Chapter Three: AERONAUTICAL ACTIVITY FORECAST

Airport Master Plan Update

Aurora State Airport

Forecasting aviation demand helps determine the size and timing of needed airport improvements. This chapter indicates the types and levels of aviation activity expected at the Aurora State Airport (Airport) during a 20-year forecast period. Projections of aviation activity for the Airport were prepared for the near-term (2015), mid-term (2020), and long-term (2030) future.

These projections are unconstrained and assume the Oregon Department of Aviation (ODA) or others will be able to develop the various facilities necessary to accommodate based aircraft and future aircraft operations. When development alternatives are evaluated later in the planning process, ODA may choose not to meet the unconstrained demand. ODA has chosen not to constrain the forecasts because undeveloped land to accommodate growth is available. In addition, the preparation of unconstrained forecasts follows the typical Federal Aviation Administration (FAA) practice. In individual airport forecasts it prepares annually, the FAA "…assumes an unconstrained demand for aviation services based upon local and national economic conditions as well as conditions within the aviation industry. In other words, an airport's forecast is developed independent of the ability of the airport and the air traffic control system to furnish the capacity required to meet demand."[1]

The primary objective of forecasting is to define the magnitude of change that can be expected over time. Because of the cyclical nature of the economy, it is impossible to predict with certainty year-to-year fluctuations in activity when looking 20 years into the future. However, a trend can be established that characterizes long-term potential. While a single line expresses the anticipated growth, actual growth may fluctuate above and below this line. **Forecasts serve only as guidelines, and planning must remain flexible to respond to unforeseen changes in aviation activity and resultant facility needs.**

[1] Federal Aviation Administration. (December 2009). *Terminal Area Forecast Summary, Fiscal Years 2009-2030*. p. 3.

This chapter presents the following forecasts:

- **Based Aircraft, Including Fleet Mix.** The number and type of aircraft based at the Airport help determine the future aircraft hangar, apron, and auto parking facility requirements. Fleet Mix refers to the distribution of aircraft by type.
- **Aircraft Operations, Including Annual, Peak, Local vs. Itinerant, and Fleet Mix.** An operation is counted as an aircraft either landing or taking off (*i.e.*, an aircraft landing then taking off counts as two operations). Local operations are touch-and-go and other training operations that stay near the airport. The operations forecast helps in analyzing runway capacity and determining runway, taxiway, and navigational aid requirements. The aircraft operations forecast provides some of the input for the computer modeling that estimates future aircraft noise exposure.
- **Critical Aircraft and Airport Reference Code.** The critical aircraft is derived from the operational fleet mix. The critical aircraft and its airport reference code determine many airfield design requirements, such as runway and taxiway size and strength, and safety clearances around aircraft movement areas.

National, state, and regional trends and forecasts for the aviation industry are reviewed in this chapter, along with socioeconomic trends and forecasts, to assess their effect on past and future aviation activity at the Airport.

Historical activity at the Airport is analyzed for growth trends that help forecast aviation demand. Sources of historical data include the FAA's Terminal Area Forecast (TAF) and based aircraft inventory, ODA's record of current based aircraft and recent fuel flowage, records of flight plans filed under Instrument Flight Rules (IFR), the airport user survey conducted as part of this planning study, and anecdotal information provided by some businesses at the Airport.

The TAF is the FAA's annual forecasting for terminal control centers and for the approximately 3,300 individual airports that are in the National Plan of Integrated Airport Systems (NPIAS). "The TAF is prepared to assist the FAA in meeting its planning, budgeting, and staffing requirements. In addition, state aviation authorities and other aviation planners use the TAF as a basis for planning airport improvements."[2] The TAF provides a benchmark for individual master plan forecasts. The FAA may modify or update the TAF based on an approved master plan forecast. If an airport master plan forecast for operations exceeds the TAF by more than 10% in the first five years, FAA Headquarters must review the forecast. According to Par. 428.a, FAA Order 5100.38C, the lack of FAA acceptance of forecasts may delay any further planning or capital improvements depending on them.

Prior forecasts specific to Aurora State Airport are presented for comparison to the historical records of activity that have occurred and for comparison to the forecasts developed for this study. These other

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[2] Federal Aviation Administration. (December 2009). *Terminal Area Forecast Summary, Fiscal Years 2009-2030*. p. 3.

forecasts include the FAA's Terminal Area Forecast (December 2009), the Oregon Aviation Plan (2007), and the prior Aurora State Airport Master Plan (2000).

The forecasts presented in this chapter are consistent with the Airport's role as an urban general aviation airport; they do not anticipate a major role change, such as the initiation of commercial passenger or cargo service.

NATIONAL AVIATION TRENDS AND FORECASTS

Aurora State Airport is part of an air transportation system and, as such, is subject to national and regional aviation trends.

General aviation (GA) in the United States peaked in the 1970s, and then experienced years of decline until growth returned in the 1990s. The growth in the 1990s was due not only to an expanding economy, but also to the General Aviation Revitalization Act (GARA) of 1994. GARA set an 18-year limit on the liability of GA aircraft and component manufacturers, spurring production of single engine piston aircraft. Single engine piston is the aircraft type that accounts for the majority of the nation's GA activity.

The business aviation portion of GA grew rapidly in the 1990s and into the first part of the 21st century. Airplanes used for business tend to be larger and faster than those limited to personal use, although business use of GA aircraft ranges from small, single-engine aircraft rentals to multiple aircraft corporate fleets supported by dedicated flight crews and mechanics. Since 9/11, business aviation has benefited from airline service problems—the additional airline passenger and baggage security imposed and reductions in air service, particularly to smaller communities. Until 2008, business aviation grew rapidly as various chartering, leasing, time-sharing, fractional ownership,[3] interchange agreements, partnerships and management contracts emerged.

GA growth began to decline in 2008 and 2009, due primarily to the economic recession that began the end of 2007. Soaring fuel prices in mid-2008 kept some airplanes parked. From a high of $129.03 per barrel in July of 2008, the price of oil dropped to $37.45 in January 2009, when demand for oil plummeted with the economy. The recession dampened every aspect of GA—from flight training and aircraft production, to the number of pilots and the hours aircraft are flown. The harm to the development of new aviation technology and businesses is exemplified by the Eclipse and DayJet stories. Eclipse Aviation was the leading developer and manufacturer of a new aircraft type, the Very Light Jet (VLJ). The VLJ is a small, low-cost jet capable of using short runways and offering the speed and comfort of high-altitude jet flight. Eclipse was the first to deliver a VLJ in late 2006. DayJet, operating a fleet of Eclipse aircraft in the Southeastern U.S., employed a unique air taxi business model, "per seat, on-demand", which was a radical change from the tradition of a single customer chartering a whole aircraft.

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[3] Fractional aircraft ownership is similar to real estate time-sharing.

After producing 260 VLJs, Eclipse Aviation declared bankruptcy in November 2008. DayJet ceased operating in September 2008, blaming the tight credit market for its demise.

According to the *FAA Aerospace Forecasts Fiscal Years 2010-2030* (March 2010), "Each passing month of 2009 saw the light on consumer confidence dim as housing foreclosures climbed, credit tightened, and unemployment surged." The bad news the FAA reported about 2009 included the following:

- The world economy declined 2.4%, while the U.S. economy declined 2.5%.
- The market for GA products and services declined sharply.
- Compared to 2008, which had declined from the previous year, U.S. manufacturer aircraft shipments declined 48.5% and billings fell 32.1%.
- Student pilots decreased 10.8%, the fifth straight year of decline.
- GA flight hours decreased 10.3%.
- GA aircraft operations recorded by air traffic control towers fell 11.7% in 2009, one of the largest declines in that measure ever reported.

The General Aviation Manufacturers Association (GAMA) reported that the 2009 business jet sector declined following five straight years of growth.[4] The number of worldwide fractional share owners fell for the first time, from 5,179 to 4,881, and the number of airplanes in the fractional fleet decreased 5.2%. Aircraft shipments in the first quarter of 2010 were down 15% compared to the same period in 2009, although billings were up 7.1%.[5]

In spite of all the bad news, the FAA's March 2010 forecast stated, "Even though the highly cyclical U.S. aviation industry went into a downward spiral during 2009, history has shown the demand for air travel is resilient and growth will return." The U.S. economy grew in the fourth quarter of 2009 for the first time in five quarters, and the economies of most regions of the world appear to be recovering.

GAMA also reported that at the end of 2009, there were hopeful signs—the availability of used aircraft was declining, aircraft utilization was stabilizing, availability of financing was improving, and inquiries for new orders were starting to grow. Corporate profits were beginning to recover; profits are historically related to new airplane demand.[6] In May 2010, the GAMA President and CEO reported that flight activity is on an upward trend and the used aircraft inventory is decreasing, but the industry is far from recovery. He noted that the U.S. Congress' continuation of bonus depreciation is crucial to the industry's recovery.[7]

FAA Aerospace Forecasts Fiscal Years 2010-2030 projects recovery for GA, using economic forecasts developed by Global Insight Inc. to project domestic aviation demand. **Table 3A** shows the FAA's forecast for active GA and air taxi aircraft. An active aircraft is one that has a current registration and was flown at least one hour during the calendar year. The source of historical numbers is the FAA General Aviation and Air Taxi Activity (and Avionics) Surveys.

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[4] General Aviation Manufacturers Association: 2009 General Aviation Statistical Databook & Industry Outlook
[5] GAMA News 10-12, released 5-10-2010, www.GAMA.aero
[6] General Aviation Manufacturers Association: 2009 General Aviation Statistical Databook & Industry Outlook
[7] GAMA News 10-12, released 5-10-2010, www.GAMA.aero

Table 3A. U.S. Active General Aviation and Air Taxi Aircraft Forecast

Aircraft Type	2009 Estimated	Average Annual Growth 2000-2009 Historical	2009-2010	2010-2020 Forecast	2009-2030
Piston Fixed Wing					
Single Engine	144,745	-0.4%	-0.4%	-0.1%	0.2%
Multi-engine	17,351	-2.1%	-1.0%	-0.8%	-0.8%
Total	162,096	-0.6%	-0.5%	-0.2%	0.1%
Turbine Fixed Wing					
Turboprop	9,010	5.1%	1.0%	1.5%	1.4%
Turbojet	11,418	5.6%	3.2%	4.3%	4.2%
Total	20,428	5.4%	2.2%	3.1%	3.1%
Rotorcraft					
Piston	3,666	3.5%	4.5%	3.9%	3.4%
Turbine	6,540	4.3%	2.7%	2.7%	2.4%
Total	10,206	4.0%	3.3%	3.2%	2.8%
Experimental	23,435	1.5%	0.7%	2.3%	1.8%
Sport Aircraft	7,311	N/A	5.5%	5.6%	3.9%
Other[8]	5,673	-1.8%	0.1%	-0.1%	-0.1%
Grand Total	229,149	0.6%	0.2%	0.8%	0.9%

Source: FAA Aerospace Forecasts Fiscal Years 2010-2030 (March 2010)

The FAA forecasts growth in business aviation demand over the long term, driven by a growing U.S. and world economy. The more expensive and sophisticated turbine-powered fleet, including helicopters, is projected to grow at an average of 3.0% per year. The worldwide delivery of VLJs has been refreshed with the introduction of Embraer's Phenom 100 to the market. The FAA expects 440 VLJs to enter the U.S. fleet in the next three years, with an average of 216 per year for the remainder of the forecast period. Piston-powered aircraft are expected to decline through 2017 and then grow at a low rate. The FAA expects VLJs and sport aircraft to erode the replacement market for traditional piston aircraft at the high and low ends of the market respectively. Rotorcraft (helicopters) have experienced high growth since 2000, and growth is projected to continue.

Table 3B presents the FAA's forecast for aircraft hours flown. The number of GA hours flown is projected to increase by 2.5% annually. A larger portion of the growth is expected to occur in the short-term, post-recession period, where low utilization rates experienced in 2009 will return to normal, particularly for jets. Rotorcraft hours were relatively immune to the recession compared to other categories.

[8] Gliders and lighter than air vehicles

Table 3B. U.S. Active General Aviation and Air Taxi Hours Flown Forecast

Aircraft Type	2009 Estimated	Average Annual Growth 2000-2009 Historical	2009-2010	2010-2020 Forecast	2009-2030
Piston Fixed Wing					
Single Engine	11,436,000	-5.0%	-3.8%	1.0%	1.2%
Multi-engine	2,132,000	-5.1%	-1.3%	-1.1%	-0.2%
Total	13,568,000	-5.0%	-3.4%	0.7%	1.0%
Turbine Fixed Wing					
Turboprop	2,241,000	1.4%	1.4%	2.3%	1.7%
Turbojet	2,902,000	0.6%	0.1%	8.8%	6.1%
Total	5,143,000	0.9%	0.7%	6.4%	4.6%
Rotorcraft					
Piston	709,000	3.3%	2.4%	4.2%	3.5%
Turbine	2,356,000	4.0%	0.6%	3.3%	2.8%
Total	3,065,000	3.8%	1.0%	3.5%	3.0%
Experimental	1,031,000	-2.6%	-3.0%	5.3%	3.3%
Sport Aircraft	314,000	N/A	5.5%	7.7%	5.9%
Other[9]	208,000	-6.3%	-0.4%	0.4%	0.4%
Grand Total	23,330,000	-2.8%	-1.8%	2.9%	2.5%

Source: FAA Aerospace Forecasts Fiscal Years 2010-2030 (March 2010).

GA aircraft operations at FAA and contract towers are expected to continue declining in 2010, 3.1% from 2009, then rise 1.2% in 2011 and 2012 as unemployment decreases. For the whole forecast period, the expected GA aircraft operations growth at towered airports is 1.1% per year on average. The FAA expects military aircraft activity to remain constant through the forecast period.

The FAA identified the following risks to their forecasts:

- **Oil Prices.** Although oil prices were much lower in 2009 than in 2008, there is risk of rising oil prices when economic growth resumes. FAA's forecast, based on Global Insight's October 2009 forecast, calls for steady increases in oil prices after 2009, but does not expect the price to exceed $100 per barrel until 2025.

- **Business Aviation Risks.** Business and corporate aviation grew strongly after 9/11 but fell sharply with the economic recession. Public perception of business and corporate aviation, potential environmental regulations and taxes, and increased security measures could place downward

[9] Gliders and lighter than air vehicles

pressure on the forecast. On the other hand, new and more efficient product offerings and increased competition from new manufacturers could broaden the appeal. The growth of the on-demand air taxi industry that was expected with the VLJ entry into the market could materialize.

- **Environmental Concerns.** Air transportation could be constrained from growth by environmental concerns that might limit airport expansion or new construction or by the cost of meeting new air emissions standards. On the other hand, research and technological breakthroughs may overcome these constraints. Breakthroughs in cleaner, quieter, more efficient aircraft are possible, and Nextgen—the FAA's air traffic modernization program—promises to increase capacity at some airports without physical expansion and to reduce air and noise pollution.

STATE AVIATION TRENDS AND FORECASTS

Since 2000, aviation in Oregon has seemed to trend with the nation. In 2008, Oregon's share of the nation's active GA and air taxi fleet was 2.0%, the same share it was in 2000. The number of these aircraft was virtually the same in both years—4,687 in 2000 and 4,614 in 2008. The number peaked at 6,029 in 2007, which was also the national peak. Hours flown in GA and air taxi aircraft hit a low point in 2008 in Oregon (431,000) and in the US (26,009,000). Oregon's share of U.S. hours flown, 1.7%, was lower in 2008 than in the 2000 to 2007 period.[10]

The *Oregon Aviation Plan 2007 (OAP 2007)* used 2005 as the base year for forecasting. For statewide based aircraft, the forecast was an increase from 4,875 to 6,225 by 2025—a 1.23% average annual increase. The annual rate of growth was slightly lower than the FAA's national forecasts for active GA and air taxi aircraft, 1.29%. The mix of based aircraft was projected to remain 81% single engine, 7% multi-engine, 3% jet, 4% helicopter, and 5% other. Aircraft operations were projected to grow at the same rate as based aircraft.

OAP 2007 was prepared before the economic recession. GA did grow in Oregon from 2005 to 2007, and then dropped in 2008. Based aircraft declined 9% and operations declined 5%, most likely due to the economic downturn. However, from 2008 through 2030, the FAA's Terminal Area Forecast shows average annual growth of 1.2% for based aircraft and 1.1% for GA operations.[11]

TRENDS AT AURORA STATE AIRPORT

The Airport began the 21st century with a surge in based aircraft (**Exhibit 3A**), in part, due to the increase in hangar capacity created by the Southend Airpark development. From 2001 to 2007, the number of based aircraft grew, and then declined in 2008 and 2009. In 2010, growth resumed.

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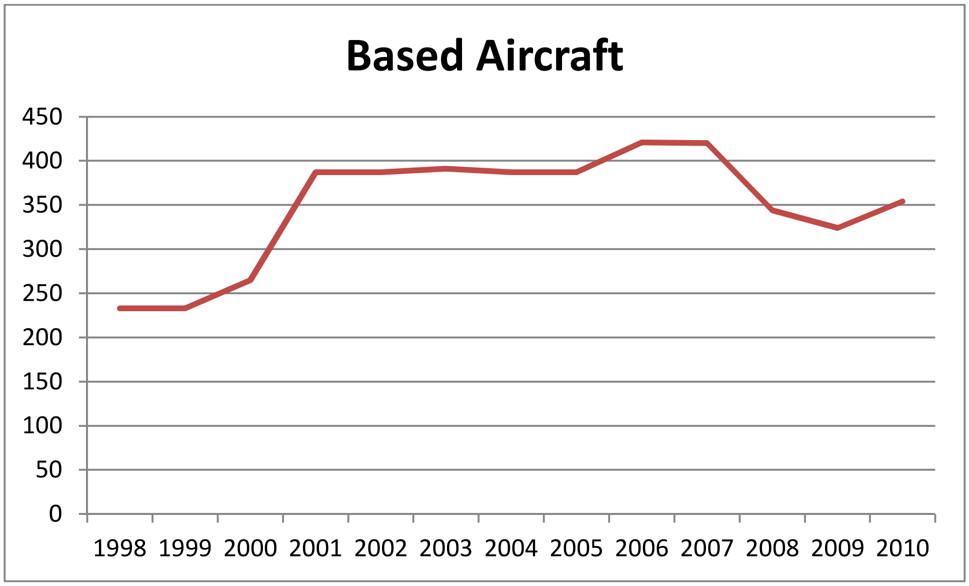
[10] General Aviation Manufacturers Association: 2009 General Aviation Statistical Databook & Industry Outlook
[11] FAA's Terminal Area Forecast (December 2009), which is limited to airports in the National Plan of Integrated Airport Systems (NPIAS)

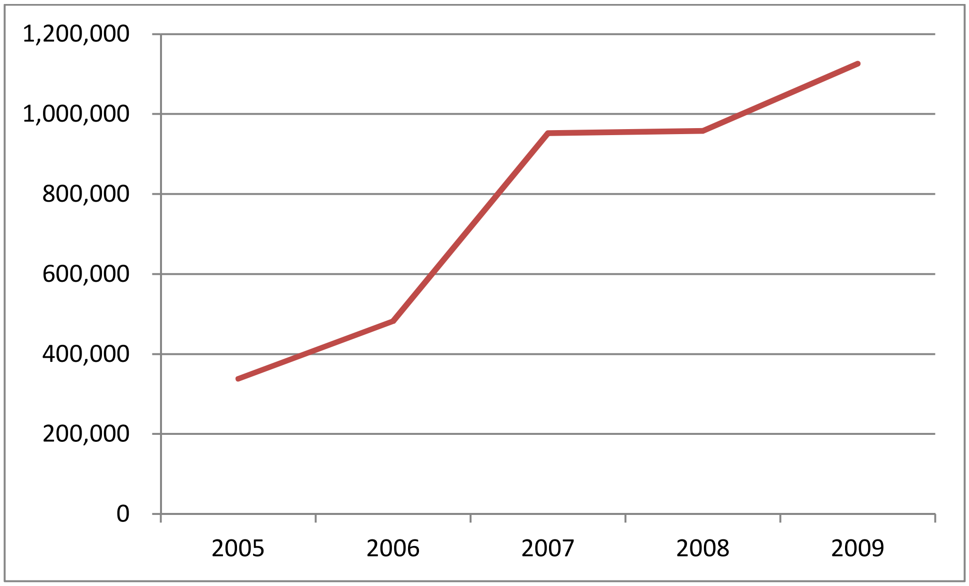
Exhibit 3A. Historical Based Aircraft at Aurora State Airport



Source: FAA Terminal Area Forecast (December 2010) for 1998 – 2010 numbers. ODA registration for 2010 numbers.

The ODA exacts fuel flowage fees on six businesses at the Airport: Aurora Aviation, Columbia Helicopters, Metal Innovations, Aurora Jet Center, TEC Equipment, and Willamette Aviation. Three of these businesses sell fuel to the operators of aircraft based at the Airport and to the operators of "transient" aircraft based at other airports. **Exhibit 3B** shows the combined fuel flowage of these businesses over the last five years. Fuel flowage is a relatively good indicator of the trend in aircraft operations, although fuel prices at other airports can affect where aircraft operators refuel. Exhibit 3B shows a sharp rise of 182% between 2005 and 2007, from 338,088 gallons to 951,870 gallons. Aviation gasoline (avgas) use dropped 47% from 2007 to 2008, while jet fuel gained 11%. Fuel flowage resumed growth in 2009, reaching 1,126,272 gallons.

Exhibit 3B. Historical Fuel Flowage at Aurora State Airport (gallons)

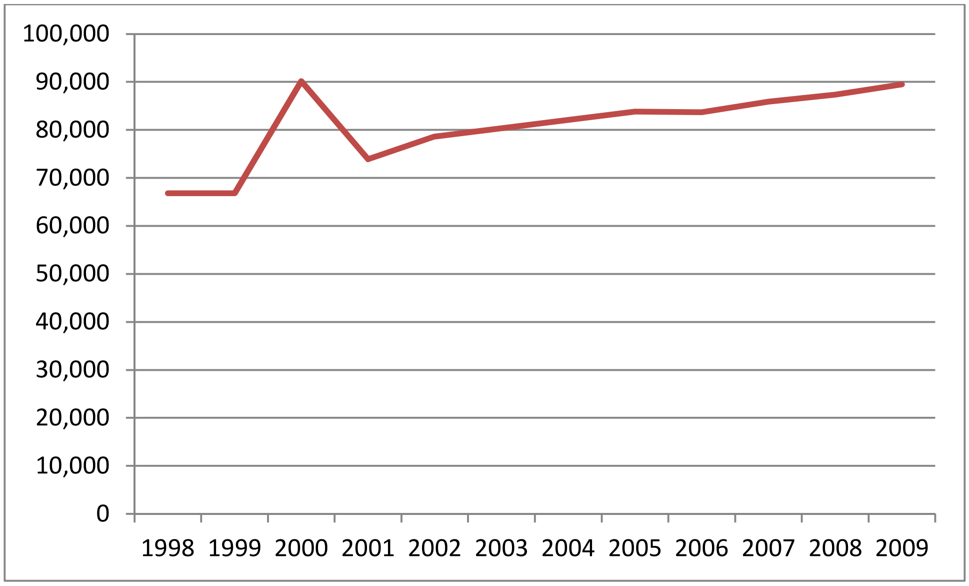


Source: Oregon Department of Aviation Records.

While the majority of aircraft based at and using the Airport are piston-powered and use avgas, about 85% of the fuel flowage is jet fuel and 15% is avgas. On average, jets have larger fuel tanks than piston-powered airplanes, and are flown more hours. ODA records and informal information from fueling operators indicate that jet fuel use is growing faster than avgas use. This implies operations by turbine-powered aircraft are growing more than piston-powered aircraft operations.

The FAA keeps records of estimated aircraft operations (takeoffs and landings) reported by airport owners on periodically updated Airport Master Records (FAA Form 5010). ODA submits Form 5010 updates every three years to the FAA Airport District Office in Seattle. The Airport District Office then reports estimated annual numbers to FAA Headquarters for inclusion in the TAF. **Exhibit 3C** shows the reported aircraft operations at Aurora State Airport for the years 1998 through 2009. Since 2001, operations at the Airport have grown slowly but steadily.

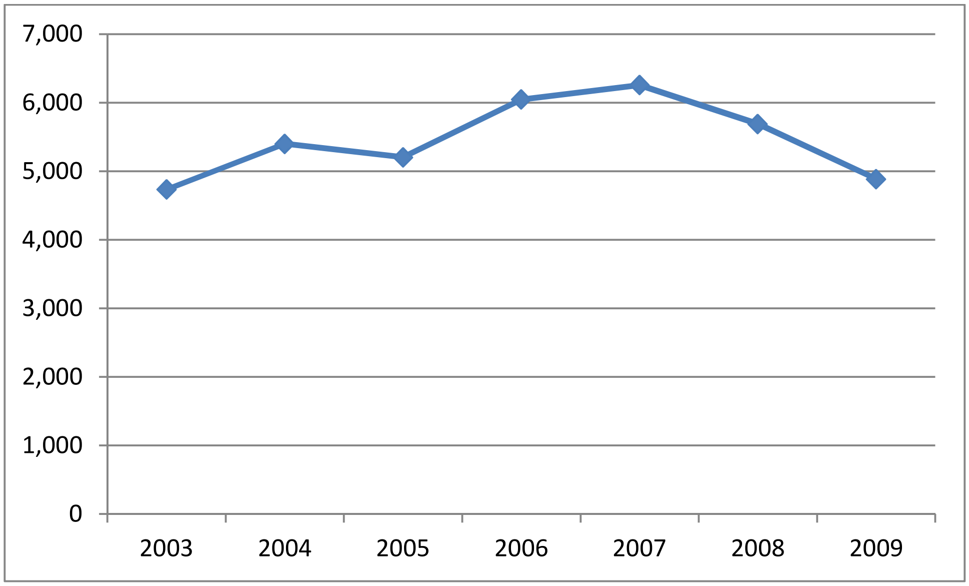
Exhibit 3C. Historical Aircraft Operations at Aurora State Airport



Source: FAA Terminal Area Forecast (December 2010).

IFR operations for the Airport appear in **Exhibit 3D**. These are actual IFR flight plans filed, although the records have been found to omit some flight plans filed after takeoff or cancelled before landing. Nevertheless, the operations in Exhibit 3D are more accurate than the total estimated operations shown in Exhibit 3C, although IFR traffic comprises only 5% to 10% of total traffic at the Airport. IFR traffic peaked at 6,257 operations in 2007, up 32% from the 4,734 operations recorded in 2003. Then traffic declined 9% to 5,688 operations in 2008. The decline continued (14% between 2008 and 2009), so that IFR ops in 2009 (4,886) were nearly the same as in 2003. The IFR activity of the last five years follows the trend of GA activity nationwide—growth to peak in 2007 and then decline in 2008 and 2009. Recovery appears to be underway. For the partial year 2010 (through August 18), IFR traffic is up 22% from the same period in 2009.

Exhibit 3D. Historical IFR Operations at Aurora State Airport



Source: Derived from IFR arrival and departure data, Airport IQ Data Center, GCR.

Businesses at the Airport have informally indicated that they have suffered during the recession. The decline in aircraft charters was the most severe, but hangar rentals, aircraft maintenance, aircraft sales and rentals, flight training, and avgas sales declined substantially. These businesses report they have fewer employees now than five years ago. However, they project business will grow between 1% and 3% per year in the future, and they will be expanding staff. Their projections for the Airport's future include continued increases in turbine-powered aircraft operations, more corporate and individual travel for business and pleasure, and declines in flight training and recreational flying.

SOCIOECONOMIC TRENDS AND FORECASTS

Aviation activity at an airport is usually tied closely to the population and economy within its service area. As the population around the airport grows, airport activity grows. Aviation activity has also traditionally been linked to employment and income factors because of the discretionary nature of personal and business travel.

This section defines the core service area for Aurora State Airport and analyzes the population and economy of the core service area and surrounding region.

Identification of Core Airport Service Area

As the strategic role analysis in Chapter 1 showed, the maximum extent of the Airport's service area is about 45 minutes. This 45-minute service area distance applies primarily to higher performance aircraft, particularly transient aircraft. This is because jet aircraft generally need longer runways, instrument approaches, and more services (jet fuel, etc.) than the average GA airport has. The occupants of some transient aircraft using the Airport may be destined for downtown Portland, but the owners of smaller aircraft do not need to travel farther than 30 minutes to find an adequate airport for basing their airplanes. The typical GA airport's service area is within a 30-minute drive from the airport, or about 20 miles, although it depends on population density, the road network, and the location and services provided at other airports in the vicinity.

Airport Service Area Population

A 20-mile distance from the Airport extends into 59 zip codes located in five counties—Clackamas (18 zip codes), Marion (10 zip codes), Multnomah (14 zip codes), Washington (13 zip codes), and Yamhill (4 zip codes). **Table 3C** shows the population within this core service area in 2000.[12] Approximately half of the residential population of the five counties lives within 20 miles of the Airport. While the Airport is located in Marion County, Marion County accounts for less than 10% of the service area population. More than two-thirds of the service area population is in Clackamas and Washington Counties.

Table 3C. Core Service Area Population (2000)

County	Population of County	Portion of County Population in Core Service Area	Population in Core Service Area
Clackamas	338,391	91%	307,936
Marion	284,834	21%	59,815
Multnomah	660,486	25%	165,122
Washington	445,342	73%	325,100
Yamhill	84,992	41%	34,847
Total	1,814,045		892,819

Source: U.S. Census Bureau population by zip code.

Different components of aviation activity have been analyzed to estimate how Airport users are distributed among the five counties. The analysis resulted in the following rough estimates of Aurora State Airport use:

- 42% of aviation activity is associated with Clackamas County.
- 9% of aviation activity is associated with Marion County.
- 13% of aviation activity is associated with Multnomah County.
- 32% of aviation activity is associated with Washington County.
- 4% of aviation activity is associated with Yamhill County.

Based on these estimates, nearly three-quarters of the Airport's aviation activity is associated with Clackamas and Washington Counties. **Table 3D** shows the derivation of these estimates of aviation use

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[12] The most recent population numbers broken down by zip code are from 2000.

by county. The "Licensed Pilots" column indicates the distribution of 2,995 licensed pilots whose mailing addresses have zip codes within the Airport's core service area. The "Population" column shows the distribution of population that is within the core service area by county, using Table 3C as the source. The "IFR Operations" column indicates the distribution of owners' mailing addresses for aircraft on IFR flight plans to or from Aurora State Airport from October 2007 through October 2009.

Table 3D. Aviation Activity Indicators Distributed by County

County	Licensed Pilots	Population	IFR Operations	Average
Clackamas	40%	34%	52%	42%
Marion	6%	7%	14%	9%
Multnomah	11%	18%	11%	13%
Washington	37%	37%	20%	32%
Yamhill	6%	4%	3%	4%
Total	100%	100%	100%	100%

Source: FAA Civil Aviation Registry, U.S. Census 2000, IFR arrival and departure data for October 2007 through October 2009 from GCR's Airport IQ Data Center.

All the five service area counties, except Marion, are in the seven-county Portland-Beaverton-Vancouver OR-WA Primary Metropolitan Statistical Area (PMSA).[13] Metro, the regional government for three Greater Portland counties, recently published aggregate population forecasts for the PMSA. Metro projects that the seven-county area will grow from 1.9 million people in 2000 to between 2.9 and 3.2 million by 2030. The growth rates these high and low forecasts represent are compared with other forecasts in **Table 3E**. The table shows that higher population growth is expected for the Portland metro region than for Oregon or the United States.

Regional population growth, particularly in-migration, varies with economic growth. However, the Portland metropolitan area no longer experiences wide swings in population due to its size and maturity. The population growth of the 1990s (2.4% per year on average) has slowed in the last decade to 1.7% per year. Future growth is expected to slow as birth rates slowly decrease and stabilize near the national average, life expectancies no longer rise as sharply as in the past, and migration trends change. Migration trends of the last century have favored movement from rural to metropolitan areas and to states on the west coast, gulf coast, and eastern seaboard; in some areas, an emerging trend is to move back to rural communities.[14]

[13] The seven counties are Clackamas, Columbia, Multnomah, Washington, and Yamhill in Oregon, and Clark and Skamania in Washington.

[14] Metro: 20 and 50 Year Regional Population and Employment Range Forecasts (April 2009 Draft)

Table 3E. Comparative Population Forecast Growth Rates, 2000 - 2030

Average Annual Growth	Geography of Forecast	Forecast Source
0.85%	United States	U.S. Census middle series (2004)
0.95%	United States	Global Insight (2008)
1.14%	Oregon	Global Insight (2008)
1.16%	Oregon	U.S. Census middle series (2004)
1.18%	Oregon	OR Office of Economic Analysis (2004)
1.28%	Portland metro region (3 counties)	OR Office of Economic Analysis (2004)
1.40%	Portland metro region (7 counties)	Global Insight Regional Service (2008)
1.37%	Portland metro region (7 counties)	Metro – low end of range (2009)
1.70%	Portland metro region (7 counties)	Metro – high end of range (2009)

Source: Metro: 20 and 50 Year Regional Population and Employment Forecasts, April 2009 Draft.

Since Metro's PMSA forecast did not distinguish individual counties, other sources were sought for county population forecasts. **Table 3F** shows historical and projected populations for the five counties in the Airport's service area. The highest growth since 1990 has been in Washington County, while the lowest growth has been in Multnomah County. Future populations forecast by the Oregon Office of Economic Analysis (OEA) and by Portland State University (for Marion County) show the highest growth rate in Washington County and the lowest in Multnomah County. In all five counties, future growth is expected to slow from the pace of the 1990s.

Applying the percentages of county populations in the Airport's core service area from Table 3C to the population projections in Table 3F results in an estimated Airport service area population of 1,407,579 in 2030. This shows considerable growth from the estimated 2000 service area population of 892,819. The average annual population growth in the core service area is 1.53% from 2000 to 2030, which is midway between the low (1.37%) and high (1.70%) rates that Metro forecast for the seven-county MSA.

Table 3F. Population History and Forecasts by County

	Clackamas County	Marion County	Multnomah County	Washington County	Yamhill County
1990	278,850	228,483	583,887	311,554	65,551
2000	338,391	284,834	660,486	445,342	84,992
2009	386,143	317,981	726,855	537,318	99,037
2030	536,123	410,431	800,565	788,162	141,505
			Average Annual Growth Rates		
1990-2009	1.73%	1.75%	1.16%	2.91%	2.20%
2000-2009	1.48%	1.23%	1.07%	2.11%	1.71%
2009-2030	1.57%	1.22%	0.46%	1.84%	1.71%

Source: For 1990, 2000, and estimated 2009 populations, U.S. Census Bureau. For 2030 forecast of Marion County, Portland State University forecast (Adopted by Marion County October 2009). For 2030 forecasts of other counties, Oregon Office of Economic Analysis, Department of Administrative Services, State of Oregon: Forecasts of Oregon's County Populations and Components of Change, 2000 - 2040 (Release: April 2004). The OEA's forecast for Marion County population in 2030 is 410,022.

Airport Service Area Economy

Air transportation use and aircraft ownership typically rises and falls with the airport service area economy. Aurora State Airport's core service area encompasses the diversity of Portland's urban economy, as well as the rural economies of northern Marion County and southern Clackamas County.

Although a recession officially began in December 2007, the Portland region's economy held steady until the fourth quarter of 2008, after the economic meltdown on Wall Street. Unemployment then rose rapidly. As of June 2010, the unemployment rate in the Portland-Vancouver-Hillsboro metropolitan area was 10.2%, down from 11.2% the previous year, but far above the 4.8% unemployment rate of 2007. Oregon's unemployment rate in June 2010 was 10.5%, down from 11.6% in June 2009. In comparison, the national unemployment rate was 9.5% in June 2010 and in June 2009.[15]

In 2009, Metro forecast employment in the PMSA. From 973,000 jobs in 2000, employment is projected to reach between 1.3 and 1.7 million in 2030. The low and high ranges for the forecast reflect average annual growth between 0.84% and 1.53%.[16] Nonfarm employment is projected to grow between 0.7% and 1.8% annually from 2008 to 2040. For manufacturing jobs, the employment forecast ranges from decline to slight growth. The highest job growth is projected for information services, business services, education and health services, and other/personal services.

Higher income often relates to higher levels of aircraft ownership, pilots per capita, and aircraft use. Higher income relates to more use of air transportation for business and more discretionary income for

[15] US Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/home.htm.

[16] Metro: 20 and 50 Year Regional Population and Employment Range Forecasts (April 2009 Draft)

personal aviation use. **Table 3G** shows that the three most populous counties in the Airport service area have per capita incomes that exceed the U.S., Oregon, and Portland metropolitan area averages. Income projections for Oregon and the U.S. show declines in 2009, recovery to 2008 levels by 2010, and annual growth between 3.4% and 5.1% through 2017. Per capita income in Oregon is projected to stay below the average for the U.S. and to grow more slowly than in the U.S.as a whole.[17]

Table 3G. Per Capita Personal Income History (dollars)

Area Name	2000	2008	Average Annual Growth Rate 2000-2008
United States	30,318	40,166	3.58%
Oregon	28,718	36,365	3.00%
Clackamas County	37,212	44,803	2.35%
Marion County	25,038	32,565	3.34%
Multnomah County	33,122	41,222	2.77%
Washington County	33,942	40,188	2.13%
Yamhill County	24,420	32,700	3.72%
Portland Metropolitan Area	32,779	39,942	2.50%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, www.bea.gov/regional/reis/drill.cfm

BASED AIRCRAFT FORECAST

The based aircraft forecast begins by presenting historical numbers of based aircraft. Then, various forecast models prepared for the Airport are analyzed and the preferred forecast for based aircraft and fleet mix through 2030 is presented.

Records of the numbers and types of aircraft based at the Airport back to 1998 appear in **Table 3H**. The numbers through 2009 were taken from the TAF, which relies on airport owner-reported estimates on periodically updated Airport Master Records (FAA 5010 forms). Oregon's aircraft registration requires an airplane owner to designate where the airplane is based, and ODA has used these registration logs to determine the based aircraft at the Airport. ODA validated the number of based aircraft for 2010 with the FAA's Civil Aviation Registry, Airport tenants, and hangar inspections.

Table 3H shows that the number of aircraft based at the Airport grew steadily through 2007 then declined in 2008 and 2009, increasing again in 2010. In 2007, the FAA launched a nationwide program to inventory based aircraft by their unique "N" numbers. The FAA contended that many of the "N" numbers reported for Aurora State Airport were also reported at other airports. The result was a

[17] Oregon Economic and Revenue Forecast, June 2010, Volume XXX, No. 2, prepared by Office of Economic Analysis, and U.S. Department of Commerce, Bureau of Economic Analysis, www.bea.gov/regional/reis/drill.cfm

decrease of 76 aircraft reported for Aurora State Airport between 2007 and 2008. Nevertheless, from 1998 through 2010 based aircraft grew at a 3.6% average rate. Jet aircraft grew at the highest annual rate, 15.3%, while the number of helicopters declined at a 1.5% average annual rate. Single engine aircraft have always dominated the based aircraft fleet, accounting for 74% in 2010.

Table 3H. Historical Based Aircraft at Aurora State Airport

Year	Single Engine	Jet	Multi-Engine	Helicopter	Other	Total
1998	175	4	22	30	2	233
1999	175	4	22	30	2	233
2000	193	5	30	35	2	265
2001	319	7	27	34	0	387
2002	319	7	27	34	0	387
2003	323	7	27	34	0	391
2004	319	7	27	34	0	387
2005	319	7	27	34	0	387
2006	322	5	66	27	1	421
2007	322	33	38	27	0	420
2008	276	14	30	24	0	344
2009	258	12	30	24	0	324
2010	261	23	40	25	5	354

Source: FAA Terminal Area Forecast, December 2010 for 1998 through 2009. ODA registration records for 2010.

It appears the number of aircraft jumped up when the Southend Airpark opened. Southend Airpark's increased hangar capacity and expansion of aircraft services may have led to the Airport gaining a greater share of regional aviation activity. **Table 3I** illustrates the change in market share. It provides based aircraft history for four airports with comparable facilities and services to the Airport. These four airports are located at the edges of Aurora State Airport's maximum service area—Hillsboro Airport, Troutdale Airport, McMinnville Municipal Airport, and McNary Field in Salem. These airports have roughly comparable runway length, runway strength, instrument approach capability, and services that make them "business jet-capable."[18] Other airports in the region are used almost exclusively by single engine and multi-engine piston aircraft and generally do not have the features needed or desired for business jets.

[18] Portland International Airport is capable of handling business jets and has based general aviation aircraft, but its role as a medium-hub commercial service airport constrains its use for general aviation. Consequently, it is excluded from the analysis.

Between 1998 and 2009, Aurora State Airport's market share of based aircraft grew from 21% to 30%. Two of the other airports lost market share and two increased slightly. Aurora State Airport gained in its share of single engine, jet, and multi-engine aircraft. The Airport's share of helicopters and other aircraft declined from 1998 to 2009.

Table 3I. Change in Based Aircraft Market Shares at "Jet-Capable" Airports

Year	Aircraft Type	Aurora	Hillsboro	Troutdale	McMinnville	McNary (Salem)	Total Based Aircraft
1998	Single engine	175 (21%)	288 (34%)	149 (18%)	76 (9%)	148 (18%)	836 (100%)
	Jet	4 (11%)	24 (69%)	2 (6%)	1 (3%)	4 (11%)	35 (100%)
	Multi-Engine	22 (18%)	60 (48%)	20 (16%)	5 (4%)	17 (14%)	124 (100%)
	Helicopter	30 (46%)	18 (28%)	5 (8%)	10 (15%)	2 (3%)	65 (100%)
	Other	2 (3%)	0 (0%)	1 (2%)	18 (31%)	38 (64%)	59 (100%)
	Total	233 (21%)	390 (35%)	177 (16%)	110 (10%)	209 (18%)	1,119 (100%)
2009	Single engine	258 (33%)	145 (19%)	129 (17%)	88 (11%)	153 (20%)	773 (100%)
	Jet	12 (18%)	38 (56%)	2 (3%)	5 (7%)	11 (16%)	68 (100%)
	Multi-Engine	30 (28%)	30 (28%)	14 (13%)	11 (11%)	21 (20%)	106 (100%)
	Helicopter	24 (25%)	40 (42%)	9 (9%)	11 (12%)	11 (12%)	95 (100%)
	Other	0 (0%)	0 (0%)	0 (0%)	17 (46%)	20 (54%)	37 (100%)
	Total	324 (30%)	253 (24%)	154 (14%)	132 (12%)	216 (20%)	1,079 (100%)

Source: FAA Terminal Area Forecast, December 2010.

While some aircraft may have relocated from the Hillsboro and Troutdale Airports to Southend Airpark at Aurora, this was not likely the only cause of the market shift. The removal of hangars at other airports in the region may have contributed to the gain in the Airport's market share. In 2008, Portland International

Airport removed 18 hangars for a road improvement project. Since 2001, the following private airports have closed in the region: Basl Hill Farms Airstrip, Bonney Acres, Clackamas Heights, Cup Port, Hayden Mountain, McGill, Myers, and Pat's Pasture. Farther away in Vancouver, Washington, the privately owned Evergreen Field, with up to 165 aircraft, closed in 2006.

For the 1998 through 2009 period, Aurora's average annual growth rate was the highest of the five airports (3.0%), followed by McMinnville (1.7%), Salem, (0.3%), Troutdale (-1.3%), and Hillsboro (-3.9%). Combining the five airports, the number of based aircraft declined at an average annual rate of 0.3% between 1998 and 2009. The highest rate of decline was for other aircraft (-4.2%). On average, multiengine aircraft declined 1.4% annually and single engine aircraft declined 0.7% annually. In contrast, jets and helicopters increased – at 6.2% and 3.5% average annual growth rates, respectively.

The overall decline in based aircraft may be due to slow recovery from the economic recession or the relocation of single engine and multi-engine aircraft to airports that are not "jet-capable." Overestimated 1998 numbers or underreported 2009 numbers may also account for the decline. The FAA's based aircraft inventory in 2007 generally found overestimated numbers at airports across the country. However, since the FAA performed its based aircraft inventory in 2007, updating that database has depended on airport owners doing so voluntarily.

Socioeconomic changes often result in changes in the number of based aircraft at an airport. The population within the Airport service area has grown. Employment and income also grew until the recession hit the region hard in late 2008. However, very low statistical correlation[19] was found between historical based aircraft numbers at Aurora State Airport and the historical population, employment, or income statistics of the service area. The Airport's abrupt change in market share due primarily to the Southend Airpark development is probably the reason based aircraft numbers do not correlate with socioeconomic data.

Although the historical relationship between aviation activity and socioeconomic variables cannot be used for linear regression forecasting of activity at the Airport, other forecasting models can be used. Trend analysis is a linear regression model that relies on projecting past trends into the future. In trend analysis, a regression equation uses time as the independent variable. Market share modeling assumes an airport will retain its share of the national or state market in the future, relying on forecasts prepared for the nation or state to determine the forecast for an individual airport.

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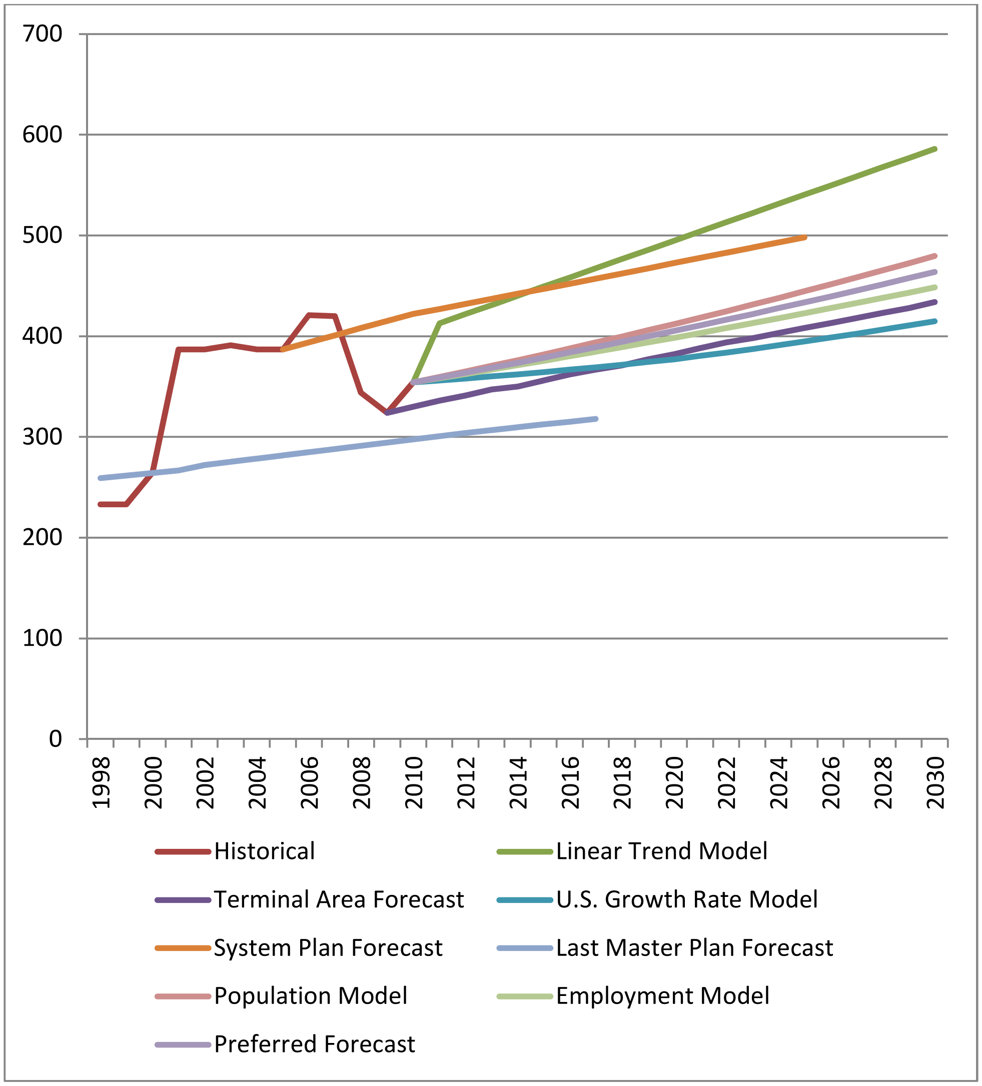
[19] Regression analysis is often used to forecast aviation activity. In regression analysis, the value being estimated (or forecast)—the dependent variable—is related to other variables—the independent or explanatory variables—that "explain" the estimated value. An example of a regression equation is to estimate based aircraft as a function of economic variables. The relationship is estimated using historic data for the independent and dependent variables. The explanatory power of the equation is measured by the R^2 statistic (called the coefficient of determination). An R^2 of 0 indicates that there is no statistical relationship between changes in the independent and dependent variables. R^2 values near 1.0 mean that there is a very strong statistical relationship. The R^2 values for Aurora State Airport based aircraft and regional population, income, and employment were less than 0.3.

Exhibit 3E shows the range of five forecast models and three other forecasts that were considered for the Aurora State Airport based aircraft forecast. They are described after the exhibit.

Exhibit 3E. Comparison of Based Aircraft Forecasts



U.S. Growth Rate Model (0.80% Annual Growth).

This is a market share model because it assumes that each type of aircraft at the Airport will retain its current share of the national market. Growth rates from the FAA's March 2010 forecasts were applied to the Airport's current fleet mix. The result is an average annual increase of 0.80% from 2010, to 415 aircraft in 2030. Growth in the first ten years is higher than in the last ten years of the forecast. The highest forecast growth rate is for jets (4.25%), followed by helicopters (3.0%), other aircraft (2.25%), multi-engine (0.65%, averaging the rates for multi-engine piston and turboprop aircraft), and single engine (0.05%). The composition of the 2030 fleet projected by this model is 264 single engine aircraft, 53 jets, 46 multi-engine aircraft, 45 helicopters, and 8 other aircraft. The drawback of this model is that the Airport's history has been to grow at a much higher rate than the nation as a whole. Population in the service area is also projected to grow at a higher rate than the U.S. population.

Linear Trend Model (2.55% Annual Growth).

This forecast model analyzes historical growth from 1998 through 2010 and continues that growth trend into the future. The result is an average annual growth rate of 2.55%, resulting in a projection of 586 based aircraft in 2030. From 2010 to 2030, single engine aircraft grow to 457 at 2.85% per year, jets grow to 48 at 3.76% per year, multi-engine aircraft grow to 69 at 2.75% per year, helicopters decline at 4.34% per year to 100, and other aircraft decline at 6.85% per year, to 1. The problem with this model is that the Airport's growing share of the regional market is likely to slow, and it is unlikely that all aircraft types will grow according to the historical trends. The model's strong growth in single engine aircraft and decline in helicopters opposes state and national trends. The decline in helicopters is also inconsistent with the fact that a new helicopter business is planning to operate from the Airport soon.

Population Model (1.53% Annual Growth).

While the historical based aircraft data did not correlate with historical population, both based aircraft and population in the service area increased between 1998 and 2010, showing they are moving in the same direction. The annual growth rate projected for the core service area population, 1.53%, is used to forecast 480 based aircraft in 2030.

Employment Model (1.19% Annual Growth).

Historical numbers of based aircraft did not correlate any better with employment data than with population. However, employment is usually a factor in based aircraft growth and decline. A 1.19% annual growth rate, the average of the high and low ranges of Metro's 2030 employment forecast, resulted in growth to 448 aircraft in 2030.

Terminal Area Forecast (1.40% Annual Growth).

The FAA's Terminal Area Forecast projects that based aircraft will grow to 424, reflecting 1.4% average annual growth from 2009 to 2030. Jet aircraft are forecast to grow at the highest rate, 6.93%, while multi-engine aircraft are projected to remain unchanged. The composition of the 2030 fleet according to the Terminal Area Forecast is 321 single engine aircraft, 49 jets, 30 multi-engine aircraft, and 34 helicopters.

System Plan Forecast (1.27% Annual Growth).

The *Oregon Aviation Plan 2007* used 2005 as the base year, when the Airport's based aircraft totaled 387. It projected yearly growth at 1.27% to 498 aircraft in 2025.

Last Master Plan Forecast (1.09% Annual Growth).

The 2000 Aurora State Airport Master Plan projected 1.09% annual growth in the number of based aircraft, from 259 in 1998 to 318 in 2017. This forecast was constrained, based on ODA's decision not to expand the Airport to serve a more demanding critical aircraft. An unconstrained forecast projected growth to 345 aircraft in 2017. The constrained and unconstrained forecasts for 2017 were reached by 2001.

Preferred Forecast (1.36% Annual Growth).

The preferred forecast uses the average of the growth rates in the Population and Employment Models, 1.36% per year, so that based aircraft reach 464 in 2030. The Preferred Forecast falls in the mid-range of the other forecasts and models. It is higher than national forecasts, but in line with growth projected by Airport businesses, between 1% and 3% per year over the next 20 years. While the Airport may experience a spurt in based aircraft resulting from additional landside development, the other comparable airports (Hillsboro, Troutdale, and McNary Field in Salem) may also expand to meet metropolitan area demand. The preferred forecast assumes it is more likely that Aurora State Airport will maintain its share of regional based aircraft than gain market share as it did in the last decade.

Table 3J presents the based aircraft forecast and fleet mix. The fleet mix was determined by averaging the fleet mixes of the Linear Trend and US Growth Rate Models, and then adjusting primarily the single engine and helicopter shares. The single engine share was lowered slightly and the helicopter share raised, to be more in line with expectations for the Airport. Multi-engine aircraft were divided between turboprop and piston, with turboprop aircraft growing faster than multi-engine piston aircraft. The resulting annual growth rates from 2010 to 2030 differ by aircraft type: 3.7% for jets, 2.6% for turboprop, 0.6% for multi-engine piston, 1.0% for single engine, 2.8% for helicopter, and 0.0% for other.

Table 3J. Based Aircraft and Fleet Mix Forecast

Year	Jet	Turboprop (Multi-engine)	Multi-engine Piston	Single Engine	Helicopter	Other	Total
2010	23	16	24	261	25	5	354
2015	27	19	24	276	28	5	379
2020	33	20	25	288	34	5	405
2030	47	26	27	316	43	5	464
				Fleet Mix			
2010	6%	5%	7%	74%	7%	1%	100%
2015	7%	5%	6%	73%	8%	1%	100%
2020	8%	5%	6%	71%	9%	1%	100%
2030	10%	6%	6%	68%	9%	1%	100%

Source: WHPacific, Inc.

The fleet mix is projected to shift over the 20-year forecast period, consistent with trends the FAA has projected nationally. Single engine aircraft remain predominant at the Airport, but decline from 74% to 68% over the next 20 years. The proportion of jets and helicopters increases over the planning period, while the proportion of total multi-engine aircraft stays about the same, with some shifting between the multi-engine turboprop and multi-engine piston shares.

AIRCRAFT OPERATIONS FORECAST

This section begins with a review of historical trends in aircraft operations. Previous aircraft operations forecasts are reviewed and the preferred aircraft operations forecast is explained and presented. The operations forecasts include total annual operations, local vs. itinerant operations, operational fleet mix, and peak activity.

Aircraft operations are difficult to measure at a non-towered airport. Research into the problem has concluded that the most accurate and cost-effective way to estimate aircraft operations at a non-towered airport is to sample traffic with an acoustical counter for two weeks for each of the four seasons and extrapolate that sample into an annual estimate.[20] However, acoustical counters can provide false readings from other sounds, miss landings and takeoffs at mid-field by quiet aircraft, and are less reliable for helicopters than fixed wing traffic when helicopters can use multiple takeoff and landing locations and routes.

From 1979 through 2003, ODA's Aircraft Traffic Monitoring Program employed acoustical counting to estimate the levels of annual aircraft operations at Oregon airports. No acoustical samples have been taken since 2003, and combined with the inherent flaws associated with this method, it has been determined that the FAA's Terminal Area Forecast is the best source of historical aircraft operations for the Airport. The Terminal Area Forecast reports periodically updated Airport Master Record estimates provided by ODA.

Table 3K shows the history of operations from 1998 to 2009. Operations peaked at 90,180 in 2000. Their decline to 72,895 in 2001 may be attributed to 9/11. Since 2001, operations have increased slowly to 89,495 in 2009, the last year of historical estimated operations records according to the Terminal Area Forecast.

The composition of operations has not varied substantially from 1998 through 2009. Air taxi (FAR Part 135) operations stayed close to 11% of total operations. Military operations remained a very small portion of total operations, and all military operations were itinerant. The split of GA aircraft operations between itinerant and local varied a bit more. Local operations ranged between 41% and 56% of total GA operations, averaging 45%.

[20] Transportation Research Board, Airport Cooperative Research Program, ACRP Synthesis 4: Counting Aircraft Operations at Non-Towered Airports (2007).

Table 3K. Historical Aircraft Operations at Aurora State Airport

Year	Air Taxi	GA Itinerant	Military Itinerant	Total Itinerant	GA Local	Total Local	Total Operations
1998	8,791	34,650	180	43,621	23,200	23,200	66,821
1999	8,791	34,650	180	43,621	23,200	23,200	66,821
2000	9,000	36,000	180	45,180	45,000	45,000	90,180
2001	6,190	39,475	250	45,915	27,980	27,980	73,895
2002	9,227	39,713	250	49,190	29,402	29,402	78,592
2003	9,325	39,951	250	49,526	30,824	30,824	80,350
2004	9,422	40,188	250	49,860	32,208	32,208	82,068
2005	9,520	40,426	250	50,196	33,628	33,628	83,824
2006	9,431	39,965	250	49,646	34,064	34,064	83,710
2007	9,564	41,176	250	50,990	34,892	34,892	85,882
2008	9,656	41,409	250	51,315	36,030	36,030	87,345
2009	9,788	42,592	250	52,630	36,865	36,865	89,495

Source: FAA Terminal Area Forecast, December 2010.

One method for forecasting aircraft operations at GA airports is to apply a ratio of operations per based aircraft (OPBA) to the based aircraft forecast. For each year in the forecast, operations equal the forecast number of based aircraft multiplied by an OPBA ratio. Some of the operations in an OPBA ratio are by based aircraft and some are by transient, or itinerant, aircraft. The FAA has provided the following guidelines for OPBA ratios:[21]

- 250 OPBA is typical at a rural GA airport with little itinerant traffic.
- 350 OPBA is typical at a busier GA airport with more itinerant traffic.
- 450 OPBA is typical at a busy reliever airport with a large amount of itinerant traffic.

The historical OPBA ratio for Aurora State Airport averages 240 per year,[22] varying from a high of 340 in 2000, to a low of 191 in 2001. In 2009, the OPBA was 276. For comparison, an OPBA ratio was extracted from the Airport user survey that was conducted as part of this Master Plan, in the fall of 2009. The survey asked airport owners and operators to estimate their annual number of landings. Information for fixed wing aircraft varied from 30 annual landings (about once every two weeks) to 300 annual landings (nearly once a day) per aircraft. The average per fixed wing aircraft was approximately 145 landings, which equates to 290 annual operations. The survey results covered a variety of aircraft

[21] FAA Order 5090.3C, Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)

[22] The number changed from the earlier forecast because three years of based aircraft numbers were lowered, which increased the ratio of operations per based aircraft for those years. Also, an additional year of operations was available.

types, from small single engine piston aircraft to mid-sized business jets. For helicopters, the number of landings per aircraft was much higher, up to 1,500 per year; however, 70% to 90% of the landings are not at the Airport. This illustrates the difference in how helicopters operate, compared to fixed wing aircraft.

The Airport has a lower OPBA than Hillsboro, McMinnville, Troutdale, and McNary Field in Salem. These other airports are located in the same region and, except for McMinnville, have more reliable records of aircraft operations because they have air traffic control towers. The average OPBA ratios for these airports from 1998 to 2008 are as follows:

- Hillsboro 639 OPBA
- McMinnville 592 OPBA
- Troutdale 419 OPBA
- Salem 411 OPBA

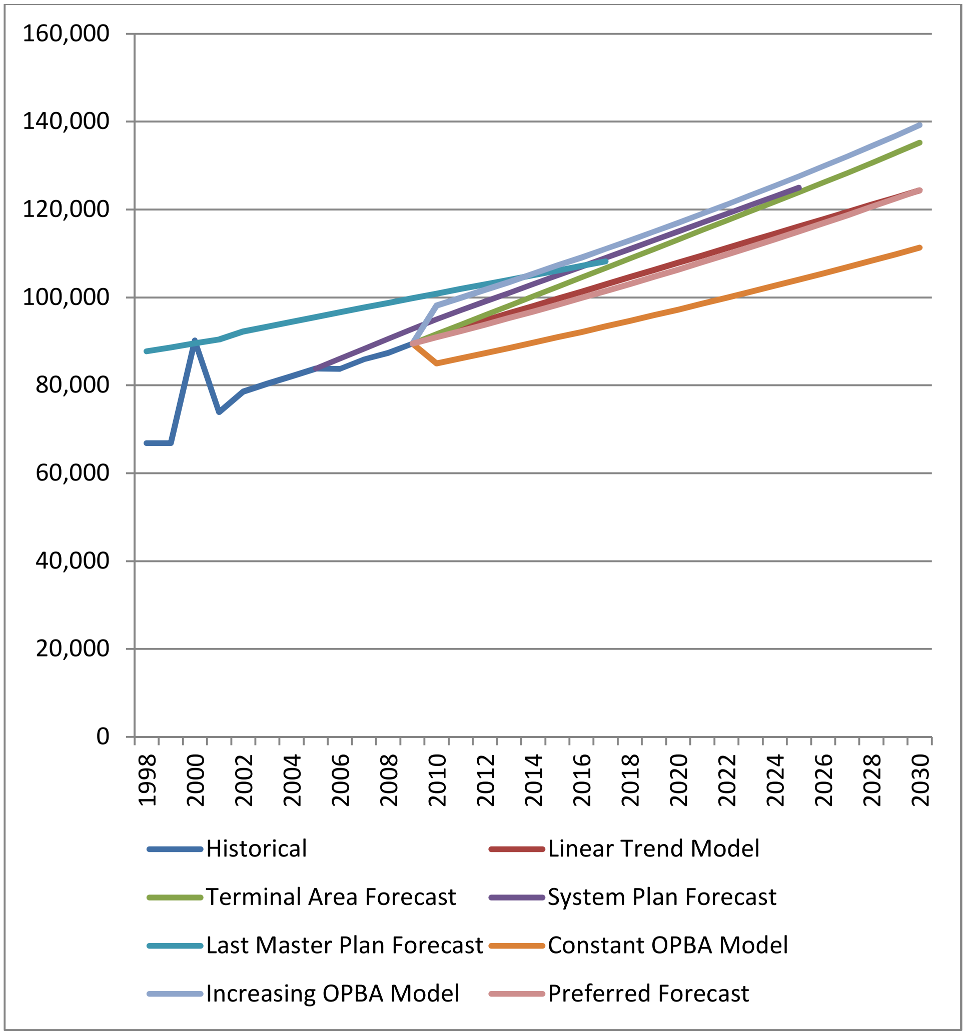
Aurora State Airport's lower OPBA ratio is probably due to a combination of factors, including a lower proportion of local operations (less flight training that entails a high number of touch-and-go operations per aircraft) and a large number of small aircraft that are flown infrequently.[23]

When an OPBA ratio is used for forecasting, the OPBA might be held constant over the forecast period, or it might increase over the forecast period. The projection of an increase in OPBA would be supported by the national trend and FAA's national forecasts over the last several years for increasing aircraft utilization. Put another way, GA and air taxi aircraft hours flown have been increasing faster than the active aircraft fleet, and the FAA has been forecasting higher growth rates for hours flown than for aircraft. Longer trips might account for some of the increase in hours flown, but most of the higher utilization translates to more trips per aircraft. More trips mean more takeoffs and landings per aircraft.

Forecast models for aircraft operations that used the OPBA model and those that did not were considered. **Exhibit 3F** compares the various forecast models and previous forecasts of aircraft operations at the Airport, which are described after the exhibit.

[23] The Airport user survey found many smaller piston airplanes are flown less than once a week, or less than 100 operations per year.

Exhibit 3F. Comparison of Aircraft Operations Forecasts for Aurora State Airport



Linear Trend Model (1.58% Annual Growth).

This model analyzes historical growth from 1998 through 2009 and continues that growth trend into the future. The result is an average annual growth rate of 1.58%, resulting in a projection of 124,347 operations in 2030. By 2030, the OPBA is 268.

Terminal Area Forecast (1.99% Annual Growth).

The FAA's Terminal Area Forecast projects that operations will grow to 135,240 in 2030, reflecting 1.99% average annual growth from 2009 to 2030. By 2030, the OPBA is 312.

System Plan Forecast (2.02% Annual Growth).

The *Oregon Aviation Plan 2007* used 2005 as the base year, when Aurora State Airport's aircraft operations totaled 83,824. It projected yearly growth at 2.02% to 124,978 operations in 2025. The OPBA ratio grew over the forecast period, from 217 to 251.

Last Master Plan Forecast (1.11% Annual Growth).

The 2000 Aurora State Airport Master Plan projected 1.11% annual growth in aircraft operations, from 87,714 in 1998 to 108,204 in 2017. The forecast was prepared by using a constant 339 OPBA ratio.

Constant OPBA Model (1.05% Annual Growth).

This model uses the average OPBA from the 1998 to 2009 period, 240. In 2030, aircraft operations reach 111,360, representing 1.05% average annual growth rate from 2009 to 2030. Since the OPBA in 2009 was 276, higher than the 11-year average, the resulting growth rate is slightly lower than the growth rate of the based aircraft forecast. This is inconsistent with the trend for higher aircraft utilization.

Increasing OPBA Model (2.13% Annual Growth).

This model follows the FAA's national forecast for higher aircraft utilization. Over the forecast period, the OPBA ratio is increased to 300. The resulting projection of aircraft operations in 2030 is 139,200, and the average annual growth rate is 2.13%.

Preferred Forecast (1.58% Annual Growth).

The preferred forecast uses the same growth rate as the linear trend[24]. In 2030, aircraft operations reach 124,386, representing 1.58% average annual growth rate from 2009 to 2030. The Preferred Forecast falls in the mid-range of the other forecasts and models. The growth rate is slightly higher than the growth rate of the based aircraft forecast, which is consistent with the trend for higher aircraft utilization. Over time, the OPBA ratio increases to reach 268 in 2030.

Table 3L distributes the preferred forecast for aircraft operations among the categories that the FAA uses for aircraft operations. Air taxi operations remain 11% of total aircraft operations. The split between GA itinerant and local operations is 60% itinerant and 40% local through the planning period. Compared to historical proportions of itinerant and local operations, future local operations are a smaller portion, which reflects the expectation of lessening flight training at the Airport. Itinerant military operations remain constant, and, consistent with the past, there are no local military aircraft operations in the forecast.

[24] The previous operations preferred forecast used the constant OPBA model (1.9% average annual growth rate) from the 1998 to 2008 period. This update took a fresh look at the models and determined this model is no longer appropriate, as it is yields an average annual growth rate inconsistent with trends expected at the Airport and nationwide.

Table 3L. Aircraft Operations Forecast

Year	Itinerant Air Taxi	Itinerant GA	Itinerant Military	Total Itinerant	Local GA	Total Operations
2009 Historical	9,788	42,592	250	52,630	36,865	89,495
2010 Estimated	10,000	48,395	250	58,645	32,264	90,909
2015	10,815	52,354	250	63,419	34,902	98,321
2020	11,697	56,635	250	68,582	37,756	106,338
2030	13,682	66,272	250	80,205	44,181	124,386

Source: WHPacific, Inc., except Terminal Area Forecast for 2009.

Operations Fleet Mix Forecast

Because aircraft operations include those by transient aircraft as well as those by based aircraft, the operational fleet mix for the Airport is not the same as the based aircraft fleet mix (Table 3J). Since it is a non-towered airport, the operational fleet mix for the Airport must be estimated. IFR traffic records help with the estimate, although IFR operations account for a small portion of the total Airport traffic, and higher performance (turbine-powered) aircraft are disproportionately represented in the IFR traffic. The Airport users surveyed reported higher utilization for jets and turboprops than for piston airplanes.[25] Local operations are predominantly for training, and are reportedly dominated by piston aircraft and helicopters.

National data confirm that business jet aircraft are used more often than piston aircraft. Tables 3A and 3B show that piston aircraft are flown 83 hours per year and jet aircraft are flown 252 hours per year on average. Consequently, jets have a greater share of the operations at the Airport than their share of based aircraft. In addition, since Aurora State Airport is "jet-capable," and most of the 46 other airports in the service area are not, the Airport will be used more by transient jet aircraft than most of the other airports.

Using this information and considering national growth rates for hours flown, the operations fleet mix forecast was prepared (**Table 3M**). Piston-powered airplanes are projected to have a declining share of total operations, while jet, turboprop, and helicopter traffic have growing shares.

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[25] For the 86 aircraft with use estimates in the user survey results, helicopters have the highest utilization—up to 1,500 operations per year per helicopter, although 70% to 90% of those operations are not at Aurora State Airport. The jets in the survey are used nearly 600 operations per year per aircraft. Piston aircraft have the lowest utilization, 60 to 150 operations per year.

Table 3M. Operations Fleet Mix Forecast

Year	Jet	Turboprop	Multi-engine Piston	Single Engine	Helicopter	Total Operations
2010	10,909	9,091	8,182	35,455	27,273	90,909
2015	12,782	10,815	7,866	35,396	31,463	98,321
2020	15,951	11,697	7,444	37,218	34,028	106,338
2030	22,389	14,926	8,707	37,316	41,047	124,386
			Fleet Mix			
2010	12%	10%	9%	39%	30%	100%
2015	13%	11%	8%	36%	32%	100%
2020	15%	11%	7%	35%	32%	100%
2030	18%	12%	7%	30%	33%	100%

Source: WHPacific, Inc.

Peak Aircraft Operations Forecast

As airport activity fluctuates from month to month, day to day, and hour to hour, airside and landside facilities should be designed to accommodate peak levels of use. The forecast of annual aircraft operations serves as the basis for generating forecasts of peak demand. Peak demand is usually expressed as "Peak Month" (the month in a calendar year when the highest level of activity occurs), "Design Day" (the average daily level of activity during the Peak Month), and "Design Hour" (the busiest hour within the Design Day).

Peak demand forecasts at the Airport are based on assumptions that consider the following:

- Peaking characteristics determined from fuel sales and IFR flight plan data
- Guidance regarding peak demand from FAA Advisory Circular 150150/5060-5, *Airport Capacity and Delay*

Historical fuel sales and IFR operations records are available by month. They indicate that May through September is typically the busiest time at the Airport, and the winter months are the slowest time. The single busiest month varies from year to year, but for both fuel and IFR activity, the busiest month accounts for 11% of the annual total, on average.

The Design Day is the average day of the Peak Month, calculated by dividing Peak Month operations by 30.5 days. Based on FAA guidance for the Airport's mix of aircraft, the Design Hour is estimated to contain 11% of the Design Day operations.[26] **Table 3N** presents the resulting peak demand forecasts for Aurora State Airport.

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[26]FAA Advisory Circular 150/5060-5, Airport Capacity and Delay, Table 2-1.

Table 3N. Peak Operations Forecast

Year	2010	2015	2020	2030
Annual	90,909	98,321	106,338	124,386
Peak Month	10,000	10,815	11,697	13,682
Design Day	328	355	384	449
Design Hour	36	39	42	49

Source: WHPacific, Inc.

CRITICAL AIRCRAFT AND AIRPORT REFERENCE CODE

According to FAA criteria, an airport's design is based on the characteristics of the critical aircraft, which is the most demanding aircraft that uses the airport "regularly" or "substantially." The FAA defines regular or substantial use as at least 500 annual itinerant operations. The Airport Reference Code (ARC) is the main criterion for determining applicable FAA airport design standards for dimensions such as runway and shoulder widths; separations of runways, taxiways, and taxilanes; and cleared areas. The Aircraft Approach Category and the Airplane Design Group of the critical aircraft define the ARC. The Aircraft Approach Category is determined by the approach speed, or 1.3 times the stall speed of the aircraft in its landing configuration at its maximum landing weight. The letters A, B, C, D, and E. represent the Aircraft Approach Category. The Airplane Design Group of the aircraft is based on the wingspan or tail height, and is defined by Roman numerals I, II, III, IV, V and VI. **Table 3O** shows the ARC component definitions and typical aircraft that meet these definitions.

According to the 2000 Airport Master Plan, the planned ARC was B-II, exemplified by the King Air turboprop and the Cessna Citation jet. At that time, ODA decided to constrain the forecast by keeping the airfield ARC at B-II. A runway designed for ARC B-II is adequate for about 45% of the business jets manufactured.[27]

[27] Central Region FAA Newsletter, October 2001.

Table 3O. Airport Reference Code (ARC) Components

Approach Category	Approach Speed	Typical Aircraft
A	Less than 91 knots	Cessna 150, 172, 206, Beech Bonanza
B	91 to 120 knots	King Air, Piper Navajo, Gulfstream I
C	121 to 140 knots	Boeing 727, 737, Learjet, Challenger
D	141 to 165 knots	Boeing 747, Gulfstream V
Airplane Design Group	**Wingspan**	**Typical Aircraft**
I	Less than 49 feet	King Air, Cessna 150, 172, 206, Gates Learjet, Beech Bonanza
II	49 to 78 feet	King Air, Super King Air, Cessna Citation, Dassault Falcon, Gulfstream I, Challenger
III	79 to 117 feet	Boeing 727, 737, DC-3, DC-6, Gulfstream V

Airplane Design Group may be determined by tail height, if more demanding than wingspan:

Airplane Design Group	Tail Height
I	Less than 20 feet
II	20 to 29 feet
III	30 to 44 feet

Source: FAA AC 150/5300-13, Airport Design

Note: Aircraft Approach Category E (166 knots or more) and Airplane Design Groups IV, V, and VI (118 feet or more) are not shown.

The Airport has now passed the 500 operations threshold for Aircraft Approach Category C, so the current ARC should be C-II. To prove this, **Table 3P** presents the distribution of documented[28] jet aircraft operations by ARC for FY 2007 and FY 2009. The two years represent recent peak and valley years, neither of which is typical of activity at the Airport. The peak year (2007) was the boom time immediately preceding the recession, and the valley year (2009) was the deepest part of the recession. The average of the two years reflects activity in a more normal year. The source of this information is IFR flight plan records. Undocumented VFR jet operations are not included in the table, nor are the many turboprop and piston aircraft operations that fall in Approach Categories A or B and in Airplane Design Groups I or II.

[28] Documentation is from IFR flight plans filed. They were reviewed, and VFR operations required to make trips whole were added. For example, if an individual aircraft's IFR record showed a flight from Aurora State to another airport, and its next sequential IFR operation originated at Aurora State, a VFR operation was added to bring the aircraft back to Aurora State for the next flight. One Flight Operations Director at the Airport confirmed that IFR clearance is sometimes obtained after VFR departure or cancelled prior to arrival, to save time.

Table 3P. Documented Jet Operations by Airport Reference Code

ARC	FY 2007	FY 2009	Average
B-I	689	273	481
B-II	883	785	834
B-III	0	4	2
C-I	293	209	251
C-II	406	181	293
C-III	2	0	1
D-I	8	0	4
D-II	2	2	2
D-III	0	2	1
Unknown or Other ARC	59	64	62
Total	2,342	1,520	1,931

Source: Derived from IFR flight plan data (Detailed GA Activity and Airline reports) obtained from GCR's Airport IQ Data Center. Note: during the update, more research was done to identify ARCs for the "Unknown" aircraft, which increased the number of B-I, B-II and C-II aircraft operations.

The Cessna Citation is the most prevalent jet aircraft represented in the documented operations and in the based aircraft fleet. In the FY 2007 data, the Cessna 525 Citation (ARC B-I, 10,400 pounds maximum takeoff weight) is predominant. In the FY 2009 data, the Cessna 560 Citation (ARC B-II, 16,300 pounds maximum takeoff weight) is predominant. Other models of the Cessna Citation[29] account for large numbers of operations at the Airport, along with the Dassault Falcon 900[30] and the Israel Aircraft Industries (IAI) Westwind 1124[31] and Astra 1125.[32]

Aircraft Approach Category C accounts for 701 documented operations in FY 2007 and 390 in FY 2009, resulting in an average of 545 operations. The number of Aircraft Approach Category D airplane operations is negligible, as are operations in Airplane Design Group III.

With more than 500 operations in Aircraft Approach Category C and more than 500 operations in Airplane Design Group II, the appropriate ARC for the Airport is C-II. With based jet aircraft and jet aircraft operations projected to grow at rates over 3% per year, the ARC is not likely to grow from

[29] ARC B-I and B-II, maximum takeoff weights up to 24,000 pounds
[30] ARC B-II, 45,500 pounds maximum takeoff weight
[31] ARC C-I, 23,500 pounds maximum takeoff weight
[32] ARC C-II, 23,500 pounds maximum takeoff weight

Aircraft Approach Category C to D or from Airplane Design Group II to III. Aurora State Airport meets many of the ARC C-II design criteria now, as the next chapter will show.

The current and forecast ARC is C-II, which reflects a family of business jets. The critical aircraft is the aircraft in ARC that uses the Airport the most. The current critical aircraft is the IAI Astra 1125. A runway designed for ARC C-II would be adequate for about 90% of the business jets manufactured.[33] In Table 3P, the Astra accounted for the largest number of C-II operations. An aircraft based in Eugene accounted for most of the Astra operations, and operations by Astra aircraft based elsewhere in Oregon and in California were also recorded. An Astra was recently based at the Airport.

In the future, a newer model of ARC C-II business jet, the Cessna Citation X, is projected to overtake the Astra as the predominant C-II aircraft. The Citation X (36,100 pounds maximum takeoff weight) is in the transient fleet using the Airport now, but is not yet part of the Airport's based aircraft fleet. An aircraft operator based at the Airport is buying a Citation X for its increased range capability, to be able to fly nonstop to the East Coast. The future critical aircraft is the Cessna Citation X.

The ARC does not determine the runway length required. Among other things, runway length differs with aircraft performance and with stage length (trip distance), which determines the fuel load. Runway length is examined in the next chapter.

SUMMARY OF FORECASTS

Table 3Q summarizes all the aviation demand forecasts presented previously in this chapter. **Appendix H** includes the FAA TAF Worksheet, which is used to compare the two forecasts.

With this forecast data, the next step in the master planning process is to calculate the ability of existing facilities to meet the forecasted demand. Additionally, the next chapter will identify needed enhancements of airside and landside facilities to accommodate forecasted demand.

[33] Central Region FAA Newsletter, October 2001.

Table 3Q. Summary of Forecasts

	2010	2015	2020	2030
Based Aircraft				
Jet	23	27	33	47
Turboprop (Multi-Engine)	16	19	20	26
Multi-engine Piston	24	24	25	27
Single Engine	261	276	288	316
Helicopter	25	28	34	43
Other	5	5	5	5
Total	**354**	**379**	**405**	**464**
Aircraft Operations				
Itinerant Operations				
Air Taxi	10,000	10,815	11,697	13,682
GA	48,395	52,354	56,635	66,272
Military	250	250	250	250
Subtotal	*58,645*	*63,419*	*68,582*	*80,205*
Local Operations				
GA	32,264	34,902	37,756	44,181
Total	**90,909**	**98,321**	**106,338**	**124,386**
Operations Fleet Mix				
Jet	12%	13%	15%	18%
Turboprop	10%	11%	11%	12%
Piston	48%	44%	42%	37%
Helicopter	30%	32%	32%	33%
Peak Operations				
Peak Month	10,000	10,815	11,697	13,682
Design Day	328	355	384	449
Design Hour	36	39	42	49

Source: WHPacific, Inc.