,206	61,385	346,591
2005	212,547	53,216	265,762	72,282	101	72,383	284,828	53,317	338,145
2006	203,820	51,928	255,748	85,377	119	85,496	289,197	52,048	341,244
2007	182,039	48,113	230,152	88,768	175	88,943	270,807	48,288	319,095
2008	161,883	44,810	206,693	84,099	54	84,153	245,982	44,865	290,846
2009	151,320	43,775	195,095	75,031	74	75,105	226,351	43,849	270,200
2010	153,144	45,133	198,277	84,918	31	84,949	238,062	45,164	283,226
2011	152,523	45,159	197,682	82,062	144	82,206	234,585	45,303	279,888
2012	155,221	46,261	201,482	82,089	35	82,124	237,310	46,296	283,606
2013	155,868	47,544	203,412	88,580	593	89,173	244,447	48,137	292,585
2014	161,134	50,620	211,754	107,604	14,568	122,172	268,738	65,188	333,926
	Compound annual percent increase (decrease)								
1990-1999	2.2%	6.0%	3.4%	2.6%	--	3.3%	2.3%	6.4%	3.3%
1999-2010	(3.5)	(8.5)	(4.9)	1.2	(35.8)	0.7	(2.1)	(8.7)	(3.6)
2010-2014	1.3	2.9	1.7	6.1	364.5	9.5	3.1	9.6	4.2
1990-2014	(0.6)	(1.4)	(0.8)	2.5	--	3.1	0.4	(0.3)	0.2

Note: Includes enplaned and deplaned air cargo.

Source: Seattle-Tacoma International Airport records.

Table 4-3
Historical Air Cargo by Airline Type
Seattle-Tacoma International Airport

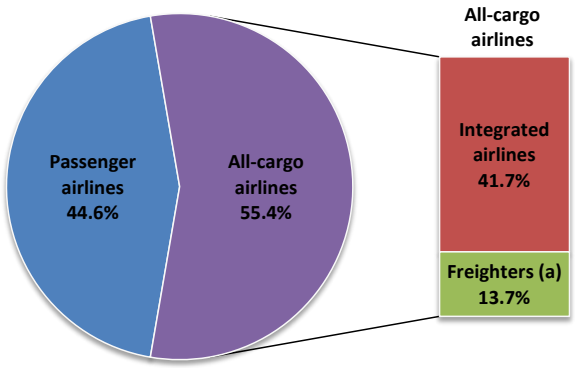
	Domestic					International			Total		
		Cargo airlines									
Year	Passenger airlines	Integrated airlines	Other	Total	Total	Passenger airlines	All-cargo airlines	Total	Passenger airlines	All-cargo airlines	Total
1990	189,907	16,971	49,678	66,649	256,556	30,189	28,827	59,016	220,095	95,477	315,572
1991	185,844	52,690	43,269	95,959	281,803	30,575	28,820	59,395	216,419	124,779	341,198
1992	188,825	70,670	38,446	109,116	297,941	31,336	27,166	58,502	220,161	136,282	356,443
1993	191,189	93,515	39,638	133,153	324,343	29,441	21,596	51,037	220,631	154,749	375,380
1994	183,670	114,242	42,652	156,894	340,564	33,721	21,236	54,957	217,392	178,130	395,521
1995	190,812	104,210	43,594	147,804	338,616	35,219	25,664	60,882	226,031	173,467	399,498
1996	188,049	96,344	28,973	125,317	313,366	36,137	27,818	63,956	224,186	153,135	377,322
1997	190,462	88,313	29,180	117,492	307,955	44,215	28,097	72,312	234,678	145,589	380,267
1998	191,624	102,652	43,472	146,125	337,748	47,001	26,643	73,644	238,624	172,768	411,392
1999	193,477	102,577	49,240	151,816	345,294	53,789	24,920	78,708	247,286	176,716	424,002
2000	144,324	129,491	56,936	186,427	330,751	55,185	25,292	80,477	201,037	210,191	411,228
2001	113,983	122,754	42,685	165,440	279,422	49,896	30,237	80,133	166,858	192,697	359,556
2002	100,362	160,243	23,578	183,821	284,184	46,736	27,339	74,074	151,589	206,669	358,258
2003	98,306	150,593	15,491	166,084	264,390	46,533	28,027	74,560	149,839	189,111	338,950
2004	99,819	149,209	17,607	166,816	266,635	46,945	33,011	79,956	152,933	193,657	346,591
2005	96,435	148,344	20,984	169,327	265,762	41,096	31,287	72,383	145,078	193,067	338,145
2006	83,671	157,489	14,588	172,077	255,748	52,231	33,265	85,496	142,558	198,686	341,244
2007	72,871	151,722	5,560	157,281	230,152	59,298	29,645	88,943	139,056	180,039	319,095
2008	68,772	135,474	2,446	137,921	206,693	58,355	25,799	84,153	132,462	158,384	290,846
2009	65,117	127,999	1,979	129,978	195,095	48,911	26,193	75,105	124,207	145,992	270,200
2010	65,387	130,632	2,259	132,891	198,277	44,224	40,725	84,949	136,275	146,951	283,226
2011	67,805	127,323	2,554	129,877	197,682	44,902	37,304	82,206	135,931	143,958	279,888
2012	66,439	132,982	2,061	135,043	201,482	49,041	33,083	82,124	135,685	147,921	283,606
2013	66,023	135,925	1,464	137,389	203,412	57,639	31,534	89,173	144,949	147,636	292,585
2014	70,218	139,095	2,441	141,536	211,754	78,662	43,510	122,172	148,880	185,046	333,926
	Compound annual percent increase (decrease)										
1990-1999	0.2%	22.1%	(0.1%)	9.6%	3.4%	6.6%	(1.6%)	3.3%	1.3%	7.1%	3.3%
1999-2010	(9.4)	2.2	(24.4)	(1.2)	(4.9)	(1.8)	4.6	0.7	(5.3)	(1.7)	(3.6)
2010-2014	1.8	1.6	2.0	1.6	1.7	15.5	1.7	9.5	8.0	1.6	4.2
1990-2014	(4.1)	9.2	(11.8)	3.2	(0.8)	4.1	1.7	3.1	(1.6)	2.8	0.2

Source: Seattle-Tacoma International Airport records. Data for 2010 through 2014 are adjusted to reflect air cargo carried on freighter aircraft by Asiana, Eva, and Korean Air based on estimates provided by SEA.

4.3 Airline Market Shares

The market shares for the passenger airlines serving the Airport are shown on Figure 4-2 and in Table 4-4. In 2014, all-cargo airlines accounted for 55.4% of total air cargo; passenger airlines accounted for the remaining 44.6%. Integrated airlines such as FedEx accounted for a large share of total air cargo, with 41.6% in 2014.

Figure 4-2
Airline Shares of Total Air Cargo in 2014
Seattle-Tacoma International Airport



(a) Includes regional airlines.

Source: Seattle-Tacoma International Airport records.

4.4 Monthly Air Cargo

Figure 4-3 presents monthly air cargo data for the Airport for January 2007 through December 2014. The monthly data show the seasonal variation in total air cargo, with peak levels occurring in July and December and the lowest monthly activity occurring from January through February.

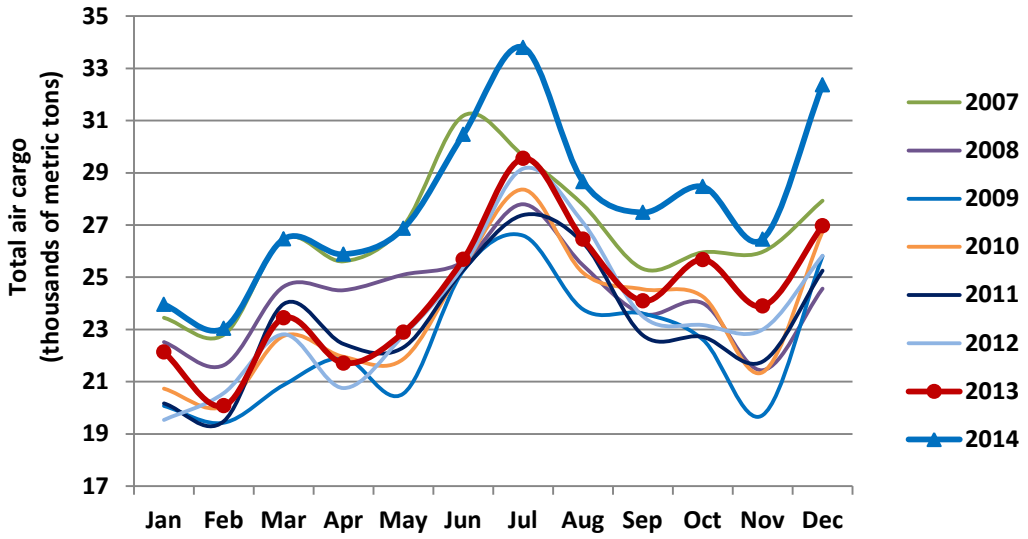
Table 4-4
Airline Market Shares of Total Air Cargo
Seattle-Tacoma International Airport

Airline	Total air cargo (metric tons)				Percent of total			
	2011	2012	2013	2014	2011	2012	2013	2014
All-cargo airlines								
Integrated airlines								
FedEx	126,987	132,922	134,631	138,755	45.4%	46.9%	46.0%	41.6%
United Parcel Service	72	60	697	182	0.0	0.0	0.2	0.1
ABX Air	264	--	613	202	0.1	0.0	0.2	0.1
Subtotal—integrated airlines	127,323	132,982	135,941	139,139	45.5%	46.9%	46.5%	41.8%
Freighters								
Cargolux	8,637	9,327	9,423	11,477	3.1%	3.3%	3.2%	3.4%
China Airlines	10,059	8,500	8,161	14,060	3.6	3.0	2.8	4.2
Other *(a)*	18,924	15,379	14,317	18,227	6.8	5.4	4.9	5.5
Subtotal—freighters	37,619	33,207	31,901	43,764	13.4%	11.7%	10.9%	13.1%
Regional airlines (feeders)	2,238	1,938	1,080	2,143	0.8%	0.7%	0.4%	0.6%
Total—all-cargo airlines	167,181	168,126	168,922	185,046	59.7%	59.3%	57.7%	55.4%
Passenger airlines								
U.S. airlines								
Delta	25,859	25,635	31,478	45,495	9.2%	9.0%	10.8%	13.6%
Alaska	29,971	29,684	28,124	30,758	10.7	10.5	9.6	9.2
United	13,794	13,644	12,908	15,459	4.9	4.8	4.4	4.6
Hawaiian	4,039	4,504	5,218	5,631	1.4	1.6	1.8	1.7
Southwest	5,510	5,344	4,838	5,127	2.0	1.9	1.7	1.5
Other	5,725	5,362	4,835	6,538	2.0	1.9	1.7	2.0
Subtotal—passenger airlines	84,899	84,173	87,402	109,008	30.3%	29.7%	29.9%	32.6%
Foreign-flag airlines								
All Nippon Airways	--	2,736	6,833	7,244	0.0%	1.0%	2.3%	2.2%
Emirates	--	4,086	5,287	4,208	0.0	1.4	1.8	1.3
British Airways	5,160	4,768	5,102	6,468	1.8	1.7	1.7	1.9
Lufthansa Airlines	6,144	5,488	4,981	6,273	2.2	1.9	1.7	1.9
Hainan Airlines	3,660	4,665	4,852	4,888	1.3	1.6	1.7	1.5
EVA Air	4,551	4,507	4,416	4,537	1.6	1.6	1.5	1.4
Korean Air	1,596	2,593	2,858	3,825	0.6	0.9	1.0	1.1
Other	6,696	2,464	1,931	2,429	2.4	0.9	0.7	0.7
Subtotal—foreign-flag airlines	27,808	31,307	36,260	39,872	9.9%	11.0%	12.4%	11.9%
Total--passenger airlines	112,707	115,480	123,662	148,880	40.3%	40.7%	42.3%	44.6%
Total air cargo	279,888	283,606	292,585	333,926	100.0%	100.0%	100.0%	100.0%

(a) Includes air cargo carried on freighter aircraft by airlines that operate passenger and freighter aircraft (Asiana Airlines, EVA Air, and Korean Air).

Source: Seattle-Tacoma International Airport records. Totals may not sum due to rounding.

Figure 4-3
Monthly Total Air Cargo
Seattle-Tacoma International Airport



Source: Seattle-Tacoma International Airport records.

Historical Aircraft Operations

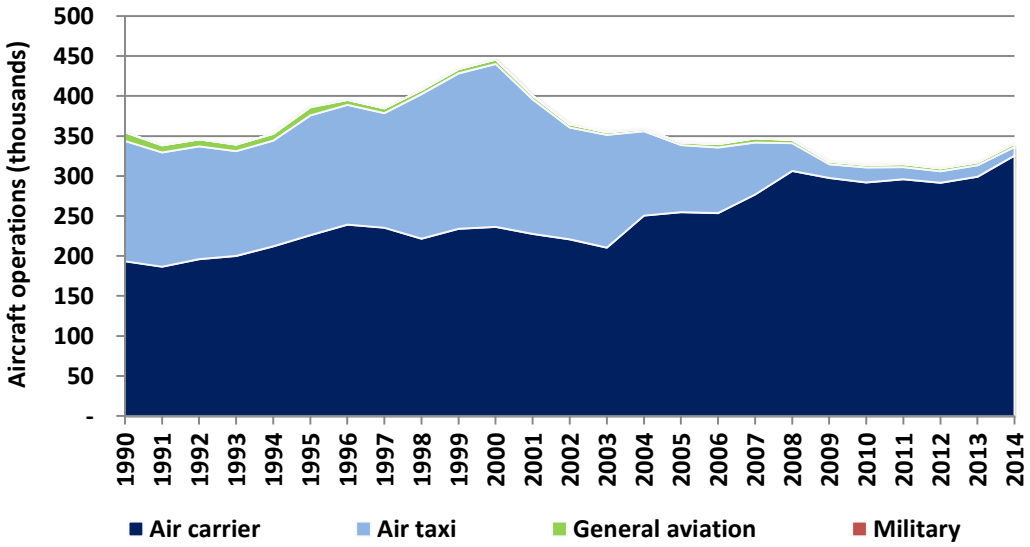
A review of aircraft operations at the Airport provides the foundation for the forecasts.

5.1 Total Aircraft Operations

This chapter summarizes historical total aircraft operations at the Airport from 1990 through 2014. Aircraft operations include the total number of departures and arrivals by air carrier, air taxi and commuter, general aviation, and military aircraft. An aircraft operation is defined as either a takeoff or a landing at the Airport. Figure 5-1 and Table 5-1 present a summary of total aircraft operations at SEA by type.

From 1990 to 2000, the number of total aircraft operations at the Airport increased an average of 2.3% per year, as a result of the introduction of new airline service by airlines such as Southwest and the continued expansion of service by Alaska Airlines, particularly by Horizon, its regional affiliate. Since 2000, total aircraft operations have decreased—an average decrease of 3.4% per year between 2000 and 2010, reflecting increased load factors, the densification of aircraft (i.e., putting more seats on existing aircraft), and overall reductions in airline capacity system wide as a result of the spike in fuel prices in 2008, and the 2008-2009 economic recession and financial crisis. From 2010 to 2014, total aircraft operations at the Airport increased an average of 2.0% per year with the development of Delta's hub, continued expansion of Alaska's hub, and average annual load factors of 86% to 87%.

Figure 5-1
Historical Aircraft Operations
Seattle-Tacoma International Airport



Source: Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.

Table 5-1
Historical Aircraft Operations
Seattle-Tacoma International Airport

Year	Commercial operations			General aviation	Military	Total aircraft operations	Percent increase (decrease)
	Air carrier	Air taxi/ commuter	Total				
1990	193,482	150,376	343,858	10,844	303	355,005	--%
1991	186,717	142,828	329,545	8,767	295	338,607	(4.6)
1992	196,141	140,744	336,885	8,800	310	345,995	2.2
1993	200,040	131,046	331,086	8,097	278	339,461	(1.9)
1994	212,016	132,158	344,174	8,505	371	353,050	4.0
1995	226,190	149,442	375,632	10,335	567	386,534	9.5
1996	239,063	149,882	388,945	6,181	90	395,216	2.2
1997	235,445	143,034	378,479	5,923	80	384,482	(2.7)
1998	221,705	180,563	402,268	5,203	126	407,597	6.0
1999	233,914	194,352	428,266	5,335	59	433,660	6.4
2000	236,355	203,723	440,078	5,504	95	445,677	2.8
2001	227,589	168,322	395,911	4,684	75	400,670	(10.1)
2002	220,733	139,793	360,526	4,086	59	364,671	(9.0)
2003	210,603	140,777	351,380	3,385	54	354,819	(2.7)
2004	250,605	105,377	355,982	2,788	124	358,894	1.1
2005	254,829	83,928	338,757	2,938	67	341,762	(4.8)
2006	253,507	82,147	335,654	4,296	108	340,058	(0.5)
2007	276,954	64,745	341,699	5,240	107	347,046	2.1
2008	306,425	34,453	340,878	4,059	120	345,057	(0.6)
2009	297,621	17,133	314,754	3,046	73	317,873	(7.9)
2010	292,016	18,562	310,578	3,262	114	313,954	(1.2)
2011	295,763	15,324	311,087	3,708	149	314,944	0.3
2012	291,664	14,196	305,860	3,604	133	309,597	(1.7)
2013	299,156	14,440	313,596	3,510	80	317,186	2.5
2014	325,425	10,813	336,238	4,113	127	340,478	7.3
	Compound annual percent increase (decrease)						
1990-2000	2.0%	3.1%	2.5%	(6.6%)	(11.0%)	2.3%	
2000-2010	2.1	(21.3)	(3.4)	(5.1)	1.8	(3.4)	
2010-2014	2.7	(12.6)	2.0	6.0	2.7	2.0	
1990-2014	2.2	(10.4)	(0.1)	(4.0)	(3.6)	(0.2)	

Source: Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.

5.2 Air Carrier

Air carrier operations are those performed in revenue service by the passenger and all-cargo airlines serving the Airport. Included are scheduled flights, charter flights, diverted flights, and ferry operations (empty flights). The FAA defines an air carrier aircraft, for traffic counting purposes, as capable of carrying more than 60 passengers and provides a list of model types that are counted as air carrier operations (Appendix 3 in Order JO 7210.3W), even if the aircraft is conducting air freight operations.* As shown in Table 5-1, air carrier aircraft operations increased an average of 2.0% per year between 1990 and 2000. Since 2000, the number of air carrier operations at SEA has continued to increase—an average of 2.1% per year between 2000 and 2010, reflecting, in part, the increasing use of the Q400 regional aircraft with 76 seats in Alaska's fleet. From 2010 to 2014, the number of air carrier operations increased at a faster rate—an average increase of 2.7% per year, reflecting the continued development of airline service by Delta and Alaska airlines.

5.3 Air Taxi and Commuter

Air taxi and commuter operations consist of unscheduled operations of "for hire" air taxis and the scheduled operations of commuter airlines, including regional affiliate airlines operating aircraft with less than 60 seats. The FAA defines air taxi and commuter operations as those performed by aircraft other than those listed in Appendix 3 noted above and which use three-letter company designators. Fractional ownership and management companies and corporate flight departments that use a three-letter company designator are included in air taxi operations. As shown in Table 5-1, air taxi and commuter aircraft operations increased an average of 3.1% per year between 1990 and 2000 and drove growth in total aircraft operations during this period. Since 2000, air taxi and commuter have decreased significantly—an average decrease of 21.3% per year between 2000 and 2010, reflecting the increased use of larger regional aircraft such as the Q400, increasing fuel costs, and the comparatively higher cost of operating small regional jet aircraft. From 2010 to 2014, the number of air taxi and commuter operations decreased at a slower rate—an average decrease of 12.6% per year.

5.4 General Aviation

General aviation operations include all civil aircraft operations not classified as air carrier or air taxi and commuter operations. As shown in Table 5-1, general aviation aircraft operations decreased an average of 4.0% per year between 1990 and 2014. According to the FAA 2014 TAF, a total of 2 jet engine general aviation aircraft were based at the Airport in 2014.

5.5 Military

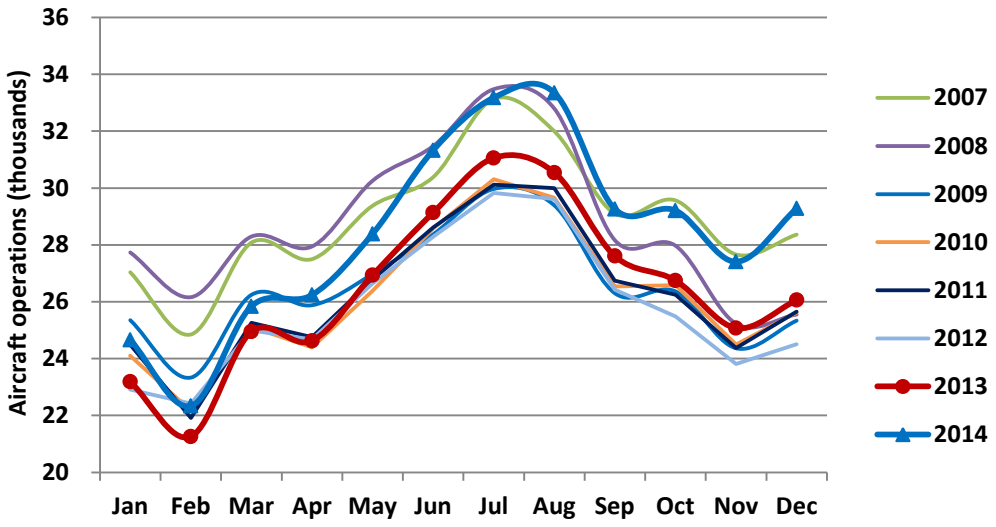
Military aircraft operations at the Airport have averaged approximately 200 operations per year from 1990 through 2014. In 2014, military operations totaled 127, less than the 24-year average. Historically, military operations have varied with geopolitical trends.

*U.S. Department of Transportation, Federal Aviation Administration, Order JO 7210.3W, February 11, 2010, http://www.faa.gov/air_traffic/publications.

5.6 Monthly Aircraft Operations

Table 5-2 presents monthly total aircraft operations data for the Airport for January 2007 through December 2014. The monthly data show the seasonal variation in total aircraft operations, with July and August each accounting for 9.8% and 9.6%, respectively, of annual operations in 2014. From 2007 through 2014, July and August accounted for the peak share of annual aircraft operations at the Airport, with an average of nearly 10% of annual operations.

Figure 5-2
Monthly Aircraft Operations
Seattle-Tacoma International Airport



Source: Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.

Aviation Demand Forecasts

Unconstrained forecasts do not include specific assumptions about physical, regulatory, environmental or other impediments to aviation activity growth.

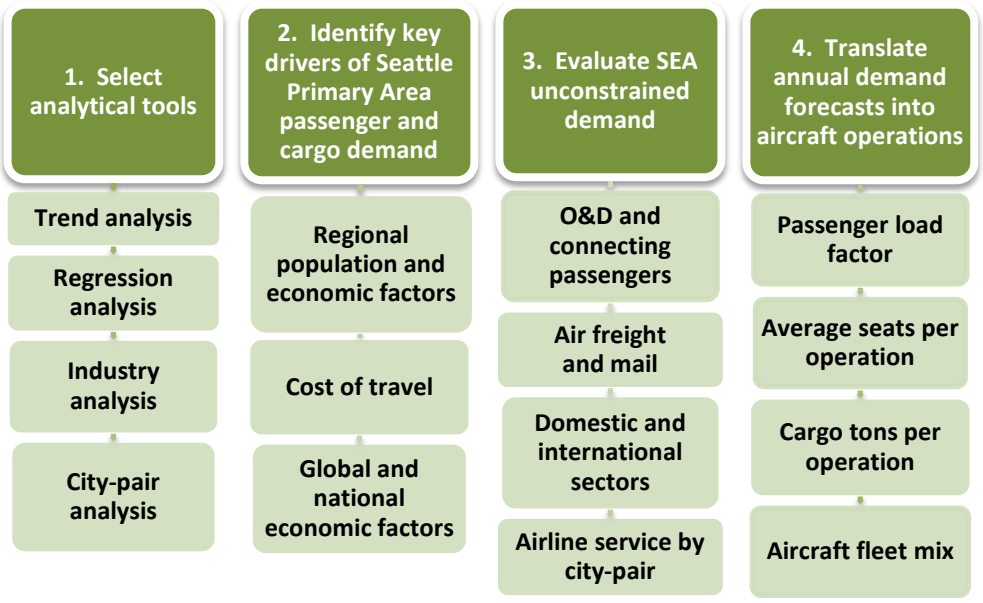
6.1 Unconstrained Forecasts

This chapter summarizes unconstrained forecasts of enplaned passengers, air cargo, and total aircraft operations for SEA, including the forecast approach, methodology, and assumptions. As noted earlier, the baseline forecasts presented in this report are "unconstrained" and, therefore, do not include specific assumptions about physical, regulatory, environmental or other impediments to aviation activity growth. Forecasts of aviation activity are presented for enplaned passengers, air cargo, and aircraft operations, including passenger, all-cargo, general aviation, and military operations. Using calendar year 2014 as the base year, annual forecasts were prepared for four future demand years—2019, 2024, 2029, and 2034.

6.2 Forecast Approach

As shown in Figure 6-1, the forecast approach incorporated a multi-tiered approach to evaluate passenger traffic in the Seattle Primary Area.

Figure 6-1
Forecast Approach
Seattle-Tacoma International Airport



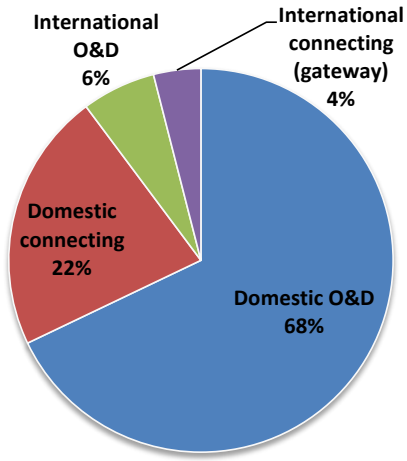
Seattle-Tacoma International Airport records (based on data reported by the airlines) were used as the basis for the enplaned passenger, air cargo, and commercial airline aircraft operations forecasts. Federal Aviation Administration, Air Traffic Activity System (ATADS) data were used as the basis for the total aircraft operations forecasts.

It was recognized that no one approach would provide input on all of the key factors that affect passenger and cargo activity in the Seattle Primary Area. For example, an econometric analysis would provide input on the relationships between historical passengers and regional economic conditions but little to no input on such factors as (1) the role of individual markets in airline scheduling and service decisions, (2) recent trends in the airline industry that have affected an airline's decisions in route planning and aircraft acquisition, and (3) new service development at the Airport. Input on these factors is important to the development of reliable forecasts that can serve as the basis for planning efforts at the Airport.

6.3 Enplaned Passengers

As shown on Figure 6-2, domestic O&D passengers accounted for 68% of enplaned passengers at the Airport in 2014, followed by domestic connecting passengers with 22%, international O&D (6%), and international connecting passengers using SEA as their international gateway (4%). The forecast approach and results for these four key components of passenger demand at the Airport are described in the following sections.

Figure 6-2
Key Components of Passenger Demand in 2014
Seattle-Tacoma International Airport



Note: Connecting passengers in 2014 are estimated based on data for January through September.

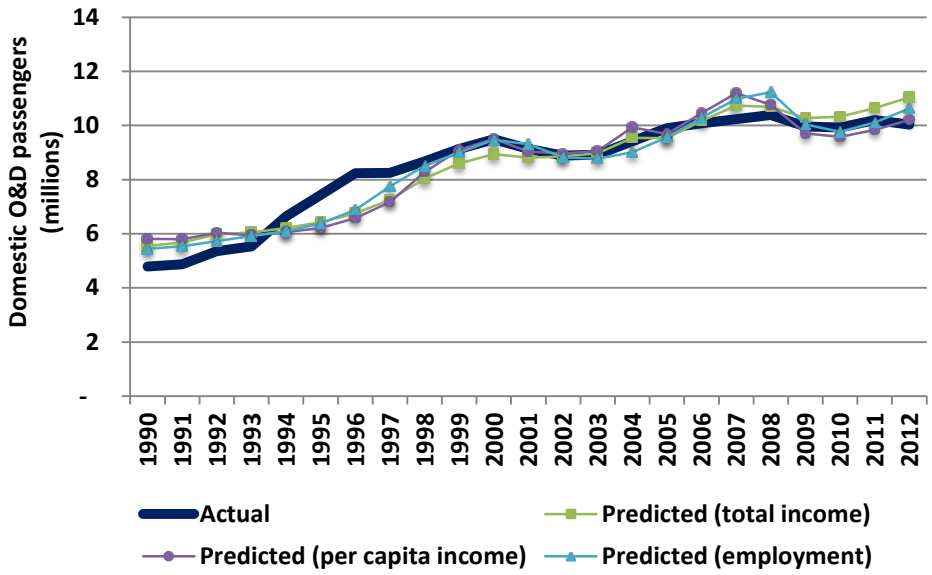
Sources: Seattle-Tacoma International Airport records and U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic,* online database, accessed September 2014.

6.3.1 Domestic Origin-Destination Passengers

The forecasts of domestic O&D passengers at the Airport are based on an econometric model relating passenger trends to economic and airline industry metrics. Typically, a passenger regression model includes an income variable (e.g., total personal income, per capita income, or GDP—all expressed in constant dollars) and a cost of travel variable (e.g., yield or airfare—also expressed in constant dollars). The primary objective is to represent the two key variables that affect air travel demand, i.e., how much people have to spend and how much it costs to travel. Other variables may be important as well, depending on the traffic market characteristics.

As shown in Figure 6-3, the historical trend in domestic O&D passengers relates strongly to regional economic activity. Regression models which included economic variables such as total income, per capita personal income, or employment in the Seattle Primary Area explained 83% to 90% of the historical variation in domestic O&D passengers.

Figure 6-3
Economic Drivers
Historical and Predicted Domestic Origin-Destination Passengers
Seattle-Tacoma International Airport

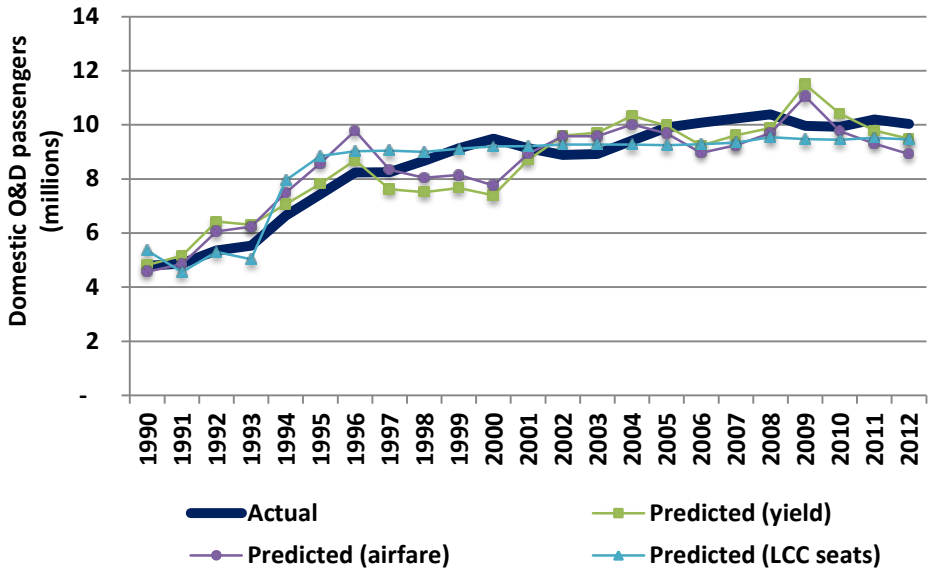


Source: Actual—U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic,* online database, accessed September 2014.
Predicted regression model results—LeighFisher, based on available data through September 2014.

Figure 6-4 presents regression models which included cost of travel variables such as airfare, airline yield, or the number of low cost carrier seats* at SEA explained 81% to 88% of the historical variation in domestic O&D passengers.

*The number of low cost carrier seats at SEA was used as a proxy for the cost of travel because increased low cost carrier competition at an airport has a downward influence on the cost of travel. That is, average airfares typically decrease with the addition of low cost carrier service and stimulate additional passenger traffic at an airport.

Figure 6-4
Cost of Travel Drivers
Historical and Predicted Domestic Origin-Destination Passengers
Seattle-Tacoma International Airport

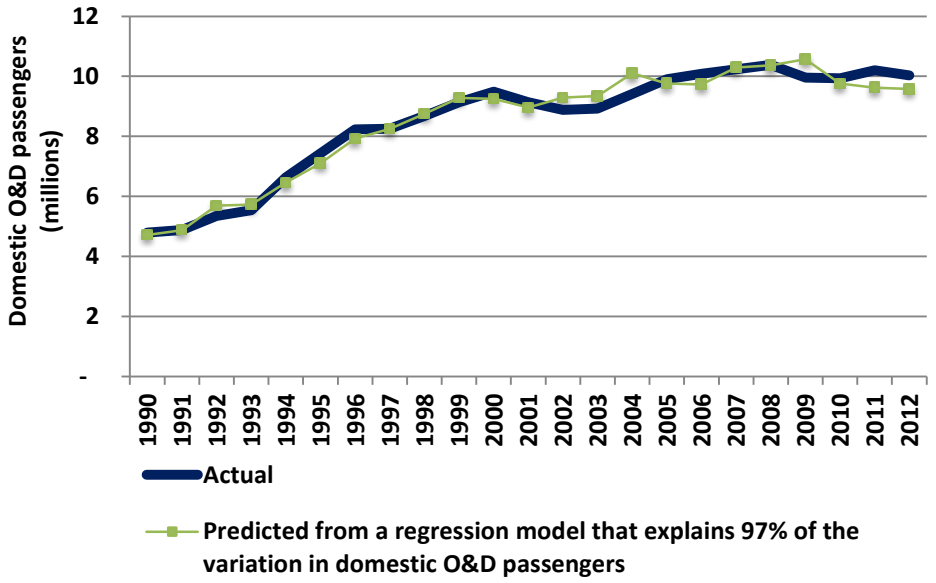


Source: Actual—U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic,* online database, accessed September 2014.
Predicted regression model results —LeighFisher, based on available data through September 2014.

A representative regression model which includes an income variable and a cost of travel variable is shown on Figure 6-5. The historical trend in domestic O&D passengers at SEA relates strongly to the predicted values from a regression model which includes per capita income in the Seattle Primary Area and airfares at SEA, in constant dollars. The forecasts of domestic O&D passengers at SEA were based on projections of per capita income in the Seattle Primary Area prepared by the Puget Sound Regional Council (PSRC), presented in Table 2-1, and projections of SEA airfares based on the FAA's national forecasts.

As shown in Table 6-1, domestic O&D passengers at the Airport are forecast to increase an average of 2.6% per year between 2014 and 2034, with faster growth in the near-term—an average increase of 3.5% between 2014 and 2018. The percent of domestic O&D passengers at the Airport is forecast to decrease from an estimated 68% in 2014 to 65% in 2034, reflecting the continued expansion of international service and faster growth in the numbers of international passengers.

Figure 6-5
Representative Model
Historical and Predicted Domestic Origin-Destination Passengers
Seattle-Tacoma International Airport



Source: Actual—U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic,* online database, accessed September 2014.
Predicted regression model results —LeighFisher, based on available data through September 2014.

6.3.2 Domestic Connecting Passengers

The increasing base of domestic connecting passengers reflects the ongoing role of the Airport as a primary connecting hub in Alaska's system and the development of the Airport as West Coast connecting hub and international gateway in Delta's system. As shown in Table 6-1, domestic connecting passengers at the Airport are forecast to increase an average of 3.2% per year between 2014 and 2034, with faster growth in the near-term—an average increase of 3.7% between 2014 and 2019. The percent of domestic connecting passengers at the Airport is forecast to increase from 25% in 2014 to 26% in 2034, reflecting the continued development of the Airport by Alaska and Delta as a domestic connecting hub.

Table 6-1

Historical and Forecast Origin-Destination and Connecting Enplaned Passengers

Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Domestic						
Origin-destination	11,798,559	12,688,500	15,095,300	17,248,500	19,366,800	21,309,000
Connecting	3,805,570	4,135,716	4,952,200	5,811,600	6,699,700	7,565,800
Domestic Total	15,604,129	16,824,216	20,047,500	23,060,100	26,066,500	28,874,800
International						
Origin-destination	1,081,519	1,108,700	1,369,600	1,627,500	1,901,900	2,173,100
Connecting	690,520	783,699	990,500	1,226,100	1,492,400	1,775,700
International Total	1,772,039	1,892,399	2,360,100	2,853,600	3,394,300	3,948,800
Airport Total						
Origin-destination	12,880,078	13,797,200	16,464,900	18,876,000	21,268,700	23,482,100
Connecting	4,496,090	4,919,415	5,942,700	7,037,700	8,192,100	9,341,500
Airport Total	17,376,168	18,716,615	22,407,600	25,913,700	29,460,800	32,823,600
Percent connecting						
Domestic	24%	25%	25%	25%	26%	26%
International	39%	41%	42%	43%	44%	45%
Airport Total	26%	26%	27%	27%	28%	28%

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic					
Origin-destination	7.5%	3.5%	2.7%	2.3%	1.9%
Connecting	8.7%	3.7%	3.3%	2.9%	2.5%
International					
Origin-destination	2.5%	4.3%	3.5%	3.2%	2.7%
Connecting	13.5%	4.8%	4.4%	4.0%	3.5%
Airport total					
Origin-destination	7.1%	3.6%	2.8%	2.4%	2.0%
Connecting	9.4	3.9	3.4	3.1	2.7

Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Seattle-Tacoma International Airport records and U.S. Department of Transportation. Fo*recast*—LeighFisher, based on available data through September 2014.

6.3.3 International Origin-Destination Passengers

The number of international O&D passengers at the Airport is related to the strength of the Seattle Primary Area economy and the location of global companies and strong international communities of interest in the Seattle Primary Area. In addition, the level of international service provided at the Airport is supported by shorter flight times to Asian destinations compared with other West Coast gateways, the increasing presence of SkyTeam members at SEA, and the cost advantages of Delta's Pacific gateway at Seattle compared with Asian gateways. The forecasts of international O&D passengers are based on an analysis of international regions and city-pair markets and benchmarked to industry forecasts of international passenger traffic by world region prepared by Airbus, The Boeing Corporation, and the FAA, as shown in Table 6-2.

As shown in Table 6-1, international O&D passengers at the Airport are forecast to increase an average of 3.4% per year between 2014 and 2034, with faster growth in the near-term—an average increase of 4.3% between 2014 and 2019. The percent of international O&D passengers at the Airport is forecast to increase from 6% in 2014 to 7% in 2034, reflecting the continued expansion of international service and growth in the numbers of international passengers.

Table 6-2
Comparative Industry Forecasts
Seattle-Tacoma International Airport

International region	Airbus *(a)* 2014 to 2033	Boeing *(b)* 2014 to 2033	FAA *(c)* 2014 to 2034
Africa-North America	4.4%	6.1%	n.a.
Asia/Pacific-North America	4.8%	6.3%	4.3%
CIS-North America	4.3%	4.6%	n.a.
Europe-North America	3.0%	3.1%	4.0%
Latin America-North America	4.4%	4.7%	4.7%
Middle East-North America	6.4%	6.3%	n.a.
Within North America	1.9%	2.3%	1.9% *(d)*

n.a. = not available

Note: Percentages are compound annual growth rates for the period noted.

(a) Airbus, *Global Market Forecast, 2014-2033*, 2014, www.airbus.com.
(b) The Boeing Corporation*, Current Market Outlook, 2014-2034*, 2014, www.boeing.com.
(c) U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecast, Fiscal Years 2014-2034*, March 2014, www.faa.gov. Forecasts are for passenger traffic to the United States.
(d) Represents the growth rate for domestic passengers.

6.3.4 International Connecting Passengers

The number of international connecting passengers at the Airport is related to the development of the Airport as an international gateway by Delta and foreign-flag airlines. As shown in Table 6-1, international connecting passengers at the Airport are forecast to increase an average of 4.2% per year between 2014 and 2034, with faster growth in the near-term—an average increase of 4.8% between 2014 and 2019. The percent of international connecting passengers at the Airport is forecast to

increase from 4% in 2014 to 5% in 2034, reflecting the continued development of the Airport as an international gateway.

6.3.5 Enplaned Passenger Forecast Assumptions

Forecasts of enplaned passengers were developed taking into account analyses of the economic basis for airline traffic, analyses of historical airline traffic, and an assessment of the key factors that may affect future airline traffic. In general, it was assumed that, in the long term, changes in airline traffic at the Airport will occur largely as a function of growth in the population and economy of the Seattle Primary Area and changes in airline service. It was also assumed that continued development of airline service at the Airport will not be constrained by the availability of aviation fuel, long-term limitations in airline fleet capacity, limitations in the capacity of the air traffic control system or the Airport, or government policies or actions that restrict growth. Also considered were recent and potential developments in the national economy and in the air transportation industry as they have affected or may affect airline traffic at the Airport.

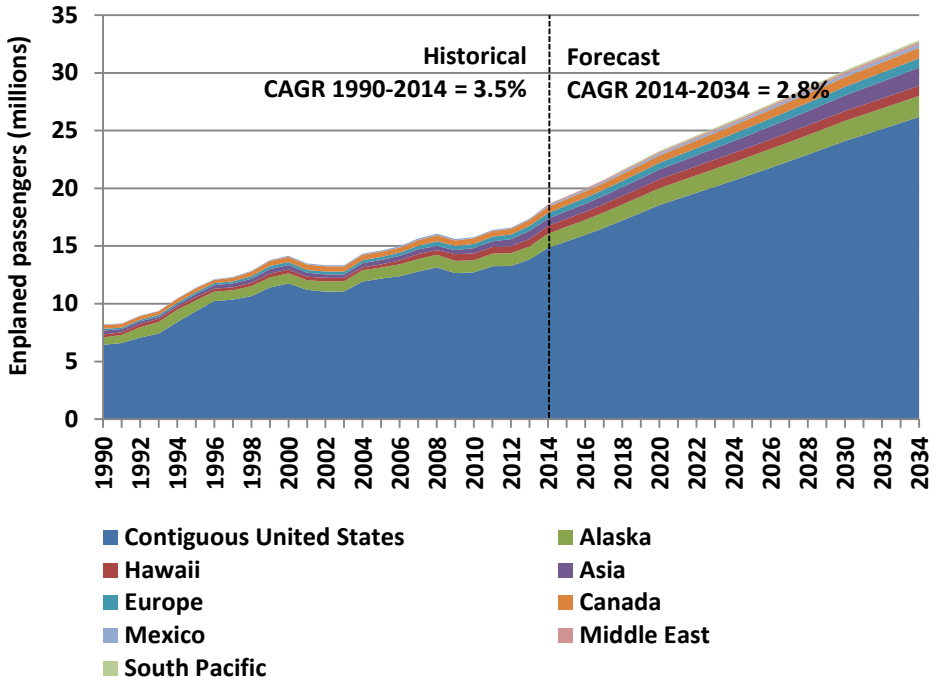
For 2015 through FY 2034, it was assumed that:

- The U.S. economy will increase an average of 2.0% to 2.5% per year during the forecast period (see Table 2-5).
- The economy of the Seattle Primary Area (as measured by employment and per capita income) will increase at a rate comparable to that of the U.S. as a whole (see Table 2-1).
- The economies of the world regions will experience sustained growth in GDP, consistent with the historical trends and long-term growth projections (see Table 2-5).
- SEA will continue to be the primary commercial service airport for the Seattle Primary Area, the primary connecting hub for Alaska Airlines, and a West Coast hub and gateway for Delta Air Lines.
- A generally stable international political environment and enhanced passenger and baggage screening procedures will maintain airline traveler confidence in aviation security without imposing unreasonable inconvenience.
- There will be no material disruption of airline service or passenger travel behavior as a result of international hostilities, terrorist acts or threats, or global safety or health concerns
- Aviation fuel prices will stabilize at levels that are historically high, but lower than the record prices reached in mid-2008.
- Competition among the airlines serving the Airport will ensure the continued availability of competitive airfares.

6.3.6 Enplaned Passenger Forecasts

As shown on Figure 6-6 and in Table 6-3, the number of enplaned passengers at the Airport is forecast to increase from 18.7 million passengers in 2014 to 32.8 million in 2034, increasing an average of 2.8% per year. The number of domestic passengers at the Airport is forecast to increase an average of 2.7% per year between 2014 and 2034, compared with an average increase of 3.7% in international passenger traffic.

Figure 6-6
Historical and Forecast Enplaned Passengers
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

CAGR = Compound annual growth rate

Source: Historical—Seattle-Tacoma International Airport records.
Forecast—LeighFisher, based on available data through September 2014.

Table 6-3
Historical and Forecast Enplaned Passengers by Industry Sector and Region
Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Domestic						
Contiguous United States						
Mainline airlines *(b)*	9,202,362	9,915,780	11,999,900	13,984,000	16,012,800	17,967,200
Low cost carriers	2,379,308	2,320,854	2,729,900	3,106,000	3,471,800	3,801,700
Regional airlines	2,263,968	2,692,243	3,146,700	3,588,200	4,019,800	4,412,100
Subtotal--Contiguous United States	13,845,638	14,928,877	17,876,500	20,678,200	23,504,400	26,181,000
Alaska	1,129,145	1,220,044	1,418,700	1,574,200	1,714,300	1,826,800
Hawaii	629,346	675,295	752,300	807,700	847,800	867,000
Domestic Total	15,604,129	16,824,216	20,047,500	23,060,100	26,066,500	28,874,800
International						
Asia	630,994	647,840	807,500	1,029,600	1,289,200	1,576,000
Europe	429,100	485,703	559,600	648,100	736,900	817,600
Canada	523,882	548,023	621,800	720,100	818,700	908,400
Mexico/Latin America	102,793	105,894	153,300	190,900	233,400	278,500
Middle East/Africa	85,270	104,939	125,700	152,800	182,300	212,400
South Pacific	--	--	92,200	112,100	133,800	155,900
International Total	1,772,039	1,892,399	2,360,100	2,853,600	3,394,300	3,948,800
Airport Total	17,376,168	18,716,615	22,407,600	25,913,700	29,460,800	32,823,600

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic	7.8%	3.6%	2.8%	2.5%	2.1%
International	6.8	4.5	3.9	3.5	3.1
Airport Total	7.7	3.7	3.0	2.6	2.2

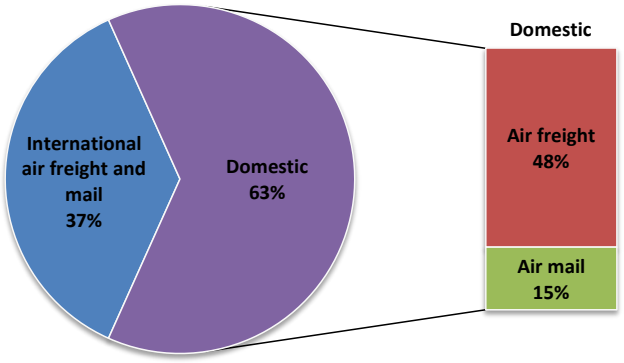
Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Seattle-Tacoma International Airport records and U.S. Department of Transportation.
Forecast—LeighFisher, based on available data through September 2014.

6.4 Air Cargo

As shown on Figure 6-7, domestic air cargo accounted for 63% of total air cargo at the Airport in 2014; international air cargo accounted for the remaining 37%. The forecast approach and results for the domestic and international components of air cargo demand at the Airport are described in the following sections.

Figure 6-7
Key Components of Air Cargo Demand in 2014
Seattle-Tacoma International Airport



Source: Seattle-Tacoma International Airport records.

6.4.1 Domestic Air Cargo

The decreasing trend in domestic air cargo at the Airport since 1990 (an average decrease of 0.8% per year between 1990 and 2014) does not correlate with economic variables which generally have an increasing trend. However, since 2010, the trend in domestic air cargo has stabilized, with average increases of 1.7% per year between 2010 and 2014. Therefore, it is assumed that this recent trend will continue and that domestic air cargo growth at the Airport will approximate the growth rate forecast for the population of the Seattle Primary Area (see Table 2-1).

As shown in Table 6-4, domestic air cargo at the Airport is forecast to increase an average of 1.0% per year between 2014 and 2034. The percent of domestic air cargo at the Airport is forecast to decrease from 66% in 2014 to 58% in 2034, reflecting the continued expansion of international service and faster growth in international air cargo.

Table 6-4
Historical and Forecast Domestic and International Total Air Cargo
Seattle-Tacoma International Airport
In metric tons

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Domestic						
Enplaned	93,528	96,797	100,830	105,970	111,370	117,050
Deplaned	109,884	114,012	118,460	124,500	130,860	137,540
Domestic Total	203,412	210,810	219,290	230,470	242,230	254,590
International						
Enplaned	46,690	56,616	69,210	79,830	89,760	98,010
Deplaned	42,483	52,064	63,040	72,710	81,760	89,270
International Total	89,173	108,680	132,250	152,540	171,520	187,280
Airport Total						
Enplaned	140,217	153,413	170,040	185,800	201,130	215,060
Deplaned	152,367	166,076	181,500	197,210	212,620	226,810
Airport Total	292,585	319,490	351,540	383,010	413,750	441,870
Percent of total air cargo						
Domestic	69.5%	66.0%	62.4%	60.2%	58.5%	57.6%
International	30.5	34.0	37.6	39.8	41.5	42.4
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Enplaned	47.9%	48.0%	48.4%	48.5%	48.6%	48.7%
Deplaned	52.1	52.0	51.6	51.5	51.4	51.3
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic	3.6%	0.8%	1.0%	1.0%	1.0%
International	21.9	4.0	2.9	2.4	1.8
Airport total	9.2	1.9	1.7	1.6	1.3

Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

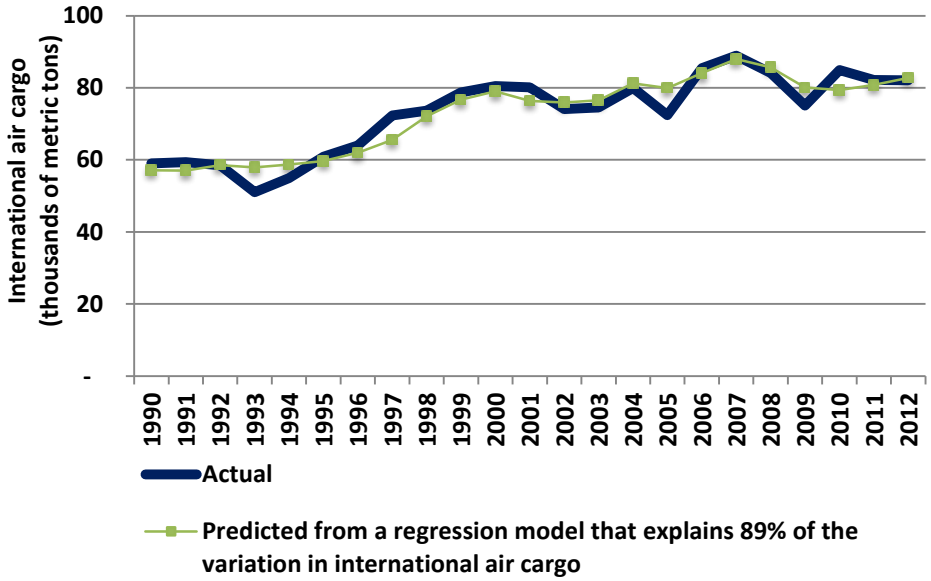
Sources: *Historical*—Seattle-Tacoma International Airport records. *Forecast*—LeighFisher, based on available data through September 2014.

6.4.2 International Air Cargo

The forecasts of international air cargo at the Airport are based on an econometric model relating international air cargo trends to economic and airline industry metrics. Typically, an air cargo regression model includes an income variable (e.g., total personal income, per capita income, or GDP—all expressed in constant dollars) and a cost variable (e.g., price of oil, jet fuel —also expressed in constant dollars). It is important to note that, unlike the analysis of passenger demand, cost variables specific to SEA cargo activity are not available.

The historical trend in international air cargo at SEA relates strongly to the predicted values from a regression model which includes per capita income in the Seattle Primary Area, in constant dollars, as shown on Figure 6-8. It is important to note that models including a cost variable were not effective in explaining the historical trends in international air cargo at the Airport. The forecasts of international air cargo at SEA were based on projections of per capita income in the Seattle Primary Area prepared by the Puget Sound Regional Council, presented in Table 2-1.

Figure 6-8
Representative Model
Historical and Predicted International Air Cargo
Seattle-Tacoma International Airport



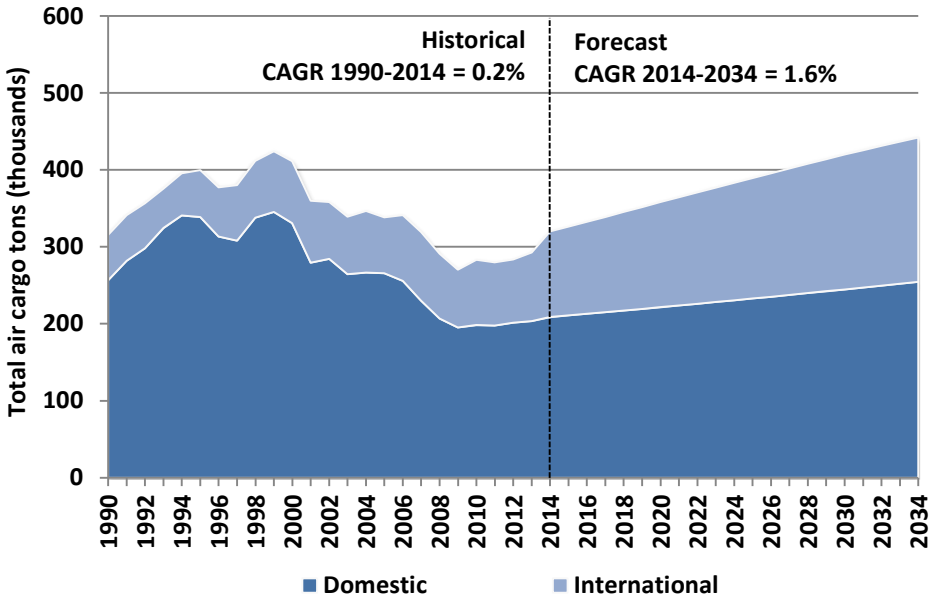
Sources: Actual—Seattle-Tacoma International Airport records.
Predicted regression model results—LeighFisher, based on available data through September 2014.

As shown in Table 6-4, international air cargo at the Airport is forecast to increase an average of 2.8% per year between 2014 and 2034. The percent of international air cargo at the Airport is forecast to increase from 34% in 2014 to 42% in 2034, reflecting the continued expansion of international service and growth in the numbers of international passengers.

6.4.3 Total Air Cargo Forecasts

As shown on Figure 6-9 and in Table 6-5, total air cargo at the Airport is forecast to increase from 319,490 metric tons in 2014 to 441,770 metric tons in 2034, an average rate of 1.6% per year.

Figure 6-9
Historical and Forecast Total Air Cargo
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

CAGR = Compound annual growth rate

Source: Historical—Seattle-Tacoma International Airport records.
Forecast—LeighFisher, based on available data through September 2014.

Table 6-5

Historical and Forecast Historical And Forecast Total Air Cargo by Type and Sector

Seattle-Tacoma International Airport

In metric tons

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Air freight						
Domestic						
Cargo airlines						
Integrated air freight	102,626	105,478	110,590	116,990	123,750	130,900
Other air freight						
Air carrier	389	103	130	140	140	150
Regional airlines	997	1,393	1,030	1,090	1,160	1,220
Subtotal—cargo airlines	104,012	107,774	111,750	118,220	125,050	132,270
Passenger airlines	51,856	53,360	56,300	59,560	63,010	66,650
Subtotal--Domestic	155,868	161,134	168,050	177,780	188,060	198,920
International						
Cargo airlines						
Integrated air freight	16	27	--	--	--	--
Other air freight						
All-cargo airlines	31,512	43,482	52,510	59,800	66,400	71,570
Regional airlines	6	1	10	10	10	10
Subtotal--cargo airlines	24,154	43,510	52,520	59,810	66,410	71,580
Passenger airlines	70,171	64,094	78,460	91,250	103,460	113,890
Subtotal—International	94,325	107,604	130,980	151,060	169,870	185,470
Total air freight	250,193	268,738	299,030	328,840	357,930	384,390

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic					
Cargo airlines	3.6%	0.7%	1.1%	1.1%	1.1%
Passenger airlines	2.9	1.1	1.1	1.1	1.1
Subtotal—Domestic freight	3.4	0.8	1.1	1.1	1.1
International					
Cargo airlines	38.0	0.3	2.6	2.1	1.5
Passenger airlines	12.4	0.4	3.1	2.5	1.9
Subtotal—International freight	21.5	0.4	2.9	2.4	1.8
Total air freight	9.9	2.2	1.9	1.7	1.4

Table 6-5 *(page 2 of 3)*
Historical and Forecast Historical and Forecast Total Air Cargo by Type and Sector
Seattle-Tacoma International Airport
In metric tons

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Air mail						
Domestic						
Cargo airlines						
Integrated air mail	33,299	33,620	35,240	36,240	37,260	38,280
Other air mail						
Air carrier	--	--	--	--	--	--
Regional airlines	78	--	--	--	--	--
Subtotal—cargo airlines	33,377	33,620	35,240	36,240	37,260	38,280
Passenger airlines	14,167	16,056	16,000	16,450	16,910	17,380
Subtotal—Domestic	47,544	49,676	51,240	52,690	54,170	55,660
International						
Cargo airlines						
Integrated air mail	--	--	--	--	--	--
Other air mail						
All-cargo airlines	--	--	--	--	--	--
Regional airlines	--	--	--	--	--	--
Subtotal—cargo airlines	--	--	--	--	--	--
Passenger airlines	593	1,076	1,280	1,470	1,650	1,810
Subtotal—International	593	1,076	1,280	1,470	1,650	1,810
Total air mail	48,137	50,752	52,520	54,160	55,820	57,470

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic					
Cargo airlines	0.7%	0.9%	0.6%	0.6%	0.5%
Passenger airlines	13.3	-0.1	0.6	0.6	0.5
Subtotal—Domestic mail	4.5	0.6	0.6	0.6	0.5
International					
Cargo airlines	--	--	--	--	--
Passenger airlines	81.5	0.3	2.8	2.3	1.9
Subtotal—International mail	81.5	0.3	2.8	2.3	1.9
Total air mail	5.4	0.7	0.6	0.6	0.6

Table 6-5 (page 3 of 3)
Historical and Forecast Historical and Forecast Total Air Cargo by Type and Sector
Seattle-Tacoma International Airport
In metric tons

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Total air cargo (freight and mail)						
Domestic						
Cargo airlines						
Integrated air cargo	135,925	139,098	145,830	153,230	161,010	169,180
Other air cargo						
Air carrier	389	903	130	140	140	150
Regional airlines	1,074	1,393	1,030	1,090	1,160	1,220
Subtotal—cargo airlines	137,389	141,394	146,990	154,460	162,310	170,550
Passenger airlines	66,023	69,416	72,300	76,010	79,920	84,040
Subtotal—Domestic	203,412	210,810	219,290	230,470	242,230	254,590
International						
Cargo airlines						
Integrated air cargo	16	27	--	--	--	--
Other air cargo						
All-cargo airlines	31,512	43,482	52,510	59,800	66,400	71,570
Regional airlines	6	1	10	10	10	10
Subtotal—cargo airlines	31,534	43,510	52,520	59,810	66,410	71,580
Passenger airlines	57,639	65,170	79,740	92,720	105,110	115,700
Subtotal—International	89,173	108,680	132,260	152,530	171,520	187,280
Total air cargo	298,330	319,490	351,480	382,920	413,660	441,770

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Domestic					
Cargo airlines	2.9%	0.8%	1.0%	1.0%	1.0%
Passenger airlines	5.1	0.8	1.0	1.0	1.0
Subtotal—Domestic cargo	3.6	0.8	1.0	1.0	1.0
International					
Cargo airlines	38.0	0.3	2.6	2.1	1.5
Passenger airlines	13.1	0.4	3.1	2.5	1.9
Subtotal—International cargo	21.9	0.4	2.9	2.4	1.8
Total air cargo	9.2	1.9	1.7	1.6	1.3

Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Seattle-Tacoma International Airport records. *Forecast*—LeighFisher, based on available data through September 2014.

6.5 Aircraft Operations

This section summarizes the forecasts of total aircraft operations, including passenger airline, all-cargo airline, general aviation, and military operations.

6.5.1 Forecast Approach and Methodology

The forecasts of total aircraft operations are derived from the forecasts of passenger and cargo demand described previously and an evaluation of general aviation and military operations. In particular:

- The forecasts of passenger airline aircraft departures are based on the enplaned passenger forecasts and assumptions regarding average aircraft size and enplaned passenger load factor.
- The forecasts of all-cargo airline aircraft departures are based on the air cargo forecasts and assumptions regarding average cargo tonnage per operation and type of all-cargo service (integrated carrier, freighter, or regional feeder).
- The forecasts of general aviation aircraft operations are based on historical trends, the number of aircraft based at the Airport, the average daily utilization of those aircraft, assumptions regarding aircraft utilization in the future, and industry forecasts of general aviation activity such as those prepared by the FAA.
- The forecasts of military aircraft operations are based on data for the base year of the forecasts and carried forward through the forecast period. Military operations typically increase and decrease with geopolitical trends and therefore this activity may vary in a given year.

6.5.2 Commercial Airline Forecast Assumptions

Table 6-6 presents the forecast assumptions for passenger and cargo airline aircraft operations, including assumptions for the average enplaned passenger load factor, the average number of seats per departure, and average cargo tonnage per cargo airline operation.

Table 6-6

Commercial Airline Aircraft Operations Forecast Assumptions

Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
SEATS PER OPERATION						
Domestic						
Contiguous United States						
Mainline airlines	158.1	160.8	161.6	162.4	163.2	164.0
Low cost carriers	145.8	145.4	146.1	146.9	147.6	148.3
Regional airlines	71.9	73.6	77.2	80.9	84.9	89.0
Alaska	151.1	150.6	151.3	152.1	152.8	153.6
Hawaii	184.2	195.1	196.1	197.1	198.1	199.1
Domestic Total	132.0	132.4	135.0	140.2	140.2	142.7
International						
Asia	261.9	244.7	245.9	247.1	248.3	249.6
Europe	254.6	241.7	242.9	244.1	245.3	246.6
Canada	71.4	71.6	73.4	75.2	77.1	79.1
Mexico/LAC	179.0	179.4	180.2	181.2	182.1	183.0
Middle East/Africa	281.8	339.8	341.5	343.2	344.9	346.6
South Pacific	--	--	200.8	201.8	202.8	203.8
International Total	140.3	137.2	144.7	150.6	156.6	162.6
Airport Total	132.8	132.9	136.1	139.0	142.0	144.9
LOAD FACTOR						
Domestic						
Contiguous United States						
Mainline airlines	90.4%	90.0%	90.0%	90.0%	90.0%	90.0%
Low cost carriers	83.4	84.0	84.0	84.0	84.0	84.0
Regional airlines	81.5	81.4	81.9	82.4	82.9	83.4
Alaska	79.4	82.6	82.6	82.6	82.6	82.6
Hawaii	96.0	93.8	93.8	93.8	93.8	93.8
Domestic Total	87.2%	87.3%	87.4%	87.5%	87.6%	87.7%
International						
Asia	80.9%	81.1%	81.6%	82.1%	82.6%	83.1%
Europe	82.6	82.4	82.6	82.9	83.1	83.4
Canada	74.9	69.7	72.2	74.7	77.2	79.7
Mexico/LAC	78.7	79.0	79.5	80.0	80.5	81.0
Middle East/Africa	82.9	83.3	83.8	84.3	84.8	85.3
South Pacific	--	--	80.4	80.9	81.4	81.9
International Total	79.4%	77.8%	79.1%	80.2%	81.3%	82.3%
Airport Total	86.4%	86.2%	86.4%	86.6%	86.8%	87.0%

Table 6-6 *(page 2 of 2)*
Commercial Airline Aircraft Operations Forecast Assumptions
Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Domestic						
Cargo airlines						
Integrated air cargo	37.61	35.72	35.90	36.08	36.26	36.44
Other air cargo						
Air carrier	21.64	--	21.72	21.83	21.94	22.05
Regional airlines	0.52	0.51	0.51	0.51	0.52	0.52
Cargo airlines average	24.04	24.10	24.15	24.22	24.28	24.35
International						
Cargo airlines						
Integrated air cargo	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other air cargo						
All-cargo airlines	24.39	32.01	32.17	32.33	32.49	32.65
Other freighters	13.18	13.48	13.50	13.53	13.56	13.58
Regional airlines	0.02	0.02	0.02	0.02	0.02	0.02
Cargo airlines average	18.05	25.58	25.71	25.84	25.97	26.10

Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Seattle-Tacoma International Airport records and OAG Aviation Worldwide Ltd, OAG Analyser database, accessed September 2014.
Forecast—LeighFisher, based on available data through September 2014.

6.5.2.1 Passenger Airline Aircraft Operations

Passenger aircraft operations include total departures and arrivals performed by mainline and regional affiliate aircraft in the service of transporting passengers, as shown in Table 6-7. Passenger airline aircraft operation forecasts were calculated by dividing the enplaned passenger forecasts by sector (e.g., domestic and international) and category (e.g., mainline and regional affiliate carrier) by the estimated number of passengers enplaned per departure. In 2014, the estimated average number of passengers enplaned per departure for the Airport as a whole was approximately 114.6 and is derived by multiplying the load factor by the average seats per departure (e.g., 86.2% x 132.9 = 114.6). This number is expected to increase slowly over the forecast period based on an estimated increase in the average number of seats per aircraft and an estimated load factor, or percent of available seats filled with passengers. The average number of passengers enplaned per departure is expected to reach approximately 126.2 in 2034. Dividing the enplaned passenger forecasts by the forecast number of passengers enplaned per departure yields passenger airline aircraft departure forecasts. The forecast departures were then multiplied by two to yield passenger airline aircraft operations for each category of activity.

Passenger airline aircraft operations at SEA are forecast to increase from 162,186 in 2014 to 260,200 operations in 2034, an average increase of 2.4% per year, as shown in Table 6-7.

6.5.2.2 All-Cargo Airline Aircraft Operations

Cargo airline operations at SEA include the flight activity by airlines dedicated exclusively to the transportation of freight, including integrated carriers such as FedEx, all-cargo airlines such as Air China, airlines that operate both passenger and freighter aircraft such as Asiana Airlines, EVA Air, and Korean Air, and by commuter/regional size aircraft. Air carrier size aircraft that perform all-cargo operations at the airport include widebody (e.g., Airbus A-300 and MD-11) and narrowbody (e.g., Boeing 757) aircraft. Commuter or regional aircraft that perform all-cargo operations at the airport include small piston and turboprop aircraft. In 2014, there were 4,225 cargo airline operations performed at the Airport, including air carrier and air taxi operations.

The forecast of all-cargo operations was developed by first estimating the share of future cargo tonnage expected to be carried by air carrier and commuter aircraft. The cargo tonnage expected to be carried by integrated airlines such as FedEx was then divided by an estimated cargo tons per operation ratio for integrated airlines to yield cargo operations for integrated airlines. For example, integrated airlines carried an estimated average of 35.72 domestic metric tons per operation in 2014, as shown in Table 6-6. The ratio of tons per operation is expected to increase gradually over the forecast period to account for expected growth in cargo related to economic activity.

Cargo airline aircraft operations at SEA are forecast to increase an average of 1.2% per year from 4,225 in 2014 to 5,360 in 2034, as shown in Table 6-7.

Table 6-7

Historical and Forecast Commercial Airline Departures by Industry Sector and Region

Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Passenger airlines						
Domestic						
Contiguous United States						
Mainline airlines (b)	64,858	68,372	82,490	95,650	108,980	121,680
Low cost carriers	19,760	18,906	22,250	25,190	28,020	30,530
Regional airlines	38,233	44,926	49,740	53,770	57,110	59,430
Subtotal—U.S. Contiguous	122,851	132,204	154,480	174,610	194,110	211,640
Alaska	9,411	9,865	11,350	12,540	13,580	14,400
Hawaii	3,677	3,680	4,090	4,370	4,560	4,640
Domestic Total	135,939	145,749	169,920	191,520	212,250	230,680
International						
Asia	2,948	3,101	4,020	5,070	6,280	7,590
Europe	2,040	2,415	2,790	3,200	3,610	3,980
Canada	9,599	9,680	11,740	12,820	13,750	14,420
Mexico/LAC	730	876	1,070	1,320	1,590	1,880
Middle East/Africa	367	365	440	530	620	720
South Pacific	-	--	570	690	810	930
International Total	15,684	16,437	20,630	23,630	26,660	29,520
Total--passenger airlines	151,623	162,186	190,550	215,150	238,910	260,200
All-cargo airlines						
Domestic						
Air carrier	1,663	1,991	2,030	2,130	2,220	2,320
Regional feeder	1,041	1,010	1,010	1,060	1,120	1,180
Domestic Total	2,704	3,001	3,040	3,190	3,340	3,500
International						
Air carrier	875	1,073	1,270	1,530	1,590	1,700
Regional feeder	133	151	120	140	150	160
International Total	1,008	1,224	1,390	1,670	1,740	1,860
Total--all-cargo airlines	3,712	4,225	4,430	4,860	5,080	5,360
Total commercial airlines	155,335	166,411	194,980	220,010	243,990	265,560

Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov. *Forecast*—LeighFisher, based on available data through September 2014.

6.5.3 General Aviation Aircraft Operations Forecasts

General aviation (GA) activity includes all flight operations by aircraft other than scheduled or charter passenger aircraft and military aircraft. GA includes not only pilot training and recreational flights on small single engine or multi-engine propeller driven aircraft, but also operations on large business jet aircraft.

On a nationwide basis, the number of general aviation aircraft operations has been in slow decline due to factors such as increases in aircraft, fuel, and insurance costs, as well as increased avionic instrument requirements. The 2008-2009 economic recession and the financial credit crisis further reduced general aviation activity nationwide. For the future, the FAA expects general aviation traffic to recover slowly.

The flight operations of GA aircraft are categorized as local or itinerant operations. Local operations are flights that operate within visual range or close proximity of the airport. Itinerant operations typically include those flights that leave the airport destined for another airport and require the filing of flight plans with the local air traffic control authorities. Since 2008, itinerant operations have accounted for all GA operations at the Airport. In 2014, a total of 4,133 itinerant GA operations were performed at the Airport, as shown in Table 6-8.

The total number of general aviation operations is forecast to increase an average of 0.5% per year from 2014 through 2034, compared with a forecast growth rate of 0.5% per between 2014 and 2034 for the nation as a whole.*

In 2014, a total of 2 jet aircraft were based at the Airport. The total number of based aircraft at the Airport is forecast to remain unchanged through 2034.

6.5.4 Military Aircraft Operations Forecasts

The number of military operations at the Airport averaged approximately 200 operations per year between 1990 and 2014. In 2014, a total of 200 military operations were performed at the Airport, approximating the 24-year average. Military operations are expected remain at a level of about 200 operations through 2034, as shown in Table 6-8.

*U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecast, Fiscal Years 2014-2034*, March 2014, www.faa.gov.

Table 6-8
Historical and Forecast Aircraft Operations
Seattle-Tacoma International Airport

	Historical		Forecast			
	2013	2014	2019	2024	2029	2034
Commercial operations						
Air carrier *(b)*	299,148	325,425	390,210	439,910	487,980	530,950
Air taxi *(c)*	14,385	10,813	4,260	4,400	4,540	4,680
Total—commercial operations	313,533	336,238	394,470	444,310	492,520	535,630
General aviation						
Local	--	--	--	--	--	--
Itinerant	3,510	4,113	4,240	4,350	4,460	4,570
Total—General aviation	3,510	4,113	4,240	4,350	4,460	4,570
Military						
Local	--	--	--	--	--	--
Itinerant	80	200	200	200	200	200
Total—Military	80	150	200	200	200	200
Total Airport	317,123	340,478	398,910	448,860	497,180	540,400

	Percent change	Compound annual percent change			
	2013-2014	2014-2019	2019-2024	2024-2029	2029-2034
Commercial operations					
Air carrier *(b)*	8.8%	3.7%	2.4%	2.1%	1.7%
Air taxi *(c)*	(24.8)	(17.0)	0.6	0.6	0.6
Total—commercial operations	7.2	3.2	2.4	2.1	1.7
General aviation	17.2	0.6	0.5	0.5	0.5
Military	58.8	9.5	0.0	0.0	0.0
Total Airport	7.4	3.2	2.4	2.1	1.7

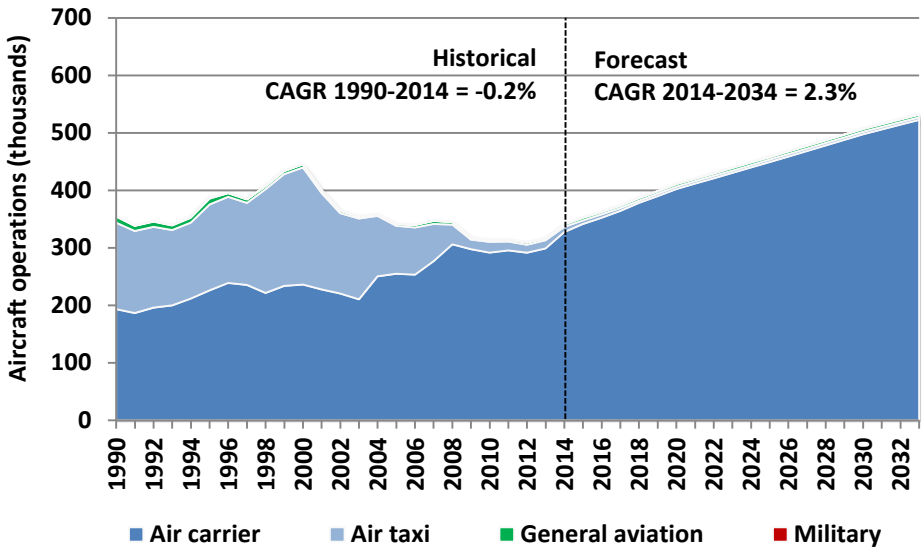
Note: The forecasts presented in this table were prepared using the information and assumptions described in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

Sources: *Historical*—Seattle-Tacoma International Airport records. *Forecast*—LeighFisher, based on available data through September 2014.

6.5.5 Total Aircraft Operations Forecasts

Total aircraft operations at SEA are forecast to increase from 340,478 in 2014 to 540,400 operations in 2034 an average increase of 2.3% per year, as shown in Table 6-8 and on Figure 6-10.

Figure 6-10
Historical and Forecast Aircraft Operations
Seattle-Tacoma International Airport



Note: The forecasts presented in this figure were prepared using the information and assumptions given in the accompanying text. Inevitably, some of the assumptions used to develop the forecasts will not be realized and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and actual results, and those differences may be material.

CAGR = Compound annual growth rate

Source: Historical— Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.
Forecast—LeighFisher, based on available data through September 2014.

Comparison with the FAA TAF

The baseline unconstrained forecasts are the "preferred" forecasts recommended for FAA approval.

7.1 Objective

Table 7-1 presents a comparison of the baseline aviation demand forecasts prepared for Seattle-Tacoma International Airport with the FAA 2014 TAF for the Airport. The baseline unconstrained forecasts are the "preferred" forecasts recommended for FAA approval. The forecasts are compared for the components of total enplaned passengers, commercial aircraft operations and total aircraft operations. The format of Table 7-1 is based on the template provided by the FAA for the comparison of airport planning forecasts and the FAA TAF.* As required, the results are presented for the base year of 2014 and forecast horizons years which are equal to the base year, plus 1, 5, 10 and 15 years (2015, 2019, 2024, and 2029). The SEA Sustainable Airport Master Plan aviation demand forecasts have been compared graphically with the FAA 2014 TAF in the figures presented throughout this report, including Figures 1-1 and 1-3.

7.2 Comparison with the FAA 2014 TAF

The key findings of the comparison of the SEA Sustainable Airport Master Plan aviation demand forecasts with the FAA 2014 TAF are:

- The forecast of enplaned passengers for SEA is higher than the TAF in 2019 and in 2024. The variance between the SEA Sustainable Airport Master Plan enplaned passenger forecast and the FAA 2014 TAF is 4.2% in 2019 and 7.6% in 2024, as shown in Table 7-1.
- The forecast of commercial operations for SEA varies from the FAA 2014 TAF by 5.9% in 2019 and 4.7% in 2024.
- The forecast of total aircraft operations for SEA varies from the FAA 2014 TAF by 5.9% in 2019 and 4.8% in 2024.

Overall, the SEA SAMP aviation demand forecasts are consistent with the FAA 2014 TAF and "differ by less than 10 percent in the 5-year forecast period, and 15 percent in the 10-year forecast period", as stipulated in the FAA forecast guidance.

*U.S. Department of Transportation, Federal Aviation Administration, *Forecasting Aviation Activity by Airport*, July 2001, and *Review and Approval of Aviation Forecasts*, June 2008, http://www.faa.gov.

Table 7-1
FAA TAF Forecast Comparison
Seattle-Tacoma International Airport

	Year (a)	SEA Sustainable Airport Master Plan forecasts	FAA 2014 TAF	SEA Sustainable Airport Master Plan forecasts vs. 2014 TAF (percent variance)
Passenger enplanements				
Base yr.	2014	18,716,615	17,088,024	9.0%
Base yr. + 5yrs.	2019	22,407,600	21,513,967	4.2%
Base yr. + 10yrs.	2024	25,913,700	24,087,811	7.6%
Base yr. + 15yrs.	2029	29,460,800	26,570,346	10.9%
Commercial operations *(b)*				
Base yr.	2014	336,238	328,274	2.6%
Base yr. + 5yrs.	2019	394,470	419,212	-5.9%
Base yr. + 10yrs.	2024	444,310	466,173	-4.7%
Base yr. + 15yrs.	2029	492,520	511,772	-3.8%
Total operations *(c)*				
Base yr.	2014	340,078	332,463	2.6%
Base yr. + 5yrs.	2019	398,910	424,031	-5.9%
Base yr. + 10yrs.	2024	448,860	471,306	-4.8%
Base yr. + 15yrs.	2029	497,180	517,238	-3.9%

(a) The SEA Sustainable Airport Master Plan forecasts were prepared on a calendar year basis and the FAA 2014 TAF was prepared on a U.S. federal fiscal year basis (October through September).
(b) Commercial operations include operations by passenger airlines, all-cargo airlines, and air taxi operators.
(c) Total operations include commercial operations plus operations by general aviation and military.

Sources: Base year 2014 (actual)—Seattle-Tacoma International Airport records and Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.
SEA Sustainable Airport Master Plan Forecasts—LeighFisher, September 2014.
FAA 2014 TAF for SEA—U.S. Department of Transportation, Federal Aviation Administration, www.faa.gov, accessed January 2015.

Table 7-2 presents a summary of the SEA SAMP aviation demand forecasts using a second template provided by the FAA.

Table 7-2

Summary of SEA SAMP Planning Forecasts Using FAA Template

Seattle-Tacoma International Airport

		Forecast				Average annual compound growth rates			
	Base year 2014	Base year + 1 year 2015	Base year + 5 years 2019	Base year + 10 years 2024	Base year + 15 years 2029	Base year to +1 year 2014 - 2015	Base year to +5 years 2014 - 2019	Base year to +10 years 2014 - 2024	Base year to +15 years 2014 - 2029
Passenger enplanements									
Air carrier *(a)*	16,024,372	16,565,700	19,260,900	22,325,500	25,441,000	3.4%	3.7%	3.4%	3.1%
Commuter *(b)*	2,692,243	2,743,300	3,146,700	3,588,200	4,019,800	1.9%	3.2%	2.9%	2.7%
Total	18,716,615	19,309,000	22,407,600	25,913,700	29,460,800	3.2%	3.7%	3.3%	3.1%
Aircraft operations									
Itinerant									
Air carrier	325,425	341,540	390,210	439,910	487,980	5.0%	3.7%	3.1%	2.7%
Commuter/air taxi	10,813	6,660	4,260	4,400	4,540	-38.4%	-17.0%	-8.6%	-5.6%
Total commercial operations	336,238	348,200	394,470	444,310	492,520	3.6%	3.2%	2.8%	2.6%
General aviation	4,113	4,160	4,240	4,350	4,460	1.1%	0.6%	0.6%	0.5%
Military	127	200	200	200	200	57.5%	9.5%	4.6%	3.1%
Local									
General aviation	--	--	--	--	--	--	--	--	--
Military	--	--	--	--	--	--	--	--	--
Total operations	340,478	352,560	398,910	448,860	497,180	3.5%	3.2%	2.8%	2.6%
Cargo/mail (enplaned + deplaned tons)	268,980	274,898	299,030	328,840	357,930	2.2%	2.1%	2.0%	1.9%
Based Aircraft									
Single-engine (nonjet)	--	--	--	--	--	--	--	--	--
Multiengine (nonjet)	--	--	--	--	--	--	--	--	--
Jet engine	2	2	2	2	2	0.0%	0.0%	0.0%	0.0%
Helicopter	--	--	--	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--
Total	2	2	2	2	2	0.0%	0.0%	0.0%	0.0%
Operational factors									
Average aircraft size (seats)									
Air Carrier *(a)*	134	134	136	139	142				
Commuter *(b)*	49	50	50	50	50				
Average enplaning load factor									
Air Carrier *(a)*	86%	86%	86%	87%	87%				
Commuter *(b)*	73%	72%	74%	76%	78%				
GA operations per based aircraft	2,057	2,080	2,120	2,175	2,230				

(a) The SEA Sustainable Airport Master Plan forecasts were prepared on a calendar year basis and the FAA 2014 TAF was prepared on a U.S. federal fiscal year basis (October through September).

(b) Commercial operations include operations by passenger airlines, all-cargo airlines, and air taxi operators.

(c) Total operations include commercial operations plus operations by general aviation and military.

Sources: Base year 2014 (actual)—Seattle-Tacoma International Airport records and Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov.
SEA Sustainable Airport Master Plan Forecasts—LeighFisher, September 2014.
FAA 2014 TAF for SEA—U.S. Department of Transportation, Federal Aviation Administration, www.faa.gov, accessed January 2015.

Commercial Airline Aircraft Fleet Distribution

The current and future mix of aircraft at the Airport is an important input for facilities planning.

This chapter summarizes the passenger airline fleet mix for 2014 and for the forecast years (2019, 2024, 2029, and 2034) in terms of the percentage of passenger airline aircraft departures during an average day in the peak month (ADPM), as shown in Table 8-1.

Table 8-1

ADPM Percent Distribution of Passenger Airline Aircraft Departures by Equipment Type – Baseline

Seattle-Tacoma International Airport

	Average age (years)	ADPM passenger airline departures					Percent of total				
		Estimated	Baseline forecast				Estimated	Baseline forecast			
		2014	2019	2024	2029	2034	2014	2019	2024	2029	2034
Domestic											
Narrowbody											
A319	7-14	6	8	8	8	8	1.1%	1.3%	1.2%	1.1%	1.0%
A320	8-15	33	40	46	50	54	6.1	6.6	6.7	6.6	6.5
A321	5	3	3	3	5	5	0.6	0.5	0.4	0.7	0.6
B737-300	20	9	7	1	--	--	1.7	1.1	0.1	0.0	0.0
B737-400	16	77	33	33	33	33	14.3	5.4	4.8	4.4	4.0
B737-700	5	57	48	54	55	55	10.6	7.9	7.9	7.3	6.7
B737-800	1-13	90	122	129	141	145	16.7	20.0	18.9	18.6	17.6
B737-900	3-12	15	62	89	116	151	2.8	10.2	13.0	15.3	18.3
B757-200/300	11-20	31	35	34	30	21	5.8	5.7	5.0	4.0	2.5
MD-80	22-24	8	6	6	--	--	1.5	1.0	0.9	0.0	0.0
Subtotal—narrowbody		329	364	403	438	472	61.0%	59.7%	59.1%	57.8%	57.2%
Regional jets											
More than 60 seats											
CRJ-700	9	12	14	15	17	18	2.2%	2.3%	2.2%	2.2%	2.2%
CRJ-900	6	13	23	32	39	43	2.4	3.8	4.7	5.1	5.2
ERJ-175	n.a.	14	21	30	42	51	2.6	3.4	4.4	5.5	6.2
Subtotal—RJs with more than 60 seats		39	58	77	98	112	7.2%	9.5%	11.3%	12.9%	13.6%
60 seats or less											
CRJ-100/200	12	3	3	--	--	--	0.6%	0.5%	0.0%	0.0%	0.0%
Subtotal—regional jets		42	61	77	98	112	7.8%	10.0%	11.3%	12.9%	13.6%
Turboprop											
Cessna	n.a.	2	2	2	2	2	0.4%	0.3%	0.3%	0.3%	0.2%
EMB120	17	7	7	7	7	7	1.3	1.1	1.0	0.9	0.8
Q400	7	96	103	108	111	113	17.8	16.9	15.8	14.6	13.7
Subtotal—turboprop		105	112	117	120	122	19.5%	18.4%	17.2%	15.8%	14.8%
Widebody											
A330-200/300	2-13	2	2	3	5	7	0.4%	0.3%	0.4%	0.7%	0.8%
B767-300	12-23	6	8	8	6	4	1.1	1.3	1.2	0.8	0.5
Subtotal—widebody		8	10	11	11	11	1.5%	1.6%	1.6%	1.5%	1.3%
Subtotal—Domestic		484	547	608	667	717	89.8%	89.7%	89.1%	88.0%	86.9%

Table 8-1 *(page 2 of 2)*

ADPM Percent Distribution of Passenger Airline Aircraft Departures by Equipment Type - Baseline

Seattle-Tacoma International Airport

	Average age (years)	ADPM passenger airline departures					Percent of total				
		Estimated	Baseline forecast				Estimated	Baseline forecast			
		2014	2019	2024	2029	2034	2014	2019	2024	2029	2034
International											
Narrowbody											
A319	7-14	--	2	2	2	2	--	0.3%	0.3%	0.3%	0.2%
A320	8-15	--	1	1	1	1	--	0.2	0.1	0.1	0.1
B737-900	3-12	--	--	4	6	10	--	0.0	0.6	0.8	1.2
B757-200/300	11-20	1	2	2	1	1	0.2%	0.3	0.3	0.1	0.1
Subtotal—narrowbody		1	5	9	10	14	0.2%	0.8%	1.3%	1.3%	1.7%
Regional jets											
More than 60 seats											
CRJ-700	9	1	1	2	3	3	0.2%	0.2%	0.3%	0.4%	0.4%
CRJ-900	6	5	2	3	8	10	0.9	0.3	0.4	1.1	1.2
ERJ-175	n.a.	--	2	3	4	7	--	0.3	0.4	0.5	0.8
ERJ-190	5-6	2	2	2	2	2	0.4	0.3	0.3	0.3	0.2
Subtotal—RJs with more than 60 seats		8	7	10	17	22	1.5%	1.1%	1.5%	2.2%	2.7%
60 seats or less											
CRJ-100/200	12	1	1	1	--	--	0.2%	0.2%	0.1%	0.0%	0.0%
Subtotal—regional jets		9	8	11	17	22	1.7%	1.3%	1.6%	2.2%	2.7%
Turboprop											
DHC8-300	n.a.	7	7	7	8	8	1.3%	1.1%	1.0%	1.1%	1.0%
Q400	7	19	19	19	24	25	3.5%	3.1%	2.8%	3.2%	3.0%
Subtotal—turboprop		26	26	26	32	33	4.8%	4.3%	3.8%	4.2%	4.0%
Widebody											
A330-200/300	2-13	6	9	9	15	16	1.1%	1.5%	1.3%	2.0%	1.9%
A340-200/300	2-9	1	1	1	3	4	0.2	0.2	0.1	0.4	0.5
A340-500	n.a.	--	--	1	1	1	--	0.0	0.1	0.1	0.1
A350	n.a.	--	1	1	1	1	--	0.2	0.1	0.1	0.1
B747-400	18-21	1	1	1	--	--	0.2	0.2	0.1	0.0	0.0
B767-300	12-23	5	5	5	1	1	0.9	0.8	0.7	0.1	0.1
B777-200	5-17	3	3	3	3	3	0.6	0.5	0.4	0.4	0.4
B777-300	1	1	2	2	3	4	0.2	0.3	0.3	0.4	0.5
B787-8	1	2	2	5	5	9	0.4	0.3	0.7	0.7	1.1
Subtotal—widebody		19	24	28	32	39	3.5%	3.9%	4.1%	4.2%	4.7%
Subtotal—international		55	63	74	91	108	10.2%	10.3%	10.9%	12.0%	13.1%
TOTAL PASSENGER AIRLINES		539	610	682	758	825	100.0%	100.0%	100.0%	100.0%	100.0%

Sources: *Historical*—OAG Worldwide Aviation Ltd, online database, accessed September 2014. *Forecast*—LeighFisher, based on data available through September 2014.

Design Aircraft

The design aircraft identified in the forecast fleet mix is classified by Aircraft Approach Category D, Airplane Design Group VI, and Taxiway Design Group 6.

9.1 Background

FAA *Advisory Circular (AC) 150/5070-6B, Airport Master Plans* defines the design aircraft as the most demanding aircraft with at least 500 annual operations that operates, or is expected to operate, at the airport. FAA *AC 150/5300-13A, Airport Design*, defines the design aircraft as having characteristics that determine the application of airport design standards for a specific runway, taxiway, taxilane, apron, or other facility. This aircraft can be a specific aircraft model or a composite of several aircraft using, expected, or intended to use the airport or part of the airport. *AC 150/5300-13A, Airport Design* does not specify a minimum threshold level of operations required for an aircraft type to be designated the design aircraft. Instead, the determination of the design aircraft is left to the airport operator's discretion, so long as design is not based on a design aircraft expected to use an airport infrequently. For the purposes of this Technical Memorandum, we have identified the design aircraft based on the definition in *AC 150/5070-6B, Airport Master Plans*.

The design aircraft is classified by three parameters: Aircraft Approach Category (AAC), Airplane Design Group (ADG), and Taxiway Design Group (TDG). The AAC categorizes aircraft according to their typical approach speeds and is denoted with letters ranging from "A" to "E," in order of increasing approach speed. The ADG categorizes aircraft according to wingspan and tail height and is denoted with Roman numerals ranging from "I" to "IV", in order of increasing wingspan. Table 9-1 provides additional detail for AAC and ADG classifications.

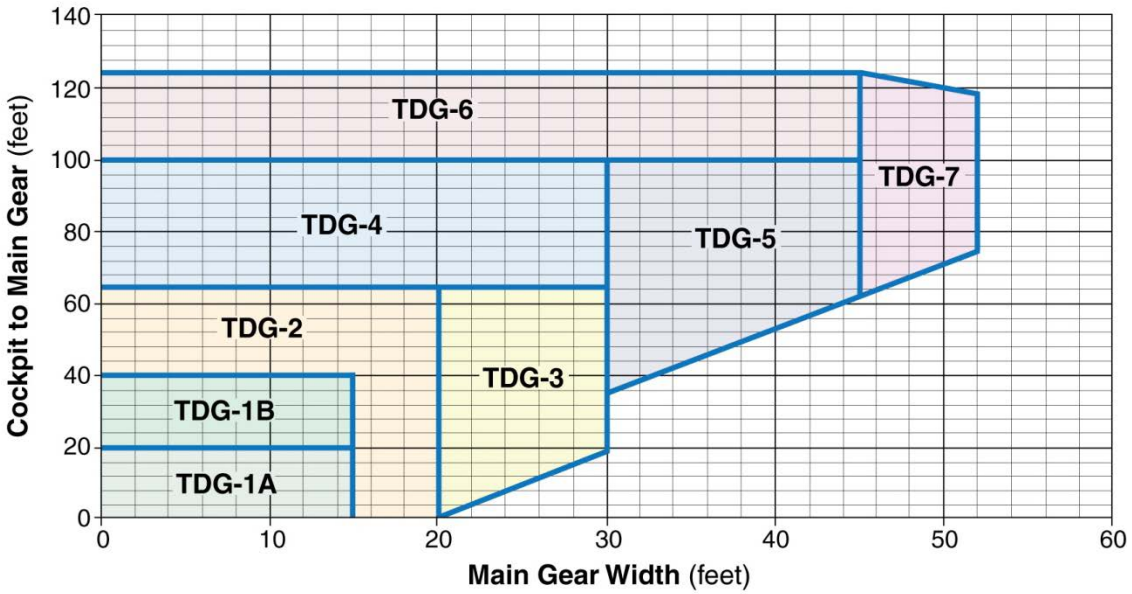
Table 9-1
Aircraft Approach Category and Aircraft Design Group
Seattle-Tacoma International Airport

Aircraft Approach Category (AAC)		Airplane Design Group (ADG)	
A	Approach speed less than 91 knots	I	Wingspan less than 49 feet *or* tail height less than 20 feet
B	Approach speed of 91 knots but less than 121 knots	II	Wingspan of 49 feet but less than 79 feet *or* tail height of 20 feet but less than 30 feet
C	Approach speed of 121 knots but less than 141 knots	III	Wingspan of 79 feet but less than 118 feet *or* tail height of 30 feet but less than 45 feet
D	Approach speed of 141 knots but less than 166 knots	IV	Wingspan of 118 feet but less than 171 feet *or* tail height of 45 feet but less than 60 feet
E	Approach speed of 166 knots or more	V	Wingspan of 171 feet but less than 214 feet *or* tail height of 60 feet but less than 66 feet
		VI	Wingspan of 214 feet but less than 262 feet *or* tail height of 66 feet but less than 80 feet

Source: FAA Advisory Circular 150/5300-13A, *Airport Design,* Federal Aviation Administration.

ADGs are based on wingspan and tail height, but not the dimensions of the aircraft undercarriage. The design of pavement fillets must consider such undercarriage dimensions. TDGs are based on the overall Main Gear Width (MGW) and the Cockpit to Main Gear Distance (CMG). Figure 9-1 depicts TDG classification parameters.

Figure 9-1
Taxiway Design Group Parameters
Seattle-Tacoma International Airport



Source: FAA Advisory Circular 150/5300-13A, *Airport Design,* Federal Aviation Administration.

9.2 Identification of Design Aircraft

In the previous chapter, Table 8-1 identifies the forecast fleet mix for the ADPM. Of the aircraft identified in the future fleet mix, the most demanding (i.e., the aircraft with the largest tail heights, wingspans, approach speeds, and runway length requirements) are the A340-500, A350, and B747-400; all are classified as "D-V" aircraft in terms of AAC and ADG, respectively.* The most demanding aircraft in terms MGW and CMG in the forecast fleet mix is the B777-300, which is classified as a TDG 6. Based on the forecast fleet mix and number of operations, the design aircraft classifications are summarized in Table 9-2, by PAL, for each of the three classification parameters.

*Boeing Commercial , Airport Reference Code and Approach Speeds for Boeing Airplanes, http://www.boeing.com/assets/pdf/commercial/airports/faqs/arcandapproachspeeds.pdf, March 1, 2011 and Boeing Commercial Aircraft - Design Groups/Codes (FAA & ICAO), http://www.boeing.com/assets/pdf/commercial/airports/faqs/aircraftdesigngroup.pdf, November 4, 2014; Airbus, ICAO ARC, FAA ADG, AIRCRAFT APPROACH CATEGORY FOR AIRBUS AIRCRAFT, Technical Memorandum, December 2, 2013, http://www.airbus.com/fileadmin/media_gallery/files/tech_data/General_information/Airbus_ICAO-ARC_FAA-ADG_App-Cat-Feb2013.pdf, accessed September 2015.

Table 9-2
Preliminary Design Aircraft Classifications
Seattle-Tacoma International Airport

Parameter	Existing	PAL 1	PAL 2	PAL 3	PAL 4
Aircraft Approach Category (AAC)	D	D	D	D	D
Airplane Design Group (ADG)	V	V	V	V	V
Taxiway Design Group (TDG)	6	6	6	6	6

Source: LeighFisher, September 2015.

9.3 Review of Design Aircraft

Table 8-1 identifies the future fleet mix for passenger airline aircraft operations only. In addition to passenger airlines, air freight aircraft such as the B747-8F also use the Airport on a regular basis. The Airport also accommodates unscheduled A380 operations. Both the B747-8F and the A380 are ADG VI aircraft.

The Airport will continue to accommodate ADG VI aircraft. As noted earlier, pursuant to the guidance in *AC 150/5300-13A, Airport Design,* determination of the design aircraft is left to the Airport's discretion, so long as facilities are not designed based on an aircraft expected to use an airport infrequently. Therefore, the applicability of different design aircraft (i.e., ADG VI) to different functional areas of the Airport (e.g., those that accommodate air freight or unscheduled operations) may be explored in subsequent tasks as the master plan progresses.

Appendix A
Regression Analysis

The forecasts of domestic O&D passengers and international air cargo at the Airport are based on an econometric model relating historical trends to economic and airline industry metrics.

Regression analysis compares the historical relationship between a dependent variable, in this case, domestic O&D passengers, and an independent or "predictor" variable. The predictor variable is eventually used to project future levels of the dependent variable. In aviation demand forecasts, the predictor variable is typically represented by an economic or demographic metric such as population, employment, or personal income. Regression analyses produce a mathematical equation that identifies the strength or reliability of the historical correlation between the dependent variable (enplaned passengers) and predictor variables. The statistical reliability of this equation is typically measured by a regression statistic known as "R-squared." An R-squared of 1.0 would represent a perfect historical correlation between the dependent and predictor variable and suggest that the measurement of this historical relationship will be a reliable predictor of future results.

Two regression models were defined during the forecast process to evaluate historical trends in SEA domestic O&D passengers and international air cargo and are presented in Table A-1.

Table A-1
Regression Models
Seattle-Tacoma International Airport

	Coefficient	t-statistic	P-value
Domestic O&D passengers			
Dependent variable = Ln (SEA domestic O&D passengers)			
Independent variables			
Ln (Seattle Primary Area per capita personal income, 2012 dollars)	1.11	9.87	0.0000
Ln (SEA airfares, 2012 dollars)	-0.83	-10.44	0.0000
Dummy variable for airline service expansion (1997-2000= 1)	0.09	3.91	0.0010
Constant	8.47	5.47	0.0000
Observations	23		
Adjusted R-squared	0.97		
International air cargo			
Dependent variable = Ln (SEA international air cargo)			
Independent variables			
Ln (Seattle Primary Area per capita personal income, 2012 dollars)	1.31	13.38	0.0000
Constant	-2.90	-2.76	0.0118
Observations	23		
Adjusted R-squared	0.89		

Source: LeighFisher, based on data available through September 2014.

Appendix B
Data Sources

The data summarized in this report and used in the preparation of the aviation activity forecasts included federal, state, and regional sources, including data reported by Seattle-Tacoma International Airport.

The data sources used in summarizing historical aviation activity and preparing annual and peak period forecasts are summarized in the following sections.

Socioeconomic Data

Historical population: U.S. Department of Commerce, Bureau of the Census, www.census.gov, accessed August 2014.

Historical nonagricultural employment, unemployment rates, and Consumer Price Index for Urban Consumers (1982-84 = 100): U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, accessed August 2014.

Historical per capita personal income: U.S. Department of Commerce, Bureau of Economic Analysis, www.bea.gov, accessed August 2014.

Top Employers in King County: Puget Sound Business Journal Book of Lists 2014, as reported by the Economic Development Council of Seattle and King County, www.edc-seaking.org, accessed October 2014.

Historical tourism statistics: Visit Seattle, Annual Economic Impacts of Travel: Seattle and King County, Washington, compiled by Dean Runyan Associates for Visit Seattle, www.visitseattle.org. Port of Seattle, 2014 Cruise Ship Fact Sheet, www.portofseattle.org, accessed October 2014.

Industry clusters in the Seattle Region: Economic Development Council of Seattle and King County , *Washington State Maritime Industry Cluster, Economic Impact Study*, November 2013, www.edc-seaking.org.

Historical housing prices in the Seattle Region: Standard & Poors/Case-Shiller Home Price Indices, www.standardandpoors.com, accessed October 2014.

Forecast population, nonagricultural employment, and per capita personal income for the Seattle Region: Puget Sound Regional Council, 2012 Regional Macroeconomic Forecast, July 2013, www.psrc.org.

Forecast population, nonagricultural employment, and per capita personal income for the State of Washington and the United States: Woods & Poole Economics, Inc., The Complete Economic and Demographic Data Source, 2013.

Historical and projected GDP by world region: Global Insight as reported in U.S. Department of Transportation, Federal Aviation Administration, FAA Aerospace Forecasts, Fiscal Years 2014-2034, March 2014.

Aviation Data

Airlines Serving Seattle-Tacoma International Airport: Seattle-Tacoma International Airport records based on data reported by the airlines and OAG Worldwide Aviation Ltd, OAG Analyser database, accessed August 2014.

Enplaned passengers (domestic, international, and total): Seattle-Tacoma International Airport records based on data reported by the airlines. These data were used as the basis for the enplaned passenger forecasts.

Air cargo (domestic, international, and total; freight and mail): Seattle-Tacoma International Airport records. These data were used as the basis for the air cargo forecasts.

Commercial airline aircraft operations (domestic, international, and total; passenger and all-cargo airlines): Seattle-Tacoma International Airport records based on data reported by the airlines. These data were used as the basis for the commercial airline aircraft operations forecasts.

Total aircraft operations (air carrier, air taxi, general aviation, and military): Federal Aviation Administration, Air Traffic Activity System (ATADS), www.faa.gov. These data were used as the basis for the total aircraft operations forecasts.

Domestic and international connecting passengers: U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, DOT Analyser online database, accessed October 2014. These data were reconciled with data reported by Seattle-Tacoma International Airport and used as the basis for the connecting passenger forecasts.

Domestic originating passengers, domestic origin-destination patterns, domestic airfares, and domestic airline yields: U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, DOT Analyser online database, accessed October 2014.

International origin-destination patterns. OAG Aviation Worldwide Ltd, OAG Traffic Analyser (passenger bookings). Bookings data were used to represent international origin-destination patterns because the U.S. Department of Transportation, *Origin-Destination Survey of Airline Passenger Traffic, Domestic*, does not include data for foreign-flag airlines and is therefore incomplete.

Passenger airline scheduled aircraft operations and seats by airline, market, and equipment type: OAG Aviation Worldwide Ltd, OAG Analyser database, accessed September 2014.

Comparative industry forecasts: Airbus, *Global Market Forecast, 2014-2033*, 2014, www.airbus.com. The Boeing Corporation*, Current Market Outlook, 2014-2034*, 2014, www.boeing.com. U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecast, Fiscal Years 2014-2034*, March 2014, www.faa.gov.