

# **CHAPTER TWO FORECAST**

A forecast of aviation activity was prepared for the purpose of developing noise exposure contours for projected future conditions for this Part 150 Noise Compatibility Study Update. This forecast projected activity levels through 2021 and was submitted to the Federal Aviation Administration (FAA) for approval in July 2010. The FAA approved the use of this forecast for this Part 150 Study in a letter dated August 19, 2010. A copy of this approval letter is included in Appendix N, *Forecast Approval*. The following sections include the information that was included in the forecast document that was submitted to the FAA in July 2010. This forecast was used to develop input data representative of 2018 conditions, which was used to prepare the noise exposure contour for the Future (2018) Noise Exposure Map (NEM).

## **2.1 INTRODUCTION**

This document was prepared to provide a forecast of future aviation characteristics and operating levels to support the requirements of the Part 150 planning process for Seattle-Tacoma International Airport (Sea-Tac Airport). The year 2009 was used as the base year for forecast purposes. The key benchmark year for the forecast is 2018, which corresponds to the 5-year projection from the Existing (2013) NEM.

The aviation forecasts are presented for the following types of activity at Sea-Tac Airport:

1. Commercial Passenger
2. Air Cargo
3. Air Taxi and General Aviation
4. Military

## **2.2 COMMERCIAL PASSENGER**

This section provides a summary of historical passenger enplanements at Sea-Tac Airport, an overview of current domestic and international air service offered at Sea-Tac Airport, passenger and operation forecasts and passenger aircraft fleet mix.

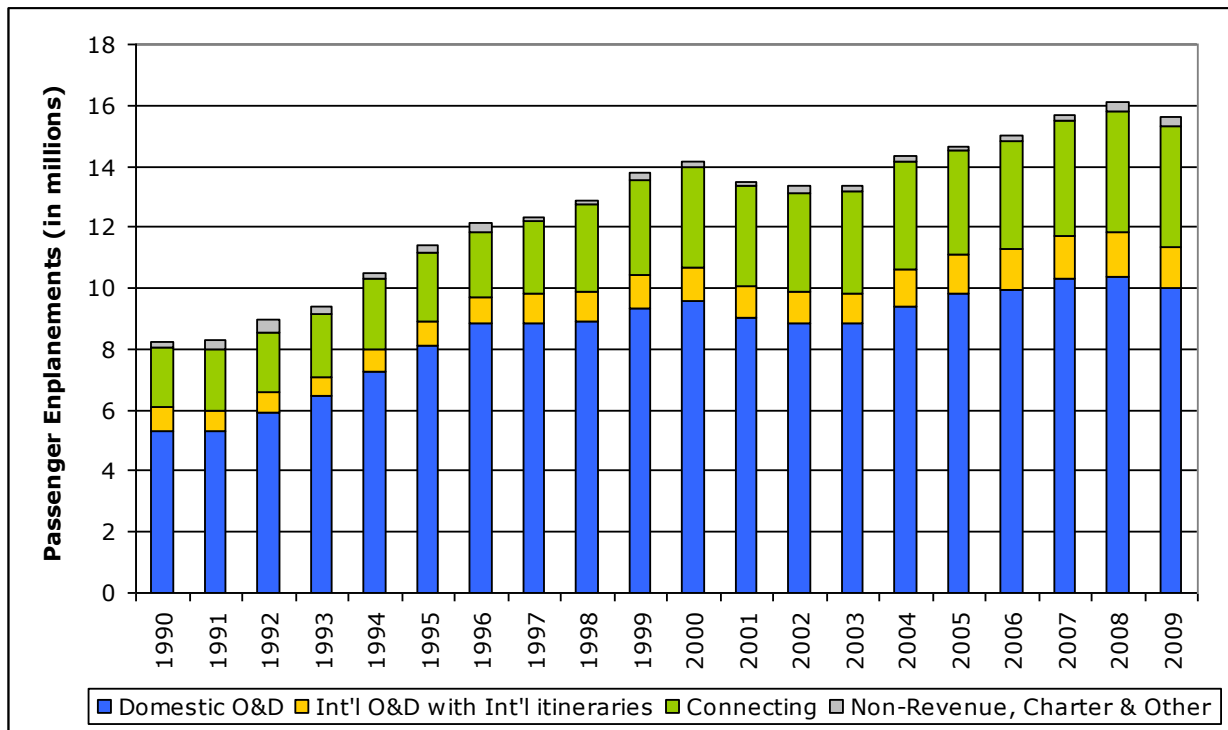
The purpose of reviewing historical enplanements and air service trends is to start building a context for the forecast. Historical data can answer questions such as who are the major airline operators from Sea-Tac Airport and what markets are served from Sea-Tac Airport? The past is not always a good predictor of the future; however, an analysis of historical data provides the opportunity to understand those factors which have caused traffic to increase or decrease and how those factors may change in the future, thus influencing the forecast. While the socio-economic base is one of the fundamental underpinnings of the forecast, demand

cannot be realized without air service at a price that induces demand. Ultimately, understanding the historical relationships between the economy and aviation activity at Sea-Tac Airport will form the building blocks of the forecast. The projected aircraft fleet mix will be used in the development of the noise exposure contours in the Part 150 study.

**2.2.1 HISTORICAL ENPLANEMENT OVERVIEW**

Sea-Tac Airport enjoys a relatively diverse base of passenger operations. According to the *Official Airline Guide (OAG)*, in 2009, 28 scheduled airlines provided 421 daily departures to 104 airports from Sea-Tac Airport. Passenger enplanements at Sea-Tac Airport increased significantly from 8.2 million in 1990 to 14.2 million in 2000 representing an average annual growth rate of 5.6 percent. Between 2000 and 2009, passenger traffic increased at a slower rate of 1.1 percent per year reaching 15.6 million by 2009 (see **Exhibit 2-1, Historical Enplaned Passengers**). Components of passenger enplanements at Sea-Tac Airport remained relatively constant between 1990 and 2009. In 2009, domestic Origin & Destination (O&D<sup>1</sup>) accounted for 64.3 percent, international O&D with international itineraries accounted for 8.5 percent, connecting passengers accounted for 25.2 percent, and non-revenue, charter and other accounted for 2.1 percent.

**Exhibit 2-1  
HISTORICAL ENPLANED PASSENGERS  
Seattle-Tacoma International Airport**



Sources: Airport records; USDOT, Air Passenger Origin-Destination Survey; Landrum & Brown analysis

<sup>1</sup> Originating and destination passengers – passengers who start or end their trip at the airport.

**2.2.2 HISTORICAL AIR SERVICE TRENDS**

In order to provide a historical context for the forecast of aircraft operations, airline schedule filings published in the OAG as of February 5, 2010 were analyzed to understand changes in air service patterns at Sea-Tac Airport. **Table 2-1** and **Table 2-2** provide a summary of air service trends by carrier for domestic and international markets.

Domestic air service accounted for 91 percent of scheduled passenger operations at Sea-Tac Airport in 2009. Alaska Airlines has accounted for a dominant share of the traffic since 1995. Alaska Airlines accounted for 51.4 percent of scheduled domestic seats and provided service to 61 U.S. airports in 2009. In 2009, Southwest, United, and Delta accounted for 10.8 percent, 7.8 percent and 5.7 percent of total scheduled domestic seats, respectively.

**Table 2-1  
DOMESTIC AIR SERVICE TRENDS  
Seattle-Tacoma International Airport**

Rank	Airline	Airports Served				Departing Flights				Departing Seats				AAG 95-09
		1995	2000	2009	2010	1995	2000	2009	2010	1995	2000	2009	2010	
1	Alaska	38	46	61	59	83,073	101,138	77,236	76,761	6,725,216	8,477,952	9,106,467	8,879,383	2.2%
2	Southwest	8	12	14	16	9,235	13,186	14,084	13,688	1,261,925	1,797,767	1,914,688	1,855,216	3.0%
3	United	15	16	8	8	32,689	37,325	12,738	13,622	2,820,119	2,756,930	1,383,366	1,333,792	-5.0%
4	Delta	11	7	6	9	7,362	6,979	6,673	7,749	1,374,198	1,262,637	1,007,475	1,160,872	-2.2%
5	Northwest	7	4	5	4	6,497	6,290	4,547	2,995	1,366,552	1,290,204	896,854	547,612	-3.0%
6	Continental	4	4	4	4	2,194	3,497	4,494	4,446	318,666	506,594	774,135	721,513	6.5%
7	American	5	9	4	4	5,799	8,075	5,190	5,143	902,750	1,177,382	764,844	744,958	-1.2%
8	US Airways	4	3	4	3	1,825	2,682	3,795	2,920	316,768	447,261	586,482	444,610	4.5%
9	Virgin America	-	-	2	2	-	-	2,593	1,808	-	-	361,112	246,523	n.a.
10	jetBlue	-	-	4	3	-	-	1,847	1,454	-	-	273,500	212,300	n.a.
11	Hawaiian	1	2	2	2	375	628	917	887	114,000	190,912	231,084	223,524	5.2%
12	Frontier	-	1	2	1	-	1,348	1,447	1,444	-	177,826	191,654	172,642	n.a.
13	AirTran	-	-	3	3	-	-	952	657	-	-	130,424	90,009	n.a.
14	Sun Country	-	1	2	1	-	365	255	158	-	66,230	40,608	25,518	n.a.
15	Midwest	-	-	1	1	-	-	365	365	-	-	36,076	35,770	n.a.
16	Kenmore Air	-	-	4	-	-	-	1,991	-	-	-	15,928	-	n.a.
	Other	20	12	-	-	10,433	5,592	-	-	1,519,259	850,569	-	-	-100.0%
	<b>Total</b>	<b>66</b>	<b>73</b>	<b>83</b>	<b>76</b>	<b>159,482</b>	<b>187,105</b>	<b>139,124</b>	<b>134,097</b>	<b>16,719,453</b>	<b>19,002,264</b>	<b>17,714,697</b>	<b>16,694,242</b>	<b>0.4%</b>

Source: Official Airline Guide

Alaska Airlines accounted for nearly 40 percent of international seats in 2009. Between 1995 and 2009, Alaska Airlines gained four additional markets and its scheduled seats increased at an average growth rate of 7.7 percent per year. Northwest<sup>2</sup>, Air Canada, and British Airways accounted for 12.0 percent, 9.4 percent and 7.6 percent of scheduled international seats, respectively.

<sup>2</sup> Northwest was merged into Delta in April 2008. Northwest continued to operate as an independent carrier (as a Delta Air Lines subsidiary) until January 2010 (the completion of the merger). The combined airline now uses the Delta name and branding.

**Table 2-2  
INTERNATIONAL AIR SERVICE TRENDS  
Seattle-Tacoma International Airport**

Rank	Airline	Airports Served				Departing Flights				Departing Seats				AAG 95-09
		1995	2000	2009	2010	1995	2000	2009	2010	1995	2000	2009	2010	
1	Alaska	5	8	9	9	6,113	13,055	8,061	7,929	236,560	584,096	668,956	643,061	7.7%
2	Northwest	3	3	3	4	714	1,003	735	691	264,212	321,399	209,290	189,286	-1.7%
3	Air Canada	1	2	3	3	3,439	2,492	2,930	3,040	127,243	151,593	164,818	171,178	1.9%
4	British Airways	1	1	1	1	364	363	511	365	98,826	106,662	133,139	97,885	2.2%
5	United	2	2	1	2	1,711	2,561	362	366	246,161	160,278	93,396	94,352	-6.7%
6	EVA	3	2	1	1	886	732	231	260	310,677	272,304	77,924	88,040	-9.4%
7	Korean Air	-	-	2	1	-	-	250	251	-	-	74,795	75,551	n.a.
8	Lufthansa	-	-	1	1	-	-	327	342	-	-	72,267	75,582	n.a.
9	Asiana	1	1	2	1	92	157	212	247	23,920	43,960	65,321	76,570	7.4%
10	Air France	-	-	1	1	-	-	288	309	-	-	63,337	69,844	n.a.
11	SAS	1	1	1	-	316	363	155	-	79,316	91,113	37,975	-	-5.1%
12	Hainan Airlines	-	-	1	1	-	-	169	162	-	-	37,518	35,964	n.a.
13	Aeromexico	-	-	2	1	-	-	205	10	-	-	25,550	1,240	n.a.
14	Icelandair	-	-	1	1	-	-	90	229	-	-	17,010	43,281	n.a.
15	Royal Air Maroc	-	-	1	-	-	-	23	-	-	-	3,519	-	n.a.
16	Delta	-	-	-	4	-	-	-	462	-	-	-	118,302	n.a.
	Other	7	4	-	-	1,927	501	-	-	255,970	119,828	-	-	-100.0%
	<b>Total</b>	<b>18</b>	<b>18</b>	<b>24</b>	<b>21</b>	<b>15,562</b>	<b>21,227</b>	<b>14,549</b>	<b>14,663</b>	<b>1,642,885</b>	<b>1,851,233</b>	<b>1,744,815</b>	<b>1,780,136</b>	<b>0.4%</b>

Source: Official Airline Guide

**Table 2-3** presents top domestic and international markets from Sea-Tac Airport in 2009. The largest domestic destinations from Sea-Tac Airport were San Francisco accounting for 11.0 percent of total scheduled domestic seats in 2009, Los Angeles accounting for 9.7 percent, and Anchorage accounting for 5.7 percent. The top international markets from Sea-Tac Airport were Vancouver, Canada accounting for 17.4 percent of total scheduled international seats, Tokyo, Japan accounting for 11.3 percent, and Seoul, Korea accounting for 7.9 percent.

**Table 2-3  
2009 TOP MARKETS - SCHEDULED SEATS  
Seattle-Tacoma International Airport**

<b>Domestic</b>				<b>International</b>			
<b>Rank</b>	<b>Market</b>	<b>Seats 2009</b>	<b>% Share</b>	<b>Rank</b>	<b>Market</b>	<b>Seats 2009</b>	<b>% Share</b>
1	San Francisco	1,956,842	11.0%	1	Vancouver, Canada	303,915	17.4%
2	Los Angeles	1,719,438	9.7%	2	Tokyo(Narita), Japan	197,486	11.3%
3	Anchorage	1,001,650	5.7%	3	Seoul, Korea	137,933	7.9%
4	Chicago	821,155	4.6%	4	Victoria, Canada	134,384	7.7%
5	Denver	815,279	4.6%	5	London(Heathrow), UK	134,354	7.7%
6	Spokane	698,116	3.9%	6	Calgary, Canada	109,500	6.3%
7	Phoenix	692,510	3.9%	7	Amsterdam, Netherlands	103,985	6.0%
8	Las Vegas	644,982	3.6%	8	Taipei	77,924	4.5%
9	Portland	635,016	3.6%	9	Kelowna, Canada	76,886	4.4%
10	New York	628,321	3.5%	10	Edmonton, Canada	72,520	4.2%
11	Minneapolis/St. Paul	627,921	3.5%	11	Frankfurt, Germany	72,267	4.1%
12	Dallas/Ft. Worth	561,447	3.2%	12	Paris, France	63,337	3.6%
13	Salt Lake City	480,670	2.7%	13	Los Cabos, Mexico	41,091	2.4%
14	Atlanta	456,459	2.6%	14	Toronto, Canada	39,618	2.3%
15	Sacramento	442,498	2.5%	15	Copenhagen, Denmark	37,975	2.2%
16	Houston	421,731	2.4%	16	Beijing, China	37,518	2.2%
17	San Diego	408,430	2.3%	17	Puerto Vallarta, Mexico	30,870	1.8%
18	Honolulu	363,688	2.1%	18	Cancun, Mexico	27,318	1.6%
19	Washington	324,130	1.8%	19	Reykjavik, Iceland	17,010	1.0%
20	Boise	273,117	1.5%	20	Mexico City, Mexico	15,304	0.9%
	Other	<u>3,741,297</u>	<u>21.1%</u>		Other	<u>13,620</u>	<u>0.8%</u>
	<b>Total</b>	<b>17,714,697</b>	<b>100.0%</b>		<b>Total</b>	<b>1,744,815</b>	<b>100.0%</b>

Source: Official Airline Guide

### **2.2.3 PASSENGER ENPLANEMENT FORECAST**

The passenger enplanement forecast provides a critical path for the commercial passenger operations forecast which is derived based on assumptions related to average aircraft size and load factor. The passenger forecasts are presented for the key years 2018 and 2021, with 2009 as the base year.

Passenger traffic at Sea-Tac Airport was divided into five main segments for the purpose of developing the detailed forecast:

- (1) domestic O&D passengers that travel on purely domestic itineraries,
- (2) O&D passengers that board domestic flights at Sea-Tac Airport and travel to another U.S. gateway to connect with international flights (bound for international destinations),
- (3) O&D passengers that board international flights at Sea-Tac Airport on purely international itineraries,
- (4) connecting passengers, and
- (5) non-revenue, charter, and other passengers.

**2.2.3.1 Passenger Forecast Methodology**

**Table 2-4** summarizes the overall approach and methodology used to develop the passenger enplanement forecast. The domestic O&D and bound for international destinations forecasts were developed using an econometric approach which ties traffic volumes to historical and forecast economic data for the Seattle-Tacoma-Bellevue Metropolitan Statistical Areas (Seattle MSA). The international O&D forecast was developed based on analysis of existing bound for international traffic that could potentially become international O&D. The connecting traffic forecast was derived from the resulting domestic O&D enplanements forecast.

**Table 2-4  
ENPLANEMENT FORECAST METHODOLOGY  
Seattle-Tacoma International Airport**

<b>Traffic Segment</b>	<b>Short-Term (2010-2013)</b>	<b>Long-Term (2014-2021)</b>
<b>Domestic O&amp;D</b>	→ Incorporates recession impact and subsequent recovery	→ Based on statistical relationship between historical traffic and personal income and yield
<b>Bound for Int'l Destinations</b>	→ Initial decline, reflecting the state of the world economy	→ Based on statistical relationship between historical traffic and GDP for each world region
<b>International O&amp;D</b>	→ Initial decline, reflecting the state of the world economy	→ Reflects growth in bound for int'l destinations segment and new non-stop destinations
<b>Connections</b>	→ Incorporates recession impact and subsequent recovery	→ Derived from resulting domestic O&D

Source: Landrum & Brown analysis

**Domestic Origin & Destination (O&D)**

A short-term 3-year forecast (2010 through 2013) was developed for domestic O&D. This approach provided the opportunity to incorporate a more appropriate year-to-year estimate of the impact of the current economic crisis and subsequent recovery on passenger traffic levels. The short-term forecast takes into account current airline schedule filings for 2010, which are important indicators of anticipated near-term demand levels, as well as annual economic forecasts promulgated by the U.S. Federal Reserve Board.

A long-term forecast (2014 through 2021) was developed based on the statistical relationship between historical demographic data and economic activity in the Seattle MSA and domestic originating passenger traffic at Sea-Tac Airport.

Independent variables considered for use in the regression included population, employment, personal income, per capita personal income (PCPI), gross regional product (GRP), and yield<sup>3</sup> for the Seattle MSA. **Table 2-5** presents historical and future socio-economic variables for the Seattle MSA. All socio-economic variables are projected to grow at slower rates between 2009 and 2021 compared to the average annual growth rates during the 1990 to 2009 period.

According to the local forecasts provided by the Office of Financial Management (OFM), State of Washington, the socio-economic forecasts are generally in line with the Woods & Poole (W&P) forecasts. Population forecasts for the Seattle MSA are expected to grow at the same rate of 1.1 percent per year between 2009 and 2021. Over the same period, per capita personal income provided by the OFM for the State of Washington is projected to grow at a slightly higher rate of 1.8 percent per year versus 1.1 percent in the W&P forecast. The OFM projects employment in the State of Washington to grow at 1.0 percent annually versus 1.3 percent in the W&P forecast.

**Table 2-5  
SOCIO-ECONOMIC VARIABLES  
Seattle MSA**

Calendar Year	Population (in thousands)	Employment (in thousands)	Personal Income (millions; \$2004)	PCPI (2004 \$)	GRP (millions; \$2004)
<b>Historical</b>					
1990	2,579	1,665	\$78,460	\$30,425	\$101,826
1995	2,815	1,762	\$89,972	\$31,966	\$115,956
2000	3,052	2,064	\$124,871	\$40,908	\$163,697
2005	3,197	2,124	\$132,948	\$41,580	\$174,004
2006	3,254	2,191	\$141,648	\$43,531	\$180,882
2007	3,298	2,263	\$150,102	\$45,510	\$189,659
2008	3,345	2,290	\$151,098	\$45,174	\$191,882
2009	3,384	2,260	\$150,968	\$44,616	\$189,461
<b>Forecast</b>					
2010	3,423	2,314	\$154,717	\$45,201	\$193,913
2016	3,663	2,479	\$176,633	\$48,227	\$218,945
2018	3,745	2,537	\$184,720	\$49,330	\$228,018
2021	3,868	2,626	\$197,643	\$51,094	\$242,351
<b>Average Annual Growth Rates</b>					
1990-1995	1.8%	1.1%	2.8%	1.0%	2.6%
1995-2000	1.6%	3.2%	6.8%	5.1%	7.1%
2000-2005	0.9%	0.6%	1.3%	0.3%	1.2%
2005-2009	1.4%	1.6%	3.2%	1.8%	2.2%
1990-2009	1.4%	1.6%	3.5%	2.0%	3.3%
2009-2016	1.1%	1.3%	2.3%	1.1%	2.1%
2016-2021	1.1%	1.2%	2.3%	1.2%	2.1%
2009-2021	1.1%	1.3%	2.3%	1.1%	2.1%

Source: Woods & Poole Economics, Inc. 2010

Note: Seattle-Tacoma-Bellevue MSA includes three counties which are King, Pierce, and Snohomish Counties.

<sup>3</sup> Yield is defined as the average revenue an airline obtains from carrying a passenger one mile. It reflects fare, length of haul, the level of competition, carrier costs, and other factors. Yield is a commonly accepted measure of the price of air travel.

In addition to these socio-economic variables, regression models oftentimes include dummy variables to consider unusual events that do not correlate to the independent variables. The only unusual event that had a noticeable impact on Sea-Tac Airport traffic was the September 11, 2001 terrorist attacks. This event had the effect of depressing traffic at U.S. airports and throughout the world for several years. The use of a dummy variable corrects for the downturn in traffic that is not reflected in the standard socio-economic variables used to forecast future aviation activity.

Several regressions of various combinations of these independent variables were tested but ultimately rejected for various reasons, such as:

- Inadequate test statistics (i.e. low r-squared values or other inadequate regression statistics) which indicates that the independent variables are not good predictors of Sea-Tac Airport traffic.
- Poor forecast results (Regression models produce “forecasts” of historical data. A satisfactory model will generate estimates that are close to actual values.)
- Theoretical contradictions (e.g. the model indicates that Gross Domestic Product (GDP) growth is negatively correlated with traffic growth).
- Overly aggressive or low forecast results that are incompatible with historical averages.

A 20-year history from 1990 to 2009 was used in the regression model. Different time periods (such as 1985-2009, 1995-2009) were also tested but these time periods resulted in inadequate regression statistics.

In the evaluation of the various regressions, a log regression using personal income, the average yield at Sea-Tac Airport, and a dummy variable to take into account the September 11, 2001 terrorist attacks proved to correlate best with the total domestic O&D traffic of the Seattle MSA. Average yield for 2009 was based on the 12 months ended September 2009. The forecast of average yield was based on the FAA’s national yield forecast. Personal income for the Seattle MSA was projected by Puget Sound Economic Forecaster to grow at an average of 3.0 percent per annum between 2009 and 2021. The resulting econometric model statistics are presented in **Table 2-6**.



**Table 2-6  
DOMESTIC O&D ECONOMETRIC MODEL STATISTICS  
Seattle-Tacoma International Airport**

<b>Time Period:</b>		1990-2009
<b>Independent Variables:</b>		Yield, Personal Income, Dummy
<b>Regression Equation:</b>		Domestic O&D Enpax = $e^{14.12} + \text{Yield}^{-0.56} + \text{Personal Income}^{0.66} + \text{Dummy} * e^{-0.09}$
<b>Regression Statistics:</b>		
Adj. R <sup>2</sup> = 0.89		R <sup>2</sup> = 0.91
T-stat (constant) = 6.97		P-value (constant) = 0.00
T-stat (Yield) = -1.85		P-value (yield) = 0.08
T-stat (PI) = 2.46		P-value (PI) = 0.02
T-stat (Dummy) = -1.12		P-value (Dummy) = 0.28

Source: Landrum & Brown analysis

**Table 2-7** provides the historical yield, personal income, and dummy variable data used in the regression as well as the resulting forecast values. Based on the short-term and long-term forecasts discussed above, domestic O&D enplanements are expected to decline initially by 1.6 percent in 2010 and recover to 2008 level by 2013 and then grow at an average annual rate of 2.7 percent from 2013 to 2021. Domestic O&D enplanements are forecast to total 12.9 million in 2021.

**Table 2-7  
DOMESTIC O&D ENPLANED PASSENGER FORECAST  
Seattle MSA**

	Year	Independent Variable		Dummy Variable	Domestic O&D Enpax
		Adj. Yield (\$2005)(cents)	Personal Income (billions; \$2005)		
Actual	1990	19.47	\$86	0	5,269,650
	1995	13.16	\$99	0	8,069,090
	2000	12.64	\$136	0	9,533,350
	2001	11.01	\$136	1	8,988,850
	2002	9.97	\$137	1	8,815,900
	2003	9.94	\$137	1	8,800,950
	2004	9.58	\$146	0	9,387,760
	2005	9.89	\$146	0	9,791,010
	2006	10.45	\$155	0	9,936,230
	2007	10.12	\$164	0	10,271,720
	2008	9.85	\$165	0	10,354,990
	2009	8.71	\$162	0	10,011,560
Forecast	2010	8.85	\$165	0	9,850,700
	2016	8.42	\$200	0	11,366,900
	2018	8.23	\$211	0	11,959,200
	2021	7.97	\$230	0	12,913,100
<b>Average Annual Growth Rates:</b>					
	1990-2009	-4.1%	3.4%	n/a	3.4%
	2009-2021	-0.7%	3.0%	n/a	2.1%

Sources: Puget Sound Economic Forecaster; U.S. DOT, *Air Passenger Origin-Destination Survey*; Federal Aviation Administration; Landrum & Brown analysis

## **Bound for International Destinations**

The Bound for International Destinations category refers to passengers traveling to or from the Seattle local area that board a domestic flight at Sea-Tac Airport and fly to another U.S. gateway airport in order to make a connection to an international destination.

Nearly 1.4 million Sea-Tac Airport O&D enplaned passengers had an international itinerary in 2009. Forty-three percent of these passengers flew through another U.S. gateway prior to arriving at their final international destination (i.e. bound for an international destination). The forecast for the “bound for international destinations” category was developed using an econometric approach which correlated this traffic segment with anticipated growth in the world economy.

A number of regression analyses were developed that correlated growth in passengers “bound for international destinations” with world economic growth at the aggregate level and by world region using GDP forecasts<sup>4</sup> provided by the FAA. The world economic growth rates were weighted to take into account the historical market share of specific world regions for this traffic segment in the Seattle market. Based on this approach, traffic is expected to grow 2.9 percent annually from 452,600 enplanements in 2009 to 641,100 enplanements in 2021. Latin America is expected to be the fastest growing segment and a portion of the traffic is expected to become a new international O&D service to/from Sea-Tac Airport.

## **International O&D**

The “international O&D enplanements” forecast was developed based on assumptions regarding growth in existing international services at the Airport and the potential for airlines to add new international service to certain international markets as demand reaches a critical mass to be served non-stop from Sea-Tac Airport. Indeed, the higher the level of “bound for international destinations” enplanements in a particular region, the greater the potential for non-stop service. Therefore, the forecast of international O&D enplanements was based on the following key considerations:

- Two additional weekly non-stop flights to Latin America are forecast to be in place by 2011 using narrow-body jet aircraft (157 seats) with an average load factor of 75 percent. This service is projected to increase to 18 weekly flights (2 daily- and 4 weekly- flights) by 2021.
- In addition to potential new markets from existing bound for international destinations, there will also be new service opportunities to Japan due to the new U.S.-Japan open-skies agreement that will provide U.S. carrier access to Haneda for the first time since 1978. With the location advantage of Sea-Tac Airport, it was assumed that Delta or other airlines will start a new daily flight to Asia using B767s (214 seats) with an average load factor of 80 percent in 2011. This service is projected to increase to 2 daily flights in 2012 and to 3 daily flights in 2015.

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<sup>4</sup> FAA Aerospace Forecasts 2009-2025

International O&D enplanements initially declined in 2009, reflecting the state of the world economy. International O&D enplanements are expected to return to positive growth rates in 2010. Based on these assumptions about the new markets and a statistical regression of GRP<sup>5</sup> for Seattle MSA and international O&D at Sea-Tac Airport between 1990 and 2009, international O&D enplanements are forecast to grow by 3.5 percent per year from 866,700 enplanements in 2009 to 1,307,100 enplanements by 2021.

## **Connections**

The volume of connecting passengers occurs largely as a result of airline network management strategies. Connecting enplanements have accounted for 18 to 25 percent share of total enplanements at Sea-Tac Airport over the historical period. The majority of the connecting traffic is from Alaska Airlines. It is assumed that Alaska Airlines will continue to operate a hub at the Airport over the forecast period, maintaining 24-26 percent connections at Sea-Tac Airport. Connecting enplanements are forecast to reach nearly 4.7 million in 2021, averaging an annual growth rate of 1.5 percent between 2009 and 2021.

**Table 2-8  
INTERNATIONAL O&D ENPLANEMENTS FORECAST  
Seattle-Tacoma International Airport**

		GRP	Regression of		International O&D
	Year	(millions; \$2004)	International O&D	New Air Service	Enplanements
			Enplanements		Forecast
<b>Actual</b>	1990	101,826	600,680		600,680
	1995	115,956	559,499		559,499
	2000	163,697	737,574		737,574
	2005	174,004	825,974		825,974
	2006	180,882	858,109		858,109
	2007	189,659	906,756		906,756
	2008	191,882	945,526		945,526
	2009	189,461	866,679		866,679
<b>Forecast</b>	2010	193,900	900,690		900,690
	2011	197,900	919,600	59,000	978,600
	2012	201,900	938,500	118,000	1,056,500
	2013	206,000	957,900	135,100	1,093,000
	2014	210,200	977,800	154,700	1,132,500
	2015	214,500	998,100	177,000	1,175,100
	2016	218,900	1,018,900	177,000	1,195,900
	2018	228,000	1,062,000	177,000	1,239,000
	2021	242,400	1,130,100	177,000	1,307,100
<b>Average Annual Growth Rates:</b>					
	1990-2009	3.3%	1.9%	n.a.	1.9%
	2009-2016	2.1%	2.3%	n.a.	4.7%
	2016-2021	2.1%	2.1%	0.0%	1.8%
	2009-2021	2.1%	2.2%	n.a.	3.5%

Notes: Adjusted R2 = 0.87; t-stat = 11.48; p-value = 0.000000001

Sources: Airport Records; Woods & Poole Economics, Inc. 2010; Landrum & Brown analysis

<sup>5</sup> Gross Regional Product (GRP) historical and forecast data from Woods & Poole Economics, Inc. 2010

**Non-Revenue, Charter, & Other**

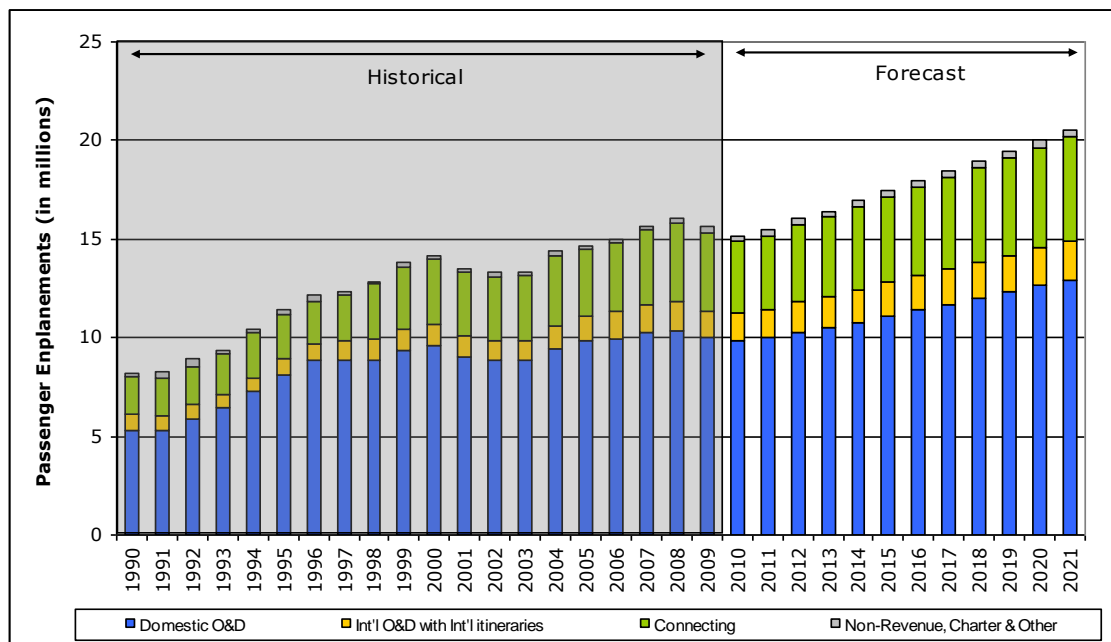
The airport reported total enplanements in 2008 that were 1.7 percent higher than the number of enplanements reported by the airlines to the U.S. Department of Transportation (DOT). This difference reflects non-scheduled charter and non-revenue traffic which is not reported to U.S. DOT. Non-revenue traffic includes airline employees and flight crew commuting to/from their assigned routes. It is assumed that this category of traffic is exclusively domestic in nature.

Since 1995, this traffic has accounted for between 1.0 and 3.4 percent of domestic O&D enplanements at Sea-Tac Airport. This category of traffic is forecast to maintain the same relationship at 2.9 percent of domestic O&D throughout the forecast period, resulting in 376,700 enplanements in 2021.

**2.2.3.2 Enplanements Forecast Summary**

A summary of the enplaned passenger forecast is shown on **Exhibit 2-2**. Total enplanements are forecast to increase from 15.6 million enplanements in 2009 to 20.5 million enplanements by 2021, an average annual growth rate of 2.3 percent. Domestic O&D enplanements are expected to continue to account for the largest share of passenger traffic throughout the forecast period, making up 66 percent of total enplanements in 2021. Passengers with international itineraries (either connecting through another gateway or flying non-stop from Sea-Tac Airport) will increase in share from 8.4 percent of total enplanements in 2009 to 9.5 percent in 2021.

**Exhibit 2-2  
ENPLANEMENTS FORECAST SUMMARY  
Seattle-Tacoma International Airport**



Source: Landrum & Brown analysis

For purposes of forecasting aircraft operations, the enplaned passenger forecast was segmented into air carrier and commuter categories for domestic and international traffic (see **Table 2-9**). The “bound for international destinations” segment is included in the domestic category because the immediate down line city on departure or up line city on arrival is in the continental U.S., Alaska, Hawaii, or a U.S. territory.

The forecast calls for domestic air carrier enplanements to grow at a rate of 2.1 percent annually over the forecast period and domestic commuter enplanements grow at a slightly higher rate of 2.6 percent. Air carrier enplanements made up about 85 percent of domestic activity in 2009; this split is expected to remain relatively unchanged through 2021.

Air carrier activity accounted for 68 percent of international activity in 2009. International air carrier enplanements are forecast to grow at a rate of 3.6 percent per annum through 2021 due to the expected introduction of new non-stop service to Latin America and Asia. The air carrier segment will make up 70 percent of international activity in 2021. International commuter enplanements are expected to average growth of 2.7 percent annually between 2009 and 2021.

**Table 2-9  
ENPLANEMENTS FORECAST BY AIR CARRIER AND COMMUTER  
Seattle-Tacoma International Airport**

Year	Domestic			International			Total		
	Air Carrier	Commuter	Total	Air Carrier	Commuter	Total	Air Carrier	Commuter	Total
<b>Actual</b>									
1995	9,266,842	1,303,830	10,570,672	511,958	307,891	819,849	9,778,800	1,611,721	11,390,521
2000	11,363,720	1,598,858	12,962,578	756,322	454,852	1,211,174	12,120,042	2,053,710	14,173,752
2005	11,845,337	1,562,596	13,407,933	844,329	379,835	1,224,164	12,689,666	1,942,431	14,632,097
2006	12,159,227	1,604,807	13,764,034	868,578	357,981	1,226,559	13,027,805	1,962,788	14,990,593
2007	12,433,289	1,880,038	14,313,327	918,231	429,625	1,347,856	13,351,520	2,309,663	15,661,183
2008	12,574,745	2,072,704	14,647,449	960,616	476,840	1,437,456	13,535,361	2,549,544	16,084,905
2009	12,251,188	2,044,830	14,296,018	891,808	422,361	1,314,169	13,142,996	2,467,191	15,610,187
<b>Forecast</b>									
2010	11,853,300	1,978,400	13,831,700	909,300	417,800	1,327,100	12,762,600	2,396,200	15,158,800
2016	13,825,800	2,379,600	16,205,400	1,235,300	546,590	1,781,890	15,061,100	2,926,190	17,987,290
2018	14,590,700	2,536,680	17,127,380	1,284,800	561,310	1,846,110	15,875,500	3,097,990	18,973,490
2021	15,802,600	2,788,640	18,591,240	1,363,300	584,280	1,947,580	17,165,900	3,372,920	20,538,820
<b>Average Annual Growth Rates:</b>									
1995-2009	2.0%	3.3%	2.2%	4.0%	2.3%	3.4%	2.1%	3.1%	2.3%
2009-2016	1.7%	2.2%	1.8%	4.8%	3.8%	4.4%	2.0%	2.5%	2.0%
2016-2021	2.7%	3.2%	2.8%	2.0%	1.3%	1.8%	2.7%	2.9%	2.7%
2009-2021	2.1%	2.6%	2.2%	3.6%	2.7%	3.3%	2.3%	2.6%	2.3%

Sources: Airport Records; Landrum & Brown analysis

In summary, domestic passenger traffic is forecast to increase at an average of 2.2 percent per year between 2009 and 2021. International passenger enplanements are forecast to increase at an average annual growth rate of 3.3 percent over the same period. Total enplanements are expected to increase from 15.6 million in 2009 to 20.5 million in 2021, an average annual growth rate of 2.3 percent.

## **2.2.4 COMMERCIAL PASSENGER OPERATION FORECAST**

The aggregate number of commercial operations at an airport depends on three factors: total passengers, average aircraft size, and average load factor (percent of seats occupied). The relationship is shown in the equation below.

$$\text{Operations} = \frac{\text{Total Passengers}}{\text{Average Load Factor} \times \text{Average Aircraft Size}}$$

After developing the enplanement projections, assumptions were developed for average aircraft size and load factor in order to develop operations counts at the air carrier and commuter level. Once the aggregate level operations forecasts were developed for air carrier and commuter activity, a top-down approach was employed to allocate these operations to aircraft groups and specific aircraft types. The fleet mix was developed to match aggregate level average seats per flight targets for air carrier and commuter categories. The detailed fleet mix also allowed for the calibration of those assumptions and, where appropriate, modifications were made prior to finalizing the assumptions presented below. The air carrier and commuter assumptions related to aircraft size and load factor are shown in **Table 2-10**.

**Table 2-10  
AIRCRAFT GAUGE AND LOAD FACTOR ASSUMPTIONS  
Seattle-Tacoma International Airport**

		<b>Gauge ( Average Seats Per Departure)</b>					
		<b>Domestic</b>			<b>International</b>		
<b>Year</b>		<b>Air Carrier</b>	<b>Commuter</b>	<b>Total</b>	<b>Air Carrier</b>	<b>Commuter</b>	<b>Total</b>
<u>Actual</u>							
	1995	152	31	106	243	38	110
	2000	148	37	102	261	41	91
	2005	151	47	120	230	44	102
	2006	152	47	121	235	46	102
	2007	153	53	123	229	54	109
	2008	153	57	125	221	63	116
	2009	154	65	129	223	67	120
<u>Forecast</u>							
	2010	150	68	127	227	67	122
	2016	152	73	132	228	67	126
	2018	153	73	132	228	67	127
	2021	153	73	132	229	67	128
<u>Average Annual Growth Rates:</u>							
	1995-2009	0.1%	5.4%	1.4%	-0.6%	4.2%	0.7%
	2009-2016	-0.1%	1.6%	0.3%	0.3%	0.1%	0.6%
	2016-2021	0.1%	0.0%	0.1%	0.1%	0.0%	0.4%
	2009-2021	0.0%	0.9%	0.2%	0.2%	0.0%	0.5%
		<b>Load Factor</b>					
		<b>Domestic</b>			<b>International</b>		
<b>Year</b>		<b>Air Carrier</b>	<b>Commuter</b>	<b>Total</b>	<b>Air Carrier</b>	<b>Commuter</b>	<b>Total</b>
<u>Actual</u>							
	1995	62.7%	68.9%	63.4%	38.2%	80.4%	47.6%
	2000	70.6%	56.5%	68.5%	60.3%	68.3%	63.1%
	2005	77.2%	77.2%	77.2%	72.8%	77.1%	74.1%
	2006	77.9%	81.9%	78.3%	78.4%	70.4%	75.9%
	2007	78.3%	79.9%	78.5%	79.6%	71.8%	77.0%
	2008	77.8%	85.8%	78.8%	82.1%	72.9%	78.8%
	2009	81.5%	80.3%	81.3%	82.1%	67.0%	76.5%
<u>Forecast</u>							
	2010	82.0%	80.3%	81.8%	82.1%	67.0%	76.6%
	2016	79.8%	80.3%	79.9%	80.7%	68.6%	76.5%
	2018	79.1%	80.3%	79.3%	80.2%	69.2%	76.5%
	2021	78.0%	80.3%	78.3%	79.5%	70.0%	76.4%
<u>Average Annual Growth Rates:</u>							
	1995-2000	2.4%	-3.9%	1.6%	9.6%	-3.2%	5.8%
	2000-2009	1.6%	4.0%	1.9%	3.5%	-0.2%	2.2%
	1995-2009	1.9%	1.1%	1.8%	5.6%	-1.3%	3.4%
	2009-2016	-0.3%	0.0%	-0.3%	-0.2%	0.3%	0.0%
	2016-2021	-0.5%	0.0%	-0.4%	-0.3%	0.4%	0.0%
	2009-2021	-0.4%	0.0%	-0.3%	-0.3%	0.4%	0.0%

Sources: Airport Records, *Official Airline Guide*; Landrum & Brown analysis.

### **Domestic Air Carrier Gauge and Load Factor Assumptions**

Domestic air carrier gauge increased from 152 in 1995 to 154 seats per departure in 2009. This reflects the historical deployment of narrow-body jet aircraft in the mid-1990s at Sea-Tac Airport in the 120 to 160 seat range, such as the Boeing 737s by Alaska, Southwest, Delta, American and Continental. Alaska Airlines, which accounts for the largest proportion of the domestic air carrier operations at Sea-Tac Airport, currently operates five series of B737 aircraft. Similarly, Southwest, the second largest air carrier airline at Sea-Tac Airport, currently operates three series of B737 aircraft at the Airport and has no stated plans to diversify its fleet in the future. Indeed, the assumed evolution of the domestic air carrier fleet at Sea-Tac Airport is primarily towards similarly sized, next generation replacement aircraft (e.g. Boeing 737-700 replacing the Boeing 737-300 or Boeing 737-800 replacing MD80 aircraft) rather than wholesale fleet changes. The following assumptions were made as a basis for the domestic air carrier commercial passenger operations forecast at Sea-Tac Airport:

- Alaska Airlines will continue to replace its B737-400s with B737-800s.
- Southwest will continue to replace its B737-300s and B737-500s with B737-700s.
- United Airlines will focus its Sea-Tac Airport fleet on A319s and A320s. United is expected to replace B757-200s with A320s by 2018.
- Delta is expected to replace B757-200s with B787-800s and B737-800s. MD90 operated by Delta will be replaced with A320s by 2018.
- MD80 operated by American Airlines will be replaced with B737-800s by 2018.
- B767-300s operated by Hawaiian Airlines is expected to be replaced with A330-200s by 2021.

As a result of these assumptions, the domestic air carrier gauge is expected to decrease from 154 seats in 2009 to 150 in 2010 and forecast to increase to 153 seats by 2021.

Domestic air carrier load factors have increased from 62.7 percent in 1995 to 81.5 percent in 2009. The average domestic air carrier load factor is expected to increase slightly to 82.0 percent in 2010, reflecting a continued tightening of airline capacity and then decline slightly reaching 78.0 percent in 2021.

### **Domestic Commuter Gauge and Load Factor Assumptions**

The domestic commuter gauge grew from 31 seats per departure in 1995 to 65 seats per departure in 2009 due to the increased deployment of regional jets at Sea-Tac Airport. In the mid-1990s, airlines used mainly small turboprop equipment (19-seat to 30-seat aircraft) such as Dash 8, British Aerospace Jetstream 31, Fairchild SA26 and Piper aircraft. By the beginning of the 21<sup>st</sup> century, the airlines had shifted from these small turboprop aircraft to larger 30-seat to 70-seat regional jet aircraft, such as the Q400 and CRJ7. In 2009, Horizon retired all of its Dash



8-100/200 (37-seat) aircraft and replaced them with the Q400 (74-seat). Horizon is planning to “transition to an all-Q400 fleet, but as market conditions have hindered the remarketing efforts on the CRJ-700 aircraft, Horizon is delaying the deliveries of Q400 until the market condition improved”.<sup>6</sup> Therefore, over the forecast period, Horizon will continue to deploy both Q400 and CRJ-700 aircraft at Sea-Tac Airport. United Express (SkyWest) is expected to replace all EMB-120 at Sea-Tac Airport with CRJ-700 aircraft by 2013. Domestic commuter load factors increased dramatically from 68.9 percent in 1995 to 80.3 percent in 2009.

Larger regional jets/turboprops in the 69-seat to 90-seat range are increasingly being used by airlines in the U.S. As a result of these assumptions, the average domestic commuter aircraft gauge is expected to increase to 73 seats per departure in 2021. Over the forecast period, the average load factor for domestic commuter activity is forecast to remain at 80.3 percent.

### **International Air Carrier Gauge and Load Factor Assumptions**

Since 1995, the international air carrier average seats per departure (ASPD) has varied significantly depending on the service offerings. International gauge has increased from 243 seats per departure in 1995 to 261 in 2000. This reflects the use of large aircraft such as B747, DC10 and MD11 in the mid-1990s, followed by a greater use of B737s by Alaska Airlines and B330s by Delta/Northwest and B777 by United and British Airways between 2000 and 2009. International air carrier load factors have increased from less than 50 percent in 1995 to 60.3 percent in 2000 and 82.1 percent in 2009.

International air carrier ASPD ratio is expected to increase from 223 seats in 2009 to 229 seats by 2021. International load factors are expected to decline slightly over the forecast period. The decline in international air carrier load factor is expected because the new services are assumed to have lower load factors than the existing service. The load factors for the new services include 75 percent load factor for service to Latin America and 80 percent load factor for service to Asia. The load factors for the existing international O&D service are expected to decline to 80.0 percent in 2021. As a result, International load factors are expected to decline to 79.5 percent in 2021.

### **International Commuter Gauge and Load Factor Assumptions**

Alaska and Air Canada Jazz are currently providing international commuter service at Sea-Tac Airport. Alaska Airlines operates its international commuter flights mainly to Canada using CRJ7 and Q400. Air Canada Jazz is also serving Canada using Dash8-100 and CRJ 100/200. Over the forecast period, it is assumed that the two carriers will continue to operate using the same fleet at Sea-Tac Airport. As a result, the international commuter ASPD is expected to remain at 67 seats through 2021. International commuter load factors are expected to increase from 67 percent in 2009 to 70 percent by 2021. **Table 2-11** provides a summary of the commercial passenger operations forecast at Sea-Tac Airport.

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<sup>6</sup> Alaska Airlines 10K SEC filing February 19, 2010

**Table 2-11  
COMMERCIAL PASSENGER OPERATIONS FORECAST  
Seattle-Tacoma International Airport**

Year	Domestic			International			Total		
	Air Carrier	Commuter	Total	Air Carrier	Commuter	Total	Air Carrier	Commuter	Total
<b>Actual</b>									
1995	194,400	120,600	315,000	11,000	20,400	31,400	205,400	141,000	346,400
2000	217,800	151,600	369,400	9,600	32,600	42,200	227,400	184,200	411,600
2005	203,170	85,332	288,502	10,076	22,332	32,408	213,246	107,664	320,910
2006	205,936	83,388	289,324	9,436	22,136	31,572	215,372	105,524	320,896
2007	207,570	88,292	295,862	10,086	22,018	32,104	217,656	110,310	327,966
2008	211,658	84,542	296,200	10,606	20,738	31,344	222,264	105,280	327,544
2009	195,540	77,796	273,336	9,742	18,792	28,534	205,282	96,588	301,870
<b>Forecast</b>									
2010	193,400	72,600	266,000	9,800	18,600	28,400	203,200	91,200	294,400
2016	227,400	81,000	308,400	13,400	23,600	37,000	240,800	104,600	345,400
2018	241,600	86,400	328,000	14,000	24,000	38,000	255,600	110,400	366,000
2021	264,400	95,000	359,400	15,000	24,800	39,800	279,400	119,800	399,200
<b>Average Annual Growth Rates:</b>									
1995-2000	2.3%	4.7%	3.2%	-2.7%	9.8%	6.1%	2.1%	5.5%	3.5%
2000-2009	-1.2%	-7.1%	-3.3%	0.2%	-5.9%	-4.3%	-1.1%	-6.9%	-3.4%
1995-2009	0.0%	-3.1%	-1.0%	-0.9%	-0.6%	-0.7%	0.0%	-2.7%	-1.0%
2009-2016	2.2%	0.6%	1.7%	4.7%	3.3%	3.8%	2.3%	1.1%	1.9%
2016-2021	3.1%	3.2%	3.1%	2.3%	1.0%	1.5%	3.0%	2.8%	2.9%
2009-2021	2.5%	1.7%	2.3%	3.7%	2.3%	2.8%	2.6%	1.8%	2.4%

Sources: Airport Records; Landrum & Brown analysis

The result of the foregoing assumptions regarding load factors and ASPD ratios is that domestic air carrier operations are forecast to grow from 195,540 operations in 2009 to 264,400 operations by 2021, representing average annual growth of 2.5 percent. Domestic commuter operations are expected to increase from 77,796 operations in 2009 to 95,000 operations by 2021 (average annual growth rate of 1.7 percent). International air carrier operations are expected to grow 3.7 percent per year from 9,742 operations to 15,000 operations by 2021 as a result of the expected introduction of Latin American and Asia services. International commuter operations are forecast to increase from 18,792 operations in 2009 to 24,800 operations by 2021. Total annual aircraft operations at Sea-Tac Airport are expected to increase from 301,870 in 2009 to 399,200 in 2021 averaging an average growth rate of 2.4 percent per year.

### **2.2.5 COMMERCIAL PASSENGER OPERATIONS FLEET MIX**

Once the operations forecast was developed for domestic air carrier, domestic commuter, international air carrier, and international commuter activity, these operations were allocated to aircraft groups and specific aircraft types. The fleet mix was developed to match the ASPD targets for each of the four components of commercial passenger demand presented in the previous subsections. The process of developing the fleet mix allowed for the calibration of those assumptions and, where appropriate, modifications were made prior to finalizing the assumptions presented in the preceding subsections. The allocation of domestic commercial passenger operations by aircraft type is shown in **Table 2-12**.

**Table 2-12  
DOMESTIC PASSENGER OPERATION FLEET MIX  
Seattle-Tacoma International Airport**

Aircraft Type	Acraft Gauge	Aircraft Operations						% of Domestic Operations					
		2000	2009	2010	2016	2018	2021	2000	2009	2010	2016	2018	2021
<b>Domestic Total</b>		<b>369,400</b>	<b>273,336</b>	<b>266,000</b>	<b>308,400</b>	<b>328,000</b>	<b>359,400</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Air Carrier</b>		<b>217,800</b>	<b>195,540</b>	<b>193,400</b>	<b>227,400</b>	<b>241,600</b>	<b>264,400</b>	<b>59.0%</b>	<b>71.5%</b>	<b>72.7%</b>	<b>73.7%</b>	<b>73.7%</b>	<b>73.6%</b>
<b>Wide Body Jet</b>		<b>12,570</b>	<b>2,777</b>	<b>2,790</b>	<b>3,080</b>	<b>3,150</b>	<b>3,240</b>	<b>3.4%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>0.9%</b>
B747-400	373	6	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B747	372	727	-	-	-	-	-	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
A330-200	305	-	-	-	-	796	2,048	0.0%	0.0%	0.0%	0.0%	0.2%	0.6%
A330-300	298	-	-	2	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
DC10	279	5,877	-	-	-	-	-	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%
B777	258	1,179	-	-	-	-	-	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
B767-400	246	-	4	2	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B767-300	240	4,115	2,621	2,699	2,997	2,303	-	1.1%	1.0%	1.0%	1.0%	0.7%	0.0%
B767	214	664	152	87	83	51	-	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%
B787	202	-	-	-	-	-	1,192	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
B767-200	168	2	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Narrow Body Jet</b>		<b>205,230</b>	<b>192,763</b>	<b>190,610</b>	<b>224,320</b>	<b>238,450</b>	<b>261,160</b>	<b>55.6%</b>	<b>70.5%</b>	<b>71.7%</b>	<b>72.7%</b>	<b>72.7%</b>	<b>72.7%</b>
B757-300	226	-	6,179	3,570	6,843	7,287	8,002	0.0%	2.3%	1.3%	2.2%	2.2%	2.2%
B757	183	28,559	9,363	6,915	793	-	-	7.7%	3.4%	2.6%	0.3%	0.0%	0.0%
A321	183	-	2,116	1,053	2,619	2,789	3,062	0.0%	0.8%	0.4%	0.8%	0.9%	0.9%
B757-200	182	-	9,067	6,264	-	-	-	0.0%	3.3%	2.4%	0.0%	0.0%	0.0%
B737-900	172	-	15,161	7,882	18,689	19,901	21,855	0.0%	5.5%	3.0%	6.1%	6.1%	6.1%
B727	170	680	-	-	-	-	-	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-800 (Winglets)	157	-	42,417	32,811	61,148	76,453	88,469	0.0%	15.5%	12.3%	19.8%	23.3%	24.6%
B737-800	155	5,716	7,336	9,919	20,335	22,510	24,970	1.5%	2.7%	3.7%	6.6%	6.9%	6.9%
MD90	150	8	977	612	-	-	-	0.0%	0.4%	0.2%	0.0%	0.0%	0.0%
B727-200	149	4,509	-	-	-	-	-	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-400 (Mixed Config)	148	-	1,408	1,490	812	-	-	0.0%	0.5%	0.6%	0.3%	0.0%	0.0%
A320	146	10,194	14,922	17,350	38,537	41,036	45,064	2.8%	5.5%	6.5%	12.5%	12.5%	12.5%
B737-400	144	40,001	21,757	38,530	12,548	3,577	-	10.8%	8.0%	14.5%	4.1%	1.1%	0.0%
MD83	140	-	8,044	5,430	-	-	-	0.0%	2.9%	2.0%	0.0%	0.0%	0.0%
MD80	140	53,951	-	2,771	-	-	-	14.6%	0.0%	1.0%	0.0%	0.0%	0.0%
A319/320	132	-	136	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-300	137	34,689	10,137	10,254	5,470	2,385	-	9.4%	3.7%	3.9%	1.8%	0.7%	0.0%
B737-700	131	14,519	32,299	33,071	43,603	49,968	55,962	3.9%	11.8%	12.4%	14.1%	15.2%	15.6%
A319	124	5,221	8,016	7,529	10,177	10,837	11,901	1.4%	2.9%	2.8%	3.3%	3.3%	3.3%
B737-700 (Winglets)	124	-	2	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-500	122	5,288	2,108	2,779	1,143	-	-	1.4%	0.8%	1.0%	0.4%	0.0%	0.0%
A318	120	-	295	137	-	-	-	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
B737 (Advanced)	114	753	-	-	-	-	-	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
B737 (Mixed Config)	111	1,142	-	-	-	-	-	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
B717	99	-	614	-	-	-	-	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
E190	98	-	409	2,243	1,603	1,707	1,875	0.0%	0.1%	0.8%	0.5%	0.5%	0.5%
<b>Commuter</b>		<b>151,600</b>	<b>77,796</b>	<b>72,600</b>	<b>81,000</b>	<b>86,400</b>	<b>95,000</b>	<b>41.0%</b>	<b>28.5%</b>	<b>27.3%</b>	<b>26.3%</b>	<b>26.3%</b>	<b>26.4%</b>
<b>Large Regional Jet</b>		<b>27,090</b>	<b>13,467</b>	<b>10,910</b>	<b>14,540</b>	<b>15,510</b>	<b>17,050</b>	<b>7.3%</b>	<b>4.9%</b>	<b>4.1%</b>	<b>4.7%</b>	<b>4.7%</b>	<b>4.7%</b>
CRJ-900	70	-	956	2,591	3,453	3,684	4,049	0.0%	0.3%	1.0%	1.1%	1.1%	1.1%
CRJ-700	68	-	12,511	8,319	11,087	11,826	13,001	0.0%	4.6%	3.1%	3.6%	3.6%	3.6%
F28	60	27,090	-	-	-	-	-	7.3%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Small Regional Jet</b>		<b>-</b>	<b>463</b>	<b>290</b>	<b>560</b>	<b>590</b>	<b>650</b>	<b>0.0%</b>	<b>0.2%</b>	<b>0.1%</b>	<b>0.2%</b>	<b>0.2%</b>	<b>0.2%</b>
CRJ-200	50	-	463	290	560	590	650	0.0%	0.2%	0.1%	0.2%	0.2%	0.2%
<b>Turboprop/prop</b>		<b>124,510</b>	<b>63,866</b>	<b>61,400</b>	<b>65,900</b>	<b>70,300</b>	<b>77,300</b>	<b>33.7%</b>	<b>23.4%</b>	<b>23.1%</b>	<b>21.4%</b>	<b>21.4%</b>	<b>21.5%</b>
DHC8-400	74	-	52,431	52,692	65,900	70,300	77,300	0.0%	19.2%	19.8%	21.4%	21.4%	21.5%
DHC8-100/200	37	72,827	-	-	-	-	-	19.7%	0.0%	0.0%	0.0%	0.0%	0.0%
EMB-120	30	40,604	7,716	8,708	-	-	-	11.0%	2.8%	3.3%	0.0%	0.0%	0.0%
Cessna (Single Turboprop)	11	11,079	-	-	-	-	-	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cessna (Light Aircraft)	8	-	3,719	-	-	-	-	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%

Sources: Airport Records; Official Airline Guide; Landrum & Brown analysis

Over the forecast period, wide-body jet activities at Sea-Tac Airport are expected to decline from 1.0 percent in 2009 to 0.9 percent in 2021. Narrow-body jet operations are expected to continue to account for the largest share of domestic passenger aircraft fleet in 2021.

- B737-400s operated by Alaska Airlines will continue to be replaced with B737-800s.
- B737-300s and B737-500s operated by Southwest Airlines will continue to be replaced with B737-700s.

- B737-300s and B737-500s operated by United Airlines were replaced with A319s in 2009. B757-200s operated by United are expected to be replaced with A320s by 2018.
- B757-200s operated by Delta are expected to be replaced with B787-800s and B737-800s. MD90 operated by Delta will be replaced with A320s by 2018.
- MD80 operated by American Airlines will be replaced with B737-800s by 2018.
- B767-300s operated by Hawaiian Airlines are expected to be replaced with A330-200s by 2021.

Domestic commuter aircraft fleet is expected to remain relatively the same as the 2009 fleet. Alaska Airlines replaced all of the Dash 8-100/200 (37 seat-aircraft) with Q400 (74 seat-aircraft) at Sea-Tac Airport in 2009. Q400 aircraft operated by Alaska Airlines are expected to continue to account for the largest share of more than 85 percent of domestic commuter aircraft through 2021. EMB 120 operated by United Express (SkyWest) at Sea-Tac Airport is expecting to be replaced with CRJ-700 aircraft by 2013.

**Table 2-13** presents international commercial passenger operations by aircraft type. The international passenger aircraft fleet is expected to remain generally unchanged and commuter aircraft will continue to account for the largest share of international passenger aircraft fleet.

In 2010, Northwest/Delta is replacing all of the A330-200 aircraft from its international fleet at Sea-Tac Airport with A330-300 and B767 aircraft. Alaska Airlines continues to replace B737-400 with B737-800. Other airlines will continue using the same aircraft fleets.

**Table 2-13  
INTERNATIONAL PASSENGER OPERATION FLEET MIX  
Seattle-Tacoma International Airport**

Aircraft Type	Acft. Gauge	Aircraft Operations						% of International Operations					
		2000	2009	2010	2016	2018	2021	2000	2009	2010	2016	2018	2021
<b>International Total</b>		<b>42,200</b>	<b>28,534</b>	<b>28,400</b>	<b>37,000</b>	<b>38,000</b>	<b>39,800</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Air Carrier</b>		<b>9,600</b>	<b>9,742</b>	<b>9,800</b>	<b>13,400</b>	<b>14,000</b>	<b>15,000</b>	<b>22.7%</b>	<b>34.1%</b>	<b>34.5%</b>	<b>36.2%</b>	<b>36.8%</b>	<b>37.7%</b>
<b>Wide Body Jet</b>		<b>7,810</b>	<b>6,551</b>	<b>7,250</b>	<b>9,370</b>	<b>9,790</b>	<b>10,490</b>	<b>18.5%</b>	<b>23.0%</b>	<b>25.5%</b>	<b>25.3%</b>	<b>25.8%</b>	<b>26.4%</b>
B747	372	3,152	174	207	238	245	257	7.5%	0.6%	0.7%	0.6%	0.6%	0.6%
747-400 (Mixed Config)	367	352	-	-	-	-	-	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
B777-300ER	316	-	282	305	372	389	418	0.0%	1.0%	1.1%	1.0%	1.0%	1.1%
B777-200	301	-	479	494	641	667	710	0.0%	1.7%	1.7%	1.7%	1.8%	1.8%
B747-400	299	69	493	423	902	944	1,014	0.2%	1.7%	1.5%	2.4%	2.5%	2.5%
DC10	273	1,428	-	-	-	-	-	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%
A330-300	273	-	1,740	2,110	2,907	3,043	3,270	0.0%	6.1%	7.4%	7.9%	8.0%	8.2%
A340-300	272	-	316	81	131	223	348	0.0%	1.1%	0.3%	0.4%	0.6%	0.9%
B777	268	1,697	1,644	1,499	1,833	1,915	2,052	4.0%	5.8%	5.3%	5.0%	5.0%	5.2%
B767-300	244	814	-	-	-	-	-	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%
A330	222	-	333	319	430	454	494	0.0%	1.2%	1.1%	1.2%	1.2%	1.2%
A330-200	219	-	912	528	569	500	413	0.0%	3.2%	1.9%	1.5%	1.3%	1.0%
B767	214	298	-	833	1,113	1,165	1,251	0.7%	0.0%	2.9%	3.0%	3.1%	3.1%
B757-200 (Winglets)	189	-	178	451	234	245	263	0.0%	0.6%	1.6%	0.6%	0.6%	0.7%
<b>Narrow Body Jet</b>		<b>1,790</b>	<b>3,191</b>	<b>2,550</b>	<b>4,030</b>	<b>4,210</b>	<b>4,510</b>	<b>4.2%</b>	<b>11.2%</b>	<b>9.0%</b>	<b>10.9%</b>	<b>11.1%</b>	<b>11.3%</b>
B757-300	236	-	14	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B757-200	182	-	-	2	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
A321	176	-	6	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-900	172	-	609	229	803	842	902	0.0%	2.1%	0.8%	2.2%	2.2%	2.3%
B737-800 (Winglets)	157	-	922	439	1,155	1,309	1,474	0.0%	3.2%	1.5%	3.1%	3.4%	3.7%
B737-800	150	-	10	-	443	463	497	0.0%	0.0%	0.0%	1.2%	1.2%	1.2%
A320	146	418	-	-	-	-	-	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B737-400	144	513	120	557	159	55	-	1.2%	0.4%	2.0%	0.4%	0.1%	0.0%
MD80	140	323	-	-	-	-	-	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
B737	124	-	395	20	-	-	-	0.0%	1.4%	0.1%	0.0%	0.0%	0.0%
B737-700	124	137	274	425	362	378	406	0.3%	1.0%	1.5%	1.0%	1.0%	1.0%
A319	120	399	-	-	-	-	-	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%
E190	93	-	841	878	1,108	1,163	1,231	0.0%	2.9%	3.1%	3.0%	3.1%	3.1%
<b>Commuter</b>		<b>32,600</b>	<b>18,792</b>	<b>18,600</b>	<b>23,600</b>	<b>24,000</b>	<b>24,800</b>	<b>77.3%</b>	<b>65.9%</b>	<b>65.5%</b>	<b>63.8%</b>	<b>63.2%</b>	<b>62.3%</b>
<b>Large Regional Jet</b>		<b>4,720</b>	<b>2,890</b>	<b>2,000</b>	<b>1,820</b>	<b>1,850</b>	<b>1,910</b>	<b>11.2%</b>	<b>10.1%</b>	<b>7.0%</b>	<b>4.9%</b>	<b>4.9%</b>	<b>4.8%</b>
CRJ-700	70	-	2,890	2,000	1,820	1,850	1,910	0.0%	10.1%	7.0%	4.9%	4.9%	4.8%
F28	60	4,720	-	-	-	-	-	11.2%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Small Regional Jet</b>		<b>-</b>	<b>1,298</b>	<b>1,300</b>	<b>1,680</b>	<b>1,650</b>	<b>1,690</b>	<b>0.0%</b>	<b>4.5%</b>	<b>4.6%</b>	<b>4.5%</b>	<b>4.3%</b>	<b>4.2%</b>
CRJ-200	50	-	1,298	1,300	1,680	1,650	1,690	0.0%	4.5%	4.6%	4.5%	4.3%	4.2%
<b>Turboprop</b>		<b>27,880</b>	<b>14,604</b>	<b>15,300</b>	<b>20,100</b>	<b>20,500</b>	<b>21,200</b>	<b>66.1%</b>	<b>51.2%</b>	<b>53.9%</b>	<b>54.3%</b>	<b>53.9%</b>	<b>53.3%</b>
DHC8-400	74	-	11,007	11,619	15,573	15,883	16,425	0.0%	38.6%	40.9%	42.1%	41.8%	41.3%
DHC8-300	50	3,587	3,597	3,681	4,527	4,617	4,775	8.5%	12.6%	13.0%	12.2%	12.2%	12.0%
DHC8-100/200	37	19,564	-	-	-	-	-	46.4%	0.0%	0.0%	0.0%	0.0%	0.0%
DHC8-100	37	506	-	-	-	-	-	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
EMB-120	30	4,223	-	-	-	-	-	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Sources: Airport Records; Official Airline Guide; Landrum & Brown analysis

## **2.3 AIR CARGO**

This chapter presents an overview of the air cargo industry, historical trends in air cargo at Sea-Tac Airport, and air cargo forecasts for the key years of 2018 and 2021, with 2009 as the base year.

### **2.3.1 AIR CARGO INDUSTRY**

The air cargo industry has experienced many changes in the last decade. The general U.S. economic downturn that began in 2000 adversely affected U.S. air cargo activity. After the terrorist attacks of September 11, 2001, cargo activity in the U.S. was immediately impacted. Critical impacts included an increased use of trucks, an escalation of insurance costs, consolidation among smaller firms, failure of many small cargo airlines and smaller support firms, higher security costs, longer processing time because of security, and increased available freighter capacity which drove down rates. The cargo industry recovered by 2003 and posted strong growth for several years.

Growth in U.S. air cargo activity began to slow down in 2006 as the price of oil began to rise to record high levels (ultimately peaking at \$145 per barrel in July 2008), causing shipping by other modes to become more attractive. While oil prices declined significantly in the 4<sup>th</sup> quarter of 2008, economic activity deteriorated in late 2008 and the resulting global recession limited the positive impact of the lower oil prices. In fact, FedEx, the largest all-cargo carrier at Sea-Tac Airport experienced a decrease in domestic volumes in 2008 and in 2009. FedEx reports on a fiscal year ending May 31. FedEx Express average daily domestic volumes for Fiscal Year 2009 (June 1, 2008 through May 31, 2009) were down 13 percent over Fiscal Year 2008. Average daily international volumes declined by only 2.4 percent in Fiscal Year 2009, but the international segment makes up only about one third of the average daily total volumes. Average daily domestic volumes for the first three quarters of Fiscal Year 2010 (June 1, 2009 through February 28, 2010) were down only 1.6 percent over the same period last year.<sup>7</sup> **Exhibit 2-3** illustrates the historical growth by U.S. cargo carriers as measured in revenue ton miles (RTMs). U.S. revenue ton miles declined 3 percent from 2007 to 2008 and declined 21 percent between 2008 and 2009.

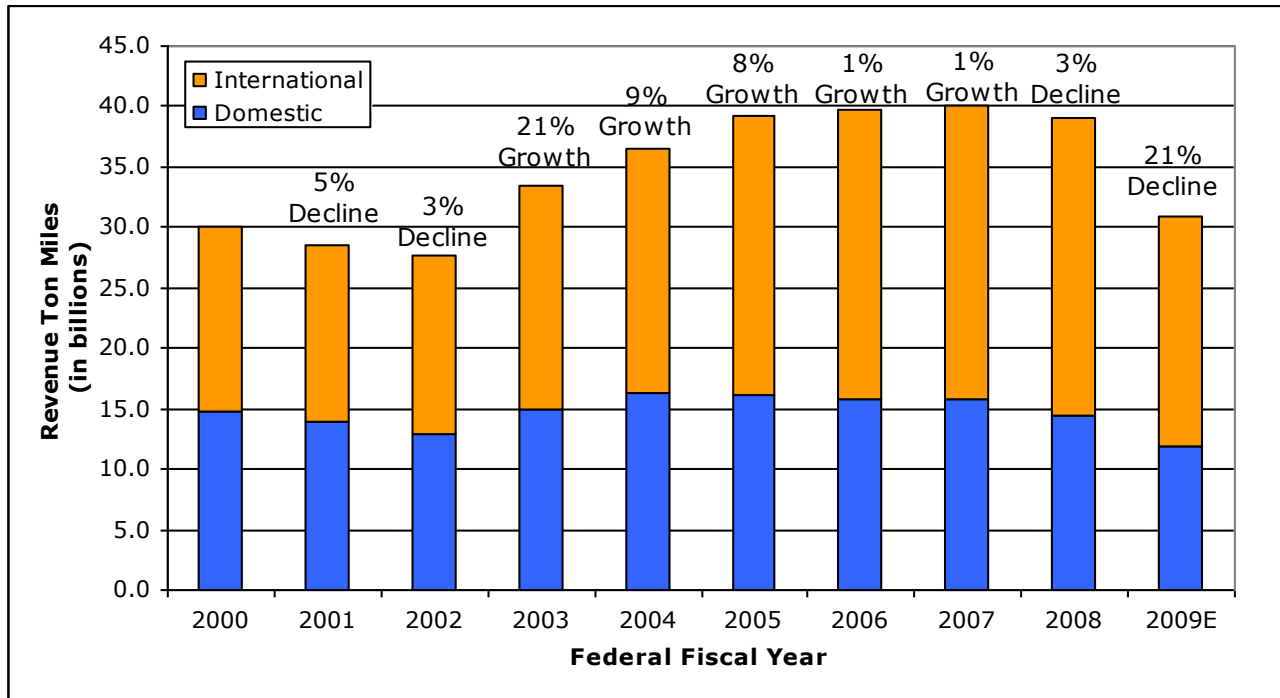
The impact of high oil prices and the economic recession is not limited to the U.S. According to Boeing statistics, growth in world air cargo traffic in the 2005 to 2007 timeframe marked "the weakest growth period for the industry since the first Gulf War, 1990-1992."<sup>8</sup> World air cargo traffic, as measured in revenue ton kilometers (RTKs), increased by 1.7 percent in 2005, 3.2 percent in 2006, and 5.1 percent in 2007. Although growth in world cargo traffic in 2005 to 2007 was slower than in the past, it was still positive growth. Worldwide cargo activities for 2008 and 2009 were not available at the time of this analysis, however, early reports from the carriers "point to either continuing weak or negative growth."<sup>9</sup>

<sup>7</sup> FedEx Corporation Financial and Operating Statistics, Third Quarter Fiscal 2010, March 18, 2010

<sup>8</sup> Boeing World Air Cargo Forecast 2008-2009, Introduction

<sup>9</sup> Boeing World Air Cargo Forecast 2008-2009, Introduction

**Exhibit 2-3  
HISTORICAL REVENUE TON MILES  
U.S. COMMERCIAL CARGO CARRIERS**

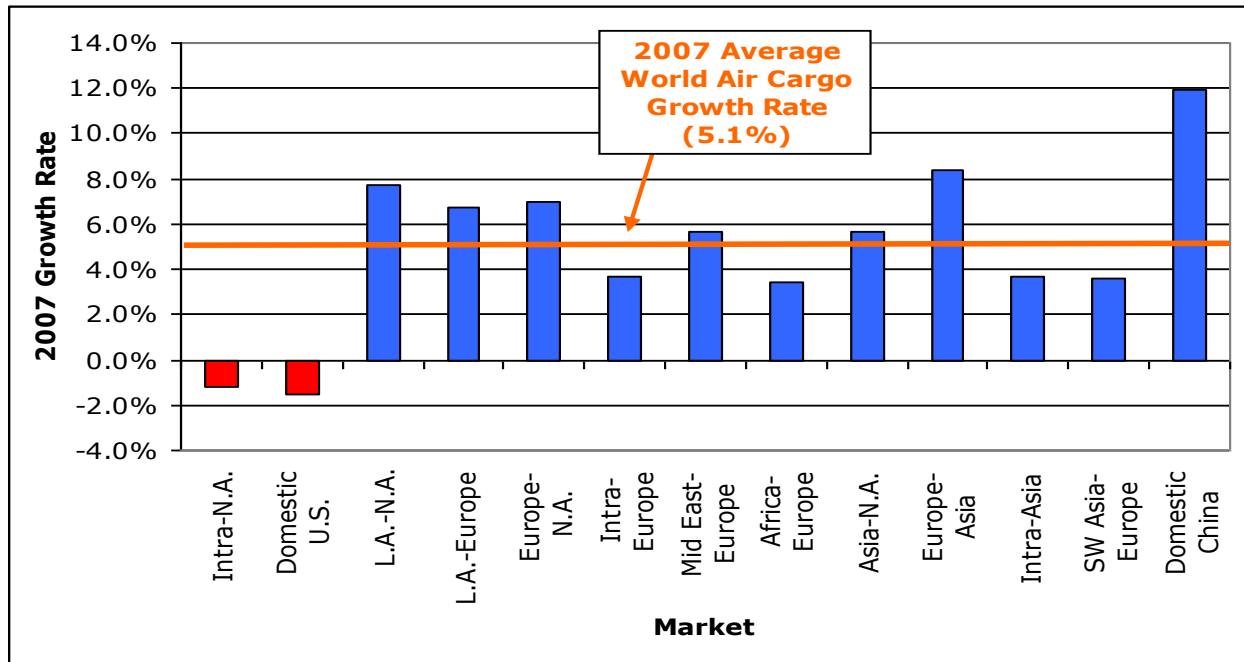


H:\STL\Aviation Forecast\Cargo Forecast\[Other cargo forecasts.xls]comp to STL

Sources: FAA Aerospace Forecast, Fiscal Years 2009-2025 and 2010-2030; Landrum & Brown analysis

In contrast, intra-North America cargo traffic shrunk by 1.2 percent and the domestic U.S. market declined by 1.5 percent in 2007 (see **Exhibit 2-4**). International shipments to and from the U.S. increased as the Latin America-North America, Europe-North America, and Asia-North America markets all experienced growth in 2007 that exceeded the world average. The highest growth market in 2007 was the domestic China market (almost 12 percent growth over 2006).

**Exhibit 2-4  
2007 AIR CARGO GROWTH BY MAJOR MARKET  
(Revenue Ton Kilometers)**



Sources: Boeing World Air Cargo Forecast 2008-2009; Landrum & Brown analysis



**2.3.2 HISTORICAL AIR CARGO TRAFFIC**

Air cargo volumes handled at Sea-Tac Airport increased at an average growth rate of 3.8 percent per year from 313,460 metric tons in 1990 to 456,920 metric tons in 2000. Since 2000, air cargo tonnage at Sea-Tac Airport has been declining; reaching 269,337 metric tons in 2009 (see **Table 2-14**). Domestic air cargo accounted for more than 70 percent of the traffic at Sea-Tac Airport. In 2009, about 65 percent of air cargo at Sea-Tac Airport was carried by all-cargo operators while the remainder was transported in the belly compartments of passenger aircraft. Belly cargo declined significantly between 2004 and 2009 at an average annual rate of 7.6 percent per year. All-cargo tonnage has been declining at a slower rate of just 3.3 percent per year over the same period.

**Table 2-14  
AIR CARGO TONNAGE (FREIGHT & MAIL; IN METRIC TONS)  
Seattle-Tacoma International Airport**

Year	Air Cargo (in metric tons)			Percent All-cargo
	Total	Belly	All-cargo	
1990	313,460	n.a.	n.a.	
1995	408,198	n.a.	n.a.	
2000	456,920	n.a.	n.a.	
2001	401,535	n.a.	n.a.	
2002	374,753	n.a.	n.a.	
2003	351,418	n.a.	n.a.	
2004	347,517	140,224	207,293	59.6%
2005	338,590	132,800	205,790	60.8%
2006	341,984	125,465	216,519	63.3%
2007	319,013	120,872	198,141	62.1%
2008	290,768	107,977	182,791	62.9%
2009	269,337	94,471	174,866	64.9%
<u>Average Annual Growth Rates:</u>				
1990-2000	3.8%			
2000-2009	-5.7%			
2004-2009	-5.0%	-7.6%	-3.3%	1.7%
1990-2009	-0.8%			

Note: Belly/all-cargo splits estimated based on "All-cargo and total landed weight by airline" airport records.

Sources: Airport Records; Landrum & Brown analysis

**Table 2-15** presents freight tonnage by operation type and airline. According to airport records, FedEx is the largest all-cargo operator at Sea-Tac Airport and accounted for 42.4 percent of total freight handled in 2009. Alaska is the largest belly cargo operator and accounted for 10.7 percent of total freight in 2009. Nearly 80 percent of Alaska’s total freight was carried in the belly of passenger flights.

**Table 2-15  
FREIGHT TONNAGE BY AIRLINE (IN METRIC TONS)  
Seattle-Tacoma International Airport**

		<b>All-Cargo Freight Tonnage</b>						<b>2009</b>	<b>AAG</b>
<b>Rank</b>	<b>Airline</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>% Share</b>	<b>04-09</b>
1	Fedex	106,791	114,379	114,485	112,586	103,417	97,695	43.3%	-1.8%
2	China Airlines	5,692	5,285	4,517	5,165	4,526	10,178	4.5%	12.3%
3	Korean Airlines	-	-	8,754	14,533	12,824	9,873	4.4%	n.a.
4	Cargolux	13,057	12,607	13,333	13,414	11,800	9,353	4.1%	-6.5%
5	EVA Air	315	189	101	323	5,931	6,883	3.0%	85.3%
6	Alaska	6,936	9,165	8,299	7,795	6,063	5,000	2.2%	-6.3%
7	Martinair Holland	9,020	9,371	9,390	9,167	7,129	4,996	2.2%	-11.1%
	Other	28,287	22,086	24,185	5,179	2,905	2,665	1.2%	-37.7%
	<b>Total</b>	<b>170,098</b>	<b>173,082</b>	<b>183,064</b>	<b>168,162</b>	<b>154,595</b>	<b>146,643</b>	<b>64.9%</b>	<b>-2.9%</b>
		<b>Belly Freight Tonnage</b>						<b>2009</b>	<b>AAG</b>
<b>Rank</b>	<b>Airline</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>% Share</b>	<b>04-09</b>
1	Alaska	23,604	20,589	17,453	15,619	16,247	19,093	8.5%	-4.2%
2	Northwest	12,568	14,113	11,360	12,261	12,052	8,492	3.8%	-7.5%
3	British Airways	8,922	6,720	7,059	8,173	8,729	6,855	3.0%	-5.1%
4	United	15,624	14,357	16,161	12,519	7,747	6,660	2.9%	-15.7%
5	Southwest	6,472	7,350	7,527	7,582	8,313	5,911	2.6%	-1.8%
6	Delta	12,034	11,707	9,314	8,227	6,799	5,603	2.5%	-14.2%
7	Lufthansa	-	-	-	-	3,124	4,113	1.8%	n.a.
8	Hawaiian	5,059	5,201	4,944	5,290	4,945	3,811	1.7%	-5.5%
9	Continental	4,002	3,746	3,905	3,994	3,123	3,289	1.5%	-3.8%
10	Air France	-	-	-	1,645	2,978	3,129	1.4%	n.a.
	Other	26,779	27,910	28,356	27,274	17,264	12,268	5.4%	-14.5%
	<b>Total</b>	<b>115,064</b>	<b>111,693</b>	<b>106,079</b>	<b>102,584</b>	<b>91,321</b>	<b>79,224</b>	<b>35.1%</b>	<b>-7.2%</b>
<b>Total Freight Tonnage</b>		<b>285,162</b>	<b>284,775</b>	<b>289,143</b>	<b>270,746</b>	<b>245,916</b>	<b>225,867</b>	<b>100.0%</b>	<b>-4.6%</b>

Notes: Freight tonnage does not include mail; Belly/all-cargo splits are estimated based on carrier detail from airport records

AAG= average annual growth rates

Sources: Airport Records; Landrum & Brown analysis

**2.3.3 AIR CARGO TONNAGE FORECAST**

The FAA, Boeing, and Airbus forecasts expect domestic growth to range from 2.6 percent to 3.0 percent annually. The Boeing forecast predicts the U.S. domestic market will grow at a rate of 2.9 percent annually between 2007 and 2017 and 2.3 percent through 2027 in the base scenario. All-cargo and belly tonnages were forecast separately.

All-cargo tonnage was divided into FedEx and other. In 2010, cargo tonnage at Sea-Tac Airport is expected to remain at the 2009 level. Cargo tonnage handled by FedEx is expected to increase at Boeing growth rates and half of the Boeing growth rate is expected for other all-cargo operators. By applying the growth rates, all-cargo tonnage is expected to reach 223,700 metric tons in 2021 averaging an annual growth rate of 2.1 percent between 2009 and 2021 (see **Table 2-16**).

Air cargo tons per operation are expected to remain at the 2009 level throughout the forecast period. As a result, cargo operations are forecast to increase to 12,140 in 2021 with an average annual growth rate of 1.8 percent.

**Table 2-16  
ALL- CARGO FORECAST (FREIGHT & MAIL; IN METRIC TONS)  
Seattle-Tacoma International Airport**

	Year	All-cargo Tonnage			Tons per operation			All-cargo operations		
		FedEx	Other	Total	FedEx	Other	Total	FedEx	Other	Total
<b>Actual</b>	2004	130,142	77,151	207,293	22.0	11.6	16.5	5,904	6,678	12,582
	2005	135,994	69,796	205,790	21.0	12.8	17.3	6,470	5,432	11,902
	2006	135,407	81,112	216,519	21.0	14.3	17.8	6,460	5,670	12,130
	2007	132,657	65,484	198,141	20.6	16.5	19.0	6,426	3,978	10,404
	2008	122,279	60,512	182,791	19.6	18.0	19.0	6,240	3,366	9,606
	2009	116,497	58,369	174,866	19.8	14.8	17.8	5,874	3,942	9,816
<b>Forecast</b>	2010	116,500	58,400	174,900	19.9	14.8	17.8	5,860	3,940	9,800
	2016	138,400	63,700	202,100	20.3	14.8	18.2	6,830	4,300	11,130
	2018	145,700	65,300	211,000	20.4	14.8	18.3	7,140	4,410	11,550
	2021	156,000	67,700	223,700	20.6	14.8	18.4	7,570	4,570	12,140
<b>Average Annual Growth Rates:</b>										
	2004-2009	-2.2%	-5.4%	-3.3%	-2.1%	5.1%	1.6%	-0.1%	-10.0%	-4.8%
	2009-2016	2.5%	1.3%	2.1%	0.3%	0.0%	0.3%	2.2%	1.2%	1.8%
	2016-2021	2.4%	1.2%	2.1%	0.3%	0.0%	0.3%	2.1%	1.2%	1.8%
	2009-2021	2.5%	1.2%	2.1%	0.3%	0.0%	0.3%	2.1%	1.2%	1.8%

Sources: Airport Records; Landrum & Brown analysis

The share of belly cargo at Sea-Tac Airport has declined from more than 40 percent in 2004 to 35 percent in 2009. This reduction in belly cargo share is consistent with national trends. According to FAA statistics, the domestic U.S. belly cargo share has declined from 30 percent in 2000 to 14 percent in 2009. The FAA predicts that the belly cargo share for the U.S. as a whole will continue to decline and reach 10 percent in 2030 due to increases in the capacity of cargo aircraft and new security regulations.<sup>10</sup>

<sup>10</sup> FAA Aerospace Forecasts, Fiscal Years 2010-2030

As a result, belly cargo volumes at Sea-Tac Airport are forecast to drop to 26 percent of total air cargo tonnage by 2021. Belly cargo tonnage will decrease from 94,471 metric tons in 2009 to 77,800 tons in 2021 averaging a declining rate of 1.6 percent per year (see **Table 2-17**). The total air cargo tonnage at Sea-Tac Airport is expected to be 301,500 metric tons in 2021.

**Table 2-17  
TOTAL CARGO TONNAGE (FREIGHT & MAIL; IN METRIC TONS)  
Seattle-Tacoma International Airport**

	Year	Total Tonnage			% Belly
		All-cargo	Belly	Total	
Actual	2004	207,293	140,224	347,517	40.4%
	2005	205,790	132,800	338,590	39.2%
	2006	216,519	125,465	341,984	36.7%
	2007	198,141	120,872	319,013	37.9%
	2008	182,791	107,977	290,768	37.1%
	2009	174,866	94,471	269,337	35.1%
Forecast	2010	174,900	93,000	267,900	34.7%
	2016	202,100	84,400	286,500	29.5%
	2018	211,000	81,700	292,700	27.9%
	2021	223,700	77,800	301,500	25.8%
	<b>Average Annual Growth Rates:</b>				
2004-2009		-3.3%	-7.6%	-5.0%	-2.8%
2009-2016		2.1%	-1.6%	0.9%	-2.5%
2016-2021		2.1%	-1.6%	1.0%	-2.6%
2009-2021		2.1%	-1.6%	0.9%	-2.5%

Sources: Airport Records; Landrum & brown analysis

### **2.3.4 AIR CARGO OPERATION FLEET MIX**

The air cargo tonnage forecast for the all-cargo operators was used to derive the all-cargo operations forecast, based on assumptions regarding the amount of air cargo tonnage handled per operation. Historical all-cargo operations by aircraft type were analyzed to better understand the fleet mix for the all-cargo carriers at Sea-Tac Airport. Additionally, aircraft orders for FedEx, the dominant cargo carrier at Sea-Tac Airport, were analyzed to evaluate how the cargo fleet mix might evolve in the future. Ultimately, these analyses allowed for the projection of all-cargo operations by aircraft type.

FedEx currently operates mainly MD10 and Cessna 208s at Sea-Tac Airport. Based on a review of fleet plans for FedEx, no major changes in the carriers' fleet deployment at Sea-Tac Airport are expected over the forecast period. In 2008, FedEx began phasing out all its B727s and A310-200s. In addition, the five remaining DC10s will be replaced by MD10s by 2011. The Cessna 208, operated by Empire Airlines (FedEx feeder), is expected to maintain relatively the same allocation throughout the forecast period.

Based on these fleet assumptions, the share of wide-body aircraft is forecast to increase from 41 percent of cargo fleet in 2005 to 65 percent by 2021, mainly due to the larger deployment of A300s and MD-10F by FedEx. Narrow-body aircraft are expected to decline to 0.7 percent of the cargo fleet by 2021. Turboprops are expected to remain relatively the same as the 2009 level.

As a result, all-cargo operations are forecast to increase from 9,816 in 2009 to 12,140 in 2021. This increase represents a 1.8 percent average annual growth rate.

**Table 2-18  
ALL-CARGO OPERATION FLEET MIX  
Seattle-Tacoma International Airport**

Aircraft	Aircraft Operations				% of Total			
	2005	2009	2016	2021	2005	2009	2016	2021
<b>Total</b>	<b>11,902</b>	<b>9,816</b>	<b>11,130</b>	<b>12,140</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Widebody Jet</b>	<b>4,920</b>	<b>5,887</b>	<b>7,270</b>	<b>7,870</b>	<b>41.3%</b>	<b>60.0%</b>	<b>65.3%</b>	<b>64.8%</b>
A300-600F	946	539	630	700	7.9%	5.5%	5.7%	5.8%
A310F	74	-	-	-	0.6%	0.0%	0.0%	0.0%
B747F	996	3,042	3,940	4,190	8.4%	31.0%	35.4%	34.5%
B767-200/300F	73	10	10	10	0.6%	0.1%	0.1%	0.1%
B777F	-	-	-	-	0.0%	0.0%	0.0%	0.0%
MD-10F	2,065	1,764	2,050	2,270	17.4%	18.0%	18.4%	18.7%
MD-11F	766	532	640	700	6.4%	5.4%	5.8%	5.8%
<b>Narrowbody Jet</b>	<b>3,056</b>	<b>686</b>	<b>90</b>	<b>90</b>	<b>25.7%</b>	<b>7.0%</b>	<b>0.8%</b>	<b>0.7%</b>
B757-200F	14	4	10	10	0.1%	0.0%	0.1%	0.1%
B727F	699	-	-	-	5.9%	0.0%	0.0%	0.0%
B737F	2,071	670	70	70	17.4%	6.8%	0.6%	0.6%
DC-9F	13	12	10	10	0.1%	0.1%	0.1%	0.1%
DC-8F	255	-	-	-	2.1%	0.0%	0.0%	0.0%
L100-30F	2	-	-	-	0.0%	0.0%	0.0%	0.0%
MD-80F	2	-	-	-	0.0%	0.0%	0.0%	0.0%
<b>Turboprop</b>	<b>3,926</b>	<b>3,243</b>	<b>3,770</b>	<b>4,180</b>	<b>33.0%</b>	<b>33.0%</b>	<b>33.9%</b>	<b>34.4%</b>
ANTONOV 12	3	1	-	-	0.0%	0.0%	0.0%	0.0%
ATR-42	-	186	200	220	0.0%	1.9%	1.8%	1.8%
ATR-72	-	94	100	110	0.0%	1.0%	0.9%	0.9%
BEECH 18	524	419	490	540	4.4%	4.3%	4.4%	4.4%
CESSNA 208	3,154	2,543	2,980	3,310	26.5%	25.9%	26.8%	27.3%
F-27	245	-	-	-	2.1%	0.0%	0.0%	0.0%

Sources: Airport Records; USDOT, Schedule T-100; Landrum & Brown analysis

## **2.4 AIR TAXI AND GENERAL AVIATION**

This section includes all operations which are not considered commercial, cargo, or military operations. Air taxi activity typically includes “for hire” aircraft chartered for specific trips on an on-demand basis. Air taxi operations are usually made up of larger General Aviation (GA) aircraft, such as large turboprop aircraft and an array of corporate jets. GA activity includes diverse uses that can range from recreational flying, flight training activities, business travel, news reporting, traffic observation, police patrol, emergency medical flights, and even crop dusting.

Air taxi and general aviation operations can be subdivided into two major subcategories: “itinerant” and “local” based on FAA classifications. Local operations are defined by the FAA as “operations remaining in the local traffic pattern, simulated instrument approaches at the Airport...and operations to or from the Airport and a practice area within a 20-mile radius of the tower.”<sup>11</sup> Itinerant operations are all operations not classified as “local”.

### **2.4.1 NATIONAL TRENDS**

The FAA’s forecast<sup>12</sup> projects the following trends in the U.S. general aviation industry from 2009 to 2030:

- The number of active general aviation aircraft is forecast to increase by 0.9 percent annually.
- Growth of 2.5 percent per annum is expected in the number of general aviation hours flown.
- The number of student pilots is expected to decline by 1.5 percent per annum through 2010 and then increase at a rate of 0.6 percent annually through 2030.
- General aviation operations at airports with air traffic control service are forecast to decline by 3.1 percent annually through 2010 before increasing by 1.3 percent annually through 2030.

### **2.4.2 HISTORICAL TRENDS**

Sea-Tac Airport is a primary commercial service airport, serving 317,873 total annual operations in 2009, with air taxi and general aviation activities making up 2 percent of total operations. Air taxi and general aviation activities make up a relatively small percentage of the operations at Sea-Tac Airport because general aviation pilots often prefer not to operate at commercial service airports due to the congestion that typically occurs at these airports, the differences in approach speeds between general aviation aircraft and commercial aircraft, and wake turbulence issues.

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<sup>11</sup> FAA Order 7210.3, Facility Operation and Administration, Section 2, Airport Operations Count

<sup>12</sup> FAA Aerospace Forecast, Fiscal Years 2010-2030

Air taxi and general aviation operations at Sea-Tac Airport declined from 18,136 in 2004 to 6,114 in 2009 (see **Table 2-19**). This represents an average decline of 19.5 percent annually. In 2009, air taxi and general aviation operations at Sea-Tac Airport were exclusively itinerant in nature. There have been no local operations recorded by the air traffic control tower since October 2007.

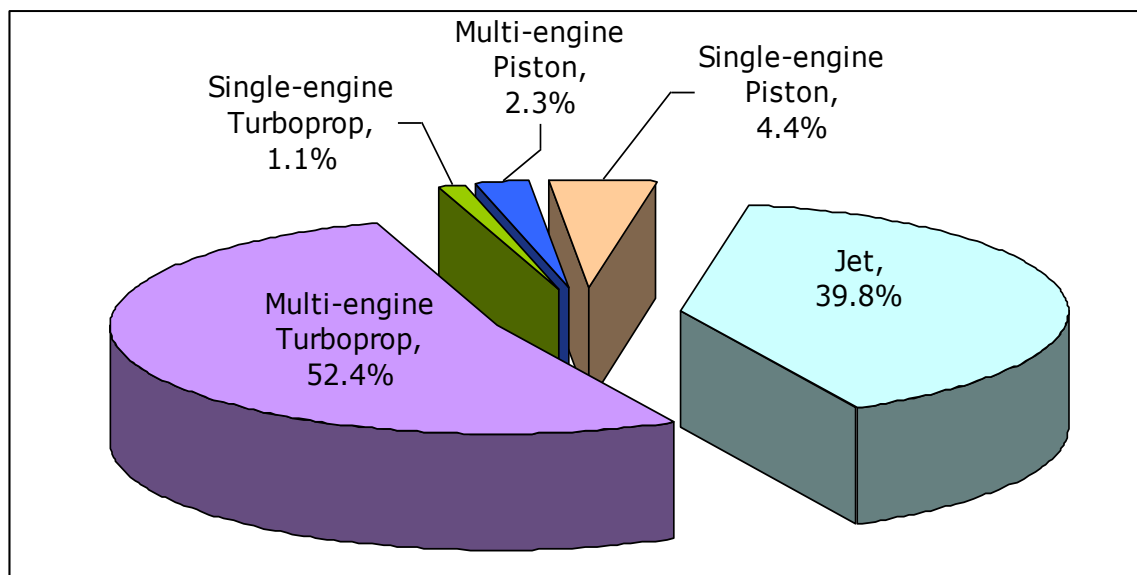
**Table 2-19  
HISTORICAL AIR TAXI AND GA OPERATIONS  
Seattle-Tacoma International Airport**

	Air Taxi and GA Operations			
	Year	Itinerant	Local	Total
Actual	2004	18,033	103	18,136
	2005	8,599	284	8,883
	2006	6,303	621	6,924
	2007	7,686	883	8,569
	2008	7,787	0	7,787
	2009	6,114	0	6,114
Average Annual Growth Rates:				
	2004-2009	-19.5%	-100.0%	-19.5%

Sources: Airport Records; FAA ATADS

**Exhibit 2-5** presents aircraft type allocations for air taxi and general aviation that operated at Sea-Tac Airport in 2009. Nearly 40 percent of the operations were jets and 53 percent were turboprop aircraft. The remaining 7 percent of operations were piston aircraft.

**Exhibit 2-5  
2009 AIR TAXI AND GA OPERATION FLEET MIX  
Seattle-Tacoma International Airport**



Sources: Radar data; Landrum & Brown analysis

**2.4.3 AIR TAXI AND GENERAL AVIATION FORECAST**

Nationally, the FAA Active Aircraft forecast in the *FAA Aerospace Forecasts, Fiscal Years 2010-2030* shows an initial decline of 0.2 percent annually in the number of active single-engine piston aircraft through 2018. The FAA expects single-engine piston aircraft to recover and grow at an average annual rate of 0.5 percent from 2018 to 2030. The number of multi-engine piston aircraft is expected to decline at an average annual rate of 0.8 percent from 2009 to 2030. Turboprops are forecast by the FAA to grow at rate of 1.4 percent annually while the number of jets is expected to grow the fastest at 4.2 percent annually.

Applying the FAA’s national forecast to each aircraft type at Sea-Tac Airport results in an average annual growth rate of 2.5 percent between 2009 and 2021. Air taxi and general aviation aircraft operations are expected to reach 8,240 in 2021 (see **Table 2-20**).

**Table 2-20  
AIR TAXI AND GA OPERATION FLEET MIX  
Seattle-Tacoma International Airport**

<b>Aircraft Type</b>	<b>AT &amp; GA Operations</b>			<b>% of total</b>		
	<b>2009</b>	<b>2018</b>	<b>2021</b>	<b>2009</b>	<b>2018</b>	<b>2021</b>
Jet	2,432	3,520	3,990	39.8%	46.2%	48.4%
Multi-engine Turboprop	3,206	3,630	3,780	52.4%	47.6%	45.9%
Single-engine Turboprop	68	77	80	1.1%	1.0%	1.0%
Multi-engine Piston	138	129	125	2.3%	1.7%	1.5%
Single-engine Piston	270	264	265	4.4%	3.5%	3.2%
<b>Total</b>	<b>6,114</b>	<b>7,620</b>	<b>8,240</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Sources: Radar data; Airport Records; FAA Aerospace Forecasts Fiscal Years 2010-2030; Landrum & Brown analysis



## **2.5 MILITARY**

Military operations ranged between 54 and 126 annually since 1996. There were 73 military operations in 2009, down from 110 in 2008. Based on an average of the past five years of military operations at Sea-Tac Airport, military operations are forecast to remain at 100 operations throughout the forecast period (see **Table 2-21**). According to radar data, there are two types of military aircraft recorded at Sea-Tac Airport in 2009: Lockheed 130 Hercules and Bombardier BD-700 Global Express. Bombardier BD-700 accounted for 75 percent of the total military operation in 2009.

**Table 2-21  
MILITARY OPERATIONS FORECAST  
Seattle-Tacoma International Airport**

	<b>Year</b>	<b>Military Operations</b>
<u>Actual</u>	1996	90
	1997	80
	1998	126
	1999	59
	2000	95
	2001	75
	2002	59
	2003	54
	2004	124
	2005	67
	2006	108
	2007	107
	2008	110
2009	73	
<u>Forecast</u>	2010	100
	2016	100
	2018	100
	2021	100
<u>Average Annual Growth Rates:</u>		
	1996-2000	1.1%
	2000-2009	-2.9%
	2009-2016	4.6%
	2016-2021	0.0%
	2009-2021	2.7%

Sources: Airport Records; Landrum & Brown analysis

## 2.6 TOTAL AIRCRAFT OPERATIONS SUMMARY

**Table 2-22** provides a summary of the operations forecast described in the previous sections for each of the primary components of aircraft operations at SEA. Aircraft operations are forecast to grow from 317,873 in 2009 to 419,680 in 2021, representing average annual growth of 2.3 percent.

**Table 2-22  
TOTAL AIRCRAFT OPERATIONS FORECAST  
Seattle-Tacoma International Airport**

	Calendar	Aircraft Operations				
	Year	Passenger	All-Cargo	Air Taxi & GA	Military	Total
<u>Actual</u>	2004	328,052	12,582	18,136	124	358,894
	2005	320,910	11,902	8,883	67	341,762
	2006	320,896	12,130	6,924	108	340,058
	2007	327,966	10,404	8,569	107	347,046
	2008	327,544	9,606	7,787	110	345,047
	2009	301,870	9,816	6,114	73	317,873
<u>Forecast</u>	2010	294,400	9,800	6,230	100	310,530
	2016	345,400	11,130	7,230	100	363,860
	2018	366,000	11,550	7,620	100	385,270
	2021	399,200	12,140	8,240	100	419,680
<u>Average Annual Growth Rates:</u>						
	2004-2009	-1.6%	-4.8%	-19.5%	-10.1%	-2.4%
	2009-2016	1.9%	1.8%	2.4%	4.6%	1.9%
	2016-2021	2.9%	1.8%	2.6%	0.0%	2.9%
	2009-2021	2.4%	1.8%	2.5%	2.7%	2.3%

Sources: Airport records; FAA, ATADS; Landrum & Brown analysis

### 2.5.1 COMPARISON TO FAA FORECASTS

The FAA develops Terminal Area Forecasts (TAF) on an annual basis for all active airports in the U.S. that are included in its National Plan of Integrated Airport Systems (NPIAS). The TAF is "prepared to meet the budget and planning needs of FAA and provide information for use by state and local authorities, the aviation industry, and the public."<sup>13</sup> The 2009 TAF was issued in December of 2009 and is compared to the Part 150 forecasts for Sea-Tac Airport in this section.

**Table 2-23** provides a comparison of this Part 150 forecast with the FAA 2009 TAF for enplanements, commercial operations and total aircraft operations for the 5- and 10-year horizons. The Part 150 forecasts are within 10 percent of the 2009 TAF for the first 5 years and within 15 percent for the first 10 years.

<sup>13</sup> <http://aspm.faa.gov/main/taf.asp>

**Table 2-23  
AVIATION FORECASTS VERSUS FAA 2009 TAF  
Seattle-Tacoma International Airport**

	Year	Part 150 Forecast	2009 TAF	P150 Variance
<b>Passenger Enplanements</b>				
Base Yr.	2009	15,610,198	14,911,310	4.7%
Base Yr. + 5 Yrs.	2014	16,946,590	16,407,630	3.3%
Base Yr. + 10 Yrs.	2019	19,485,400	18,362,887	6.1%
<b>Commercial Operations<sup>1</sup></b>				
Base Yr.	2009	311,686	317,420	-1.8%
Base Yr. + 5 Yrs.	2014	337,470	348,772	-3.2%
Base Yr. + 10 Yrs.	2019	388,740	386,959	0.5%
<b>Total Operations<sup>2</sup></b>				
Base Yr.	2009	317,873	320,559	-0.8%
Base Yr. + 5 Yrs.	2014	344,420	352,012	-2.2%
Base Yr. + 10 Yrs.	2019	396,660	390,510	1.6%

Notes: Part 150 data is on a calendar year basis. TAF data is shown on a fiscal year basis.

<sup>1</sup> Air taxi operations are included in the commercial operations totals for the TAF. The Part 150 forecast groups air taxi operations in the non-commercial category.

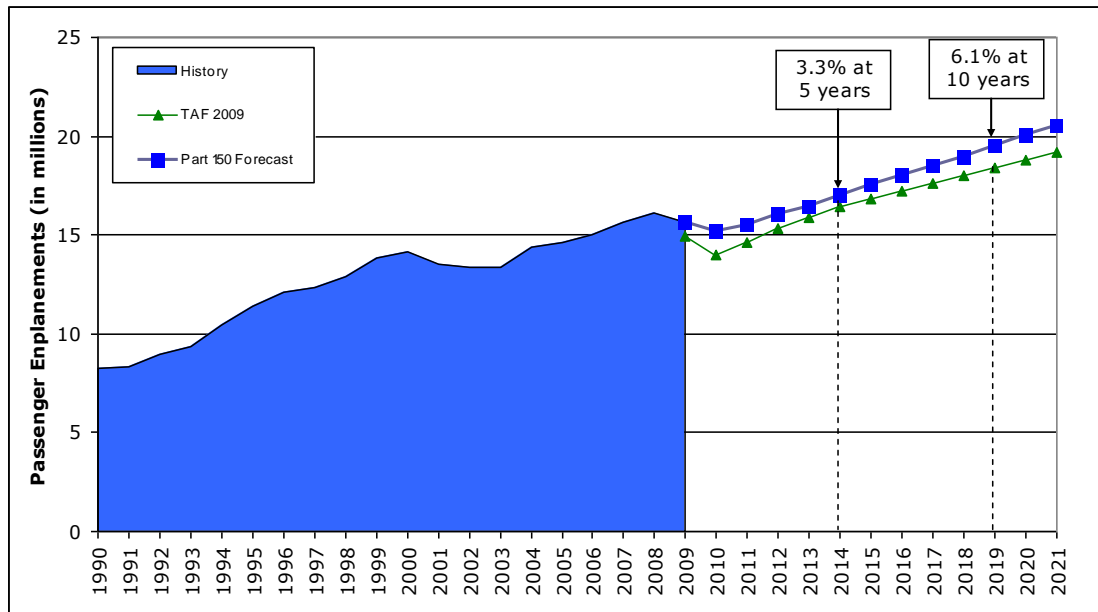
<sup>2</sup> Excludes overflights

Sources: Federal Aviation Administration 2009 Terminal Area Forecast; Airport Records; Landrum & Brown analysis

The 2009 TAF shows a 6 percent decline in enplanement levels in 2010 as a result of the economic recession and related decline in aviation activity, while the Part 150 forecast projects a slower decline of 3 percent in the traffic. The Part 150 Forecast expects passenger traffic will recover and grow at a slightly faster rate over the long-term compared to the 2009 TAF. The 2009 TAF predicts enplanements will increase at an average annual rate of 2.1 percent between 2009 and 2021. The Part 150 forecast projects an average annual growth rate of 2.3 percent over the same period. **Exhibit 2-6** provides a comparison between the enplanements forecast for this Part 150 forecast and the FAA 2009 TAF for Sea-Tac Airport. The difference in growth assumptions results in a 3.3 percent difference in enplanements in 2014 and a 6.1 percent difference in enplanements in 2019.

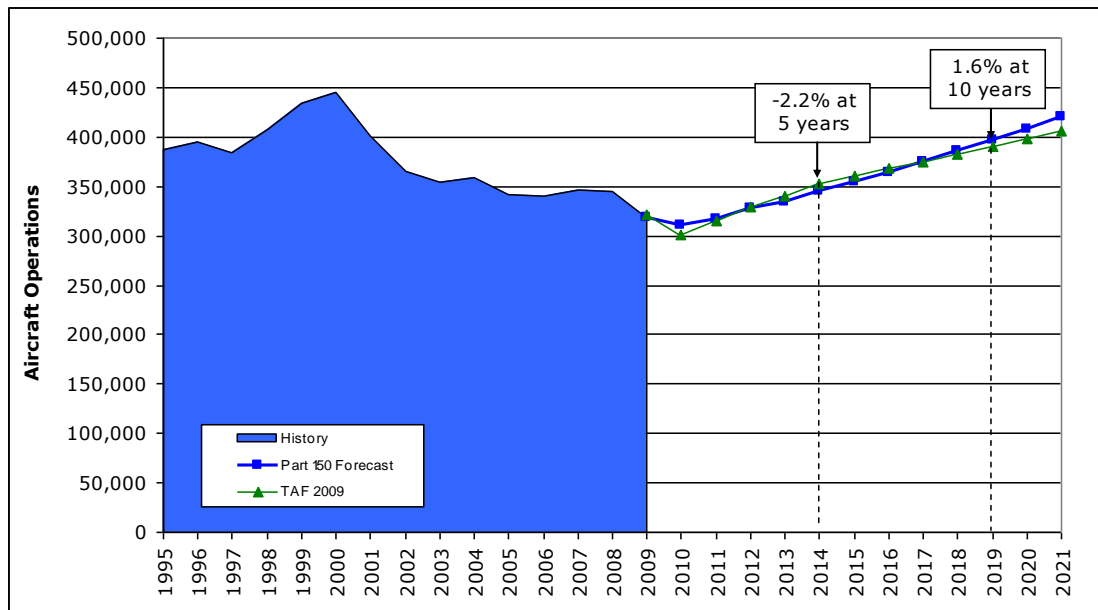
The 2009 FAA TAF predicts total aircraft operations at Sea-Tac Airport to grow 2.0 percent annually between 2009 and 2021. The Part 150 aircraft operations forecast assumes an average annual growth rate of 2.3 percent over the same period. As a result, total aircraft operations levels in the Part 150 forecast are 2.2 percent lower than the TAF in 2014 and 1.6 percent higher in 2019 (see **Exhibit 2-7**).

**Exhibit 2-6  
COMPARISON WITH FAA 2009 TAF – ENPLANEMENTS  
Seattle-Tacoma International Airport**



Sources: Federal Aviation Administration 2009 Terminal Area Forecast; Airport Records; Landrum & Brown analysis

**Exhibit 2-7  
COMPARISON WITH FAA 2009 TAF – OPERATIONS  
Seattle-Tacoma International Airport**

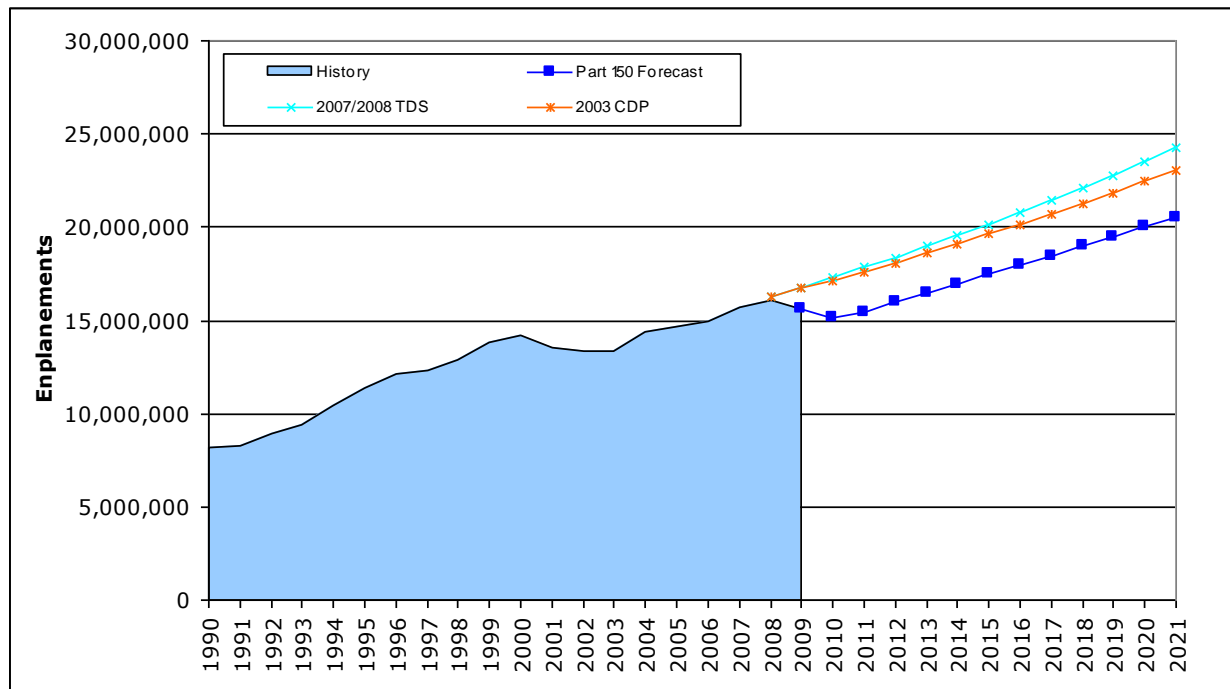


Sources: Federal Aviation Administration 2009 Terminal Area Forecast; Airport Records; Landrum & Brown analysis

**2.5.2 REVIEW OF EXISTING FORECASTS**

In addition to the comparison to the 2009 TAF, a review of other forecasts is also considered. There are two other forecasts reviewed and compared to the Part 150 forecast. **Exhibit 2-8** provides a comparison of passenger enplanement forecasts for 2003 CDP (Comprehensive Development Plan), 2007/2008 TDS (Terminal Development Strategy), and the Part 150 forecast. The 2003 CDP and the 2007/2008 TDS forecasts were done before the recession in 2008. Therefore, these forecasts did not reflect the traffic reduction in 2008 through 2010 or recovery period after 2010. The 2003 CDP forecast projected a 2.7 percent average annual growth rate between 2009 and 2021. The 2007/2008 TDS forecast projected a 3.1 percent average annual growth rate over the same period.

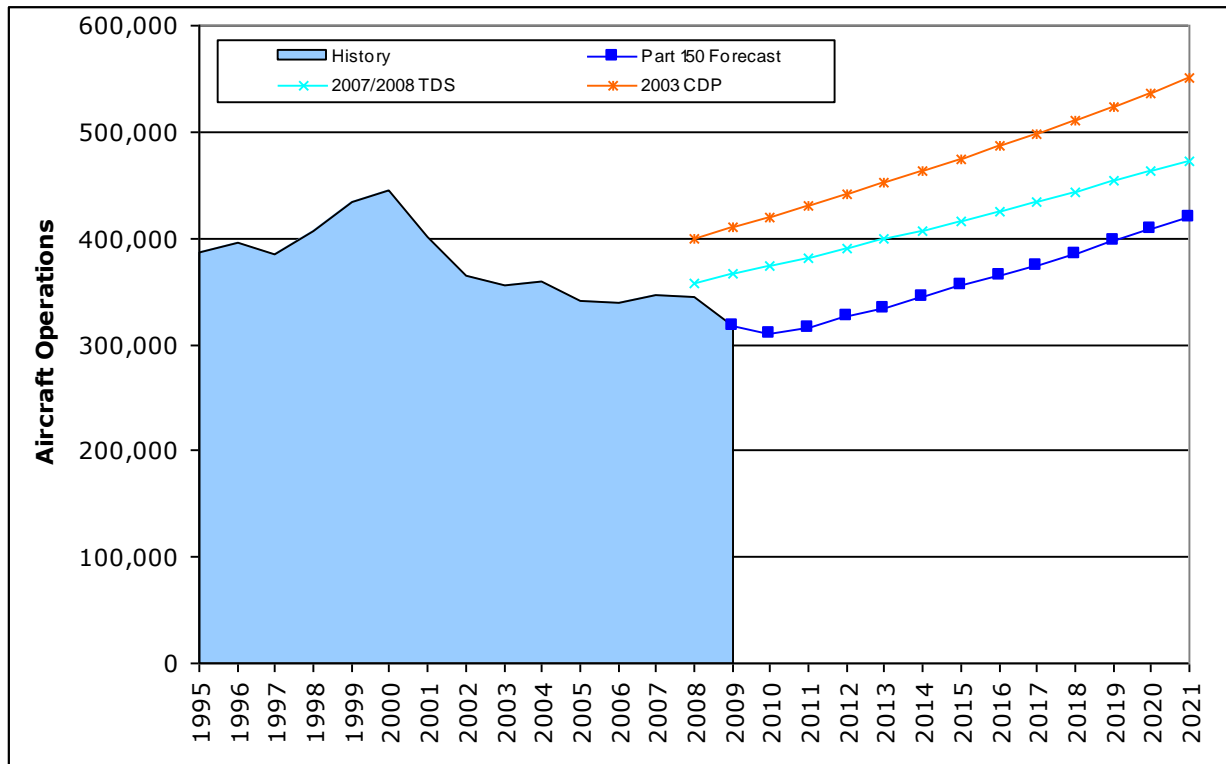
**Exhibit 2-8  
FORECASTS COMPARISON – ENPLANEMENTS  
Seattle-Tacoma International Airport**



Sources: 2007/2008 Activity and Forecasting Growth, April 1, 2008; Landrum & Brown analysis

**Exhibit 2-9** provides a comparison of aircraft operation forecasts for 2003 CDP, 2007/2008 TDS, and the Part 150 forecast. The 2003 CDP and the 2007/2008 TDS forecasts projected a 2.5 percent and a 2.2 percent of average annual growth rates between 2009 and 2021 respectively. These two forecasts were well above the actual 2008 and 2009 levels. Consequently, the 2003 CDP and the 2007/2008 TDS forecasts predict much higher forecasts compared to the Part 150 forecast.

**Exhibit 2-9  
FORECASTS COMPARISON – OPERATIONS  
Seattle-Tacoma International Airport**



Sources: 2007/2008 Activity and Forecasting Growth, April 1, 2008; Landrum & Brown analysis

For purposes of ongoing business planning, the Airport maintains and periodically updates a long-range projection of aviation activity. Landrum & Brown reviewed the Airport’s forecast and the underlying assumptions and determined that it was reasonable. The Part 150 forecast has a nearly identical average annual growth rate through 2015 as the Airport’s business planning forecast. For the period 2018 through 2021, the Part 150 forecast is projecting more robust growth than the Airport’s forecast. From a potential noise impact prospective, the Part 150 forecast is more conservative.

**2.5.3 AVERAGE ANNUAL DAY HOURLY DISTRIBUTIONS**

Part 150 analysis requires the classification of noise-modeled operations by daytime (7am-9:59pm) and nighttime (10pm-6:59am). In order to project daytime and nighttime operational proportions, an hourly distribution of traffic levels for the average annual day is provided in this section for each of the commercial passenger, air cargo, air taxi and general aviation, and military segments of the forecast.

Average annual day is developed based on annual aircraft operation forecasts for each segment divided by the number of days in the year. The average annual day operations for each segment are presented in **Table 2-24**. The total average annual day operations are projected to increase from 871 in 2009 to 1,151 in 2021.

**Table 2-24  
AVERAGE ANNUAL DAY  
Seattle-Tacoma International Airport**

Aircraft Operations Seattle-Tacoma International Airport										
Annual										
Calendar Year	Domestic Passenger		International Passenger		Commercial Passenger Operations	All-Cargo Operations	AT & GA Operations	Military Operations	Total Operations	
	Air Carrier Operations	Commuter Operations	Air Carrier Operations	Commuter Operations						
2007	207,570	88,292	10,086	22,018	327,966	10,404	8,569	107	347,046	
2008	211,658	84,542	10,606	20,738	327,544	9,606	7,787	110	345,047	
Base 2009	195,540	77,796	9,742	18,792	301,870	9,816	6,114	73	317,873	
Forecast 2010	193,400	72,600	9,800	18,600	294,400	9,800	6,230	100	310,530	
2016	227,400	81,000	13,400	23,600	345,400	11,130	7,230	100	363,860	
2018	241,600	86,400	14,000	24,000	366,000	11,550	7,620	100	385,270	
2021	264,400	95,000	15,000	24,800	399,200	12,140	8,240	100	419,680	

Average Annual Day										
Calendar Year	Domestic Passenger		International Passenger		Commercial Passenger Operations	All-Cargo Operations	AT & GA Operations	Military Operations	Total Operations	
	Air Carrier Operations	Commuter Operations	Air Carrier Operations	Commuter Operations						
2007	569	242	28	60	899	29	23	-	951	
2008	578	231	29	57	895	26	21	-	942	
Base 2009	536	213	27	51	827	27	17	-	871	
Forecast 2010	530	200	28	50	808	28	16	-	852	
2016	622	221	38	64	945	30	20	-	995	
2018	662	237	38	66	1,003	32	21	-	1,056	
2021	725	260	42	68	1,095	34	22	-	1,151	

Source: Landrum & Brown analysis

Hourly distribution for commercial passenger operations was derived from a flight schedule of a representative day (May 13, 2009) from *Official Airline Guide*. Radar data was used for cargo operation hourly distributions and a different day (May 12, 2009) was selected for cargo operation hourly distributions. Air taxi and general aviation operation hourly distribution was also derived from radar data of May 15, 2009. Selecting different days for each operation type can better represent an average day of the traffic at the Airport. The results show that 85 percent of total operations in 2009 were performed during daytime hours (see **Table 2-25**). This day/night split is expected to remain at the 2009 level throughout the forecast period.

**Table 2-25  
AVERAGE ANNUAL DAY – DAY/NIGHT SPLITS  
Seattle-Tacoma International Airport**

Year	Day/night	Domestic Passenger		International Passenger		Commercial Passenger Operations	All-Cargo Operations	AT & GA Operations	Military Operations	Total Operations
		Air Carrier Operations	Commuter Operations	Air Carrier Operations	Commuter Operations					
2009	Day	452	192	25	48	717	13	13	-	743
	Night	84	21	2	3	110	14	4	-	128
	Total	536	213	27	51	827	27	17	-	871
2016	Day	523	193	36	61	813	14	16	-	843
	Night	95	21	2	3	121	16	4	-	141
	Total	618	214	38	64	934	30	20	-	984
2021	Day	616	233	39	65	953	16	18	-	987
	Night	112	24	3	3	142	18	4	-	164
	Total	728	257	42	68	1,095	34	22	-	1,151
<b>% Day Operations</b>										
	2009	84.3%	90.1%	92.6%	94.1%	86.7%	48.1%	76.5%	n.a.	85.3%
	2016	84.6%	90.2%	94.7%	95.3%	87.0%	46.7%	80.0%	n.a.	85.7%
	2021	84.6%	90.7%	92.9%	95.6%	87.0%	47.1%	81.8%	n.a.	85.8%

Sources: Airport Records; Radar data; Official Airline Guide; Landrum & Brown analysis

**Table 2-26** presents detailed average annual day hourly distributions for each key year broken down by each operations type.

**Table 2-26  
AVERAGE ANNUAL DAY – HOURLY DISTRIBUTIONS  
Seattle-Tacoma International Airport**

**2009 Average Annual Day – Arrivals**

2009 Hour	Domestic Passenger		International Passenger		Commercial Passenger Arrivals	All-Cargo Arrivals	AT & GA Arrivals	Military Arrivals	Total Arrivals
	Air Carrier Arrivals	Commuter Arrivals	Air Carrier Arrivals	Commuter Arrivals					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	1	-	-	-	1	2	-	-	3
4	1	-	-	-	1	-	-	-	1
5	5	-	-	-	5	5	-	-	10
6	1	6	-	1	8	1	-	-	9
7	3	8	1	3	15	-	-	-	15
8	7	6	1	1	15	-	-	-	15
9	14	8	1	2	25	-	-	-	25
10	20	8	-	-	28	-	-	-	28
11	20	5	3	2	30	-	-	-	30
12	15	6	1	1	23	-	-	-	23
13	18	4	1	3	26	-	1	-	27
14	17	6	-	2	25	-	-	-	25
15	10	8	-	1	19	-	-	-	19
16	15	6	1	1	23	2	-	-	25
17	11	7	-	-	18	2	1	-	21
18	17	7	1	4	29	2	1	-	32
19	14	8	2	2	26	-	-	-	26
20	23	7	1	1	32	-	2	-	34
21	22	3	1	1	27	-	3	-	30
22	18	2	-	-	20	-	-	-	20
23	15	1	-	-	16	-	1	-	17
Total	268	106	14	25	413	14	9	-	436



**2009 Average Annual Day – Departures**

2009 Hour	Domestic Passenger		International Passenger		Commercial Passenger Departures	All-Cargo Departures	AT & GA Departures	Military Departures	Total Departures
	Air Carrier Departures	Commuter Departures	Air Carrier Departures	Commuter Departures					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	1	-	1	-	-	-	1
3	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	-	-	2
5	2	1	-	-	3	2	-	-	5
6	24	2	-	1	27	2	-	-	29
7	21	7	-	2	30	2	-	-	32
8	24	7	1	1	33	-	-	-	33
9	12	5	-	1	18	-	1	-	19
10	16	7	1	4	28	-	-	-	28
11	20	7	-	2	29	-	-	-	29
12	20	7	2	-	29	-	-	-	29
13	15	5	1	1	22	-	-	-	22
14	15	8	4	4	31	-	-	-	31
15	16	8	-	-	24	-	-	-	24
16	13	6	-	2	21	-	1	-	22
17	14	7	-	1	22	-	-	-	22
18	12	6	1	2	21	-	-	-	21
19	13	6	-	1	20	2	-	-	22
20	8	7	-	-	15	1	2	-	18
21	7	2	1	3	13	2	1	-	16
22	8	7	-	-	15	-	1	-	16
23	7	2	1	1	11	-	2	-	13
Total	268	107	13	26	414	13	8	-	435

**2018 Average Annual Day – Arrivals**

2018 Hour	Domestic Passenger		International Passenger		Commercial Passenger Arrivals	All-Cargo Arrivals	AT & GA Arrivals	Military Arrivals	Total Arrivals
	Air Carrier Arrivals	Commuter Arrivals	Air Carrier Arrivals	Commuter Arrivals					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	1	-	-	-	1	2	-	-	3
4	1	-	-	-	1	-	-	-	1
5	6	-	-	-	6	5	-	-	11
6	1	6	-	1	8	1	-	-	9
7	3	7	1	4	15	-	-	-	15
8	8	6	2	1	17	-	-	-	17
9	16	8	1	3	28	-	-	-	28
10	25	8	-	-	33	-	-	-	33
11	24	5	4	2	35	-	-	-	35
12	17	6	2	1	26	-	-	-	26
13	20	4	1	4	29	-	1	-	30
14	19	6	-	3	28	-	-	-	28
15	11	9	-	1	21	-	-	-	21
16	17	6	1	1	25	2	-	-	27
17	12	7	-	-	19	2	1	-	22
18	19	7	1	6	33	3	1	-	37
19	16	9	3	3	31	-	1	-	32
20	28	7	2	1	38	-	2	-	40
21	27	4	1	1	33	-	3	-	36
22	20	2	-	-	22	-	-	-	22
23	17	1	-	-	18	-	1	-	19
Total	309	108	19	32	468	15	10	-	493

**2018 Average Annual Day – Departures**

2016 Hour	Domestic Passenger		International Passenger		Commercial Passenger Departures	All-Cargo Departures	AT & GA Departures	Military Departures	Total Departures
	Air Carrier Departures	Commuter Departures	Air Carrier Departures	Commuter Departures					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	1	-	1	-	-	-	1
3	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	-	-	2
5	2	1	-	-	3	3	-	-	6
6	28	2	-	1	31	3	-	-	34
7	25	6	-	3	34	2	-	-	36
8	28	7	2	1	38	-	-	-	38
9	14	5	-	1	20	-	1	-	21
10	18	7	1	5	31	-	-	-	31
11	24	7	-	3	34	-	-	-	34
12	24	7	3	-	34	-	-	-	34
13	17	5	2	1	25	-	-	-	25
14	17	7	6	5	35	-	-	-	35
15	18	9	-	-	27	-	1	-	28
16	15	6	-	3	24	-	1	-	25
17	16	7	-	1	24	-	-	-	24
18	14	6	1	2	23	-	-	-	23
19	15	6	-	1	22	2	-	-	24
20	9	7	-	-	16	1	3	-	20
21	7	2	2	4	15	2	1	-	18
22	9	7	-	-	16	-	1	-	17
23	8	2	1	1	12	-	2	-	14
Total	309	106	19	32	466	15	10	-	491

**2021 Average Annual Day – Arrivals**

2021 Hour	Domestic Passenger		International Passenger		Commercial Passenger Arrivals	All-Cargo Arrivals	AT & GA Arrivals	Military Arrivals	Total Arrivals
	Air Carrier Arrivals	Commuter Arrivals	Air Carrier Arrivals	Commuter Arrivals					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	1	-	-	-	1	3	-	-	4
4	1	-	-	-	1	-	-	-	1
5	7	-	-	-	7	5	-	-	12
6	1	7	-	1	9	1	-	-	10
7	4	9	1	4	18	-	-	-	18
8	9	7	1	1	18	-	-	-	18
9	18	9	1	3	31	-	-	-	31
10	29	9	-	-	38	-	-	-	38
11	28	7	5	3	43	-	-	-	43
12	21	8	2	1	32	-	-	-	32
13	24	5	2	4	35	-	1	-	36
14	22	8	-	3	33	-	-	-	33
15	13	11	-	1	25	-	-	-	25
16	20	7	2	1	30	2	-	-	32
17	15	8	-	-	23	3	1	-	27
18	22	8	1	7	38	3	1	-	42
19	18	10	3	3	34	-	1	-	35
20	33	8	2	1	44	-	2	-	46
21	32	4	1	1	38	-	4	-	42
22	24	2	-	-	26	-	-	-	26
23	20	1	-	-	21	-	1	-	22
Total	363	128	21	34	546	17	11	-	574

**2021 Average Annual Day – Departures**

2021 Hour	Domestic Passenger		International Passenger		Commercial Passenger Departures	All-Cargo Departures	AT & GA Departures	Military Departures	Total Departures
	Air Carrier Departures	Commuter Departures	Air Carrier Departures	Commuter Departures					
0	1	-	-	-	1	-	-	-	1
1	-	-	-	-	-	-	-	-	-
2	-	-	2	-	2	-	-	-	2
3	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	3	-	-	3
5	3	1	-	-	4	3	-	-	7
6	33	2	-	1	36	3	-	-	39
7	29	8	-	3	40	3	-	-	43
8	33	8	2	1	44	-	-	-	44
9	16	7	-	1	24	-	1	-	25
10	21	9	2	5	37	-	-	-	37
11	29	8	-	3	40	-	-	-	40
12	29	8	3	-	40	-	-	-	40
13	21	7	2	2	32	-	-	-	32
14	20	9	6	5	40	-	-	-	40
15	21	10	-	-	31	-	1	-	32
16	17	8	-	3	28	-	1	-	29
17	19	8	-	1	28	-	-	-	28
18	16	7	1	3	27	-	1	-	28
19	17	7	-	1	25	2	-	-	27
20	11	9	-	-	20	1	3	-	24
21	9	2	2	4	17	2	1	-	20
22	11	9	-	-	20	-	1	-	21
23	9	2	1	1	13	-	2	-	15
Total	365	129	21	34	549	17	11	-	577

Sources: Airport Records; Radar data; Official Airline Guide; Landrum & Brown analysis

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