Chapter Three
AVIATION DEMAND FORECASTS

The definition of demand that may reasonably be expected to occur during the useful life of an airport's key components (e.g., runways, taxiways, terminal buildings, etc.) is an important factor in facility planning. In airport master planning, this involves projecting potential aviation activity for at least a 20-year timeframe. Aviation demand forecasting for the Hillsboro Airport (Airport) will primarily consider based aircraft, aircraft operations (takeoffs and landings), and peak activity periods.

The Federal Aviation Administration (FAA) has oversight responsibility to review and approve aviation forecasts developed in conjunction with airport planning studies. The FAA reviews individual airport forecasts with the objective of comparing them to its *Terminal Area Forecasts* (TAF) and the *National Plan of Integrated Airport Systems* (NPIAS). Even though the TAF is updated annually, in the past there was almost always a disparity between the TAF and master planning forecasts. This is primarily because the TAF forecasts are the result of a top-down model and the increased precision of master plan forecasting techniques that consider local conditions. While the TAF forecasts are to be a point of comparison for master plan forecasts, they primarily are developed to serve other purposes, such as asset allocation by the FAA.

When reviewing an airport sponsor's forecast (from the master plan), FAA must ensure that the forecast is based on reasonable planning assumptions, uses current data, and is developed using appropriate forecast methods. As stated in FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), forecasts should be:

- Realistic;
- Based on the latest available data;
- Reflective of current conditions at the airport (as a baseline);
- Supported by information in the study; and
- Able to provide adequate justification for airport planning and development.

The forecast process for an airport master plan consists of a series of basic steps that vary in complexity depending upon the issues to be addressed and the level of effort required. The steps include a review of previous forecasts, determination of data needs, identification of data sources, collection of data, selection of forecast methods, preparation of the forecasts, and evaluation and documentation of the results. FAA Advisory Circular (AC) 150/5070-6C, *Airport Master Plans*, outlines seven standard steps involved in the forecast process, including:

1) **Identify Aviation Activity Measures**: The level and type of aviation activities likely to impact facility needs. For general aviation, this typically includes based aircraft and operations.
2) **Review Previous Airport Forecasts**: May include the FAA *Terminal Area Forecast*, state or regional system plans, and previous master plans.
3) **Gather Data**: Determine what data are required to prepare the forecasts, identify data sources, and collect historical and forecast data.
4) **Select Forecast Methods**: There are several appropriate methodologies and techniques available, including regression analysis, trend analysis, market share or ratio analysis, exponential smoothing, econometric modeling, comparison with other airports, survey techniques, cohort analysis, choice and distribution models, range projections, and professional judgment.
5) **Apply Forecast Methods and Evaluate Results**: Prepare the actual forecasts and evaluate for reasonableness.
6) **Summarize and Document Results**: Provide supporting text and tables as necessary.
7) **Compare Forecast Results with FAA's TAF**: For airports such as Hillsboro Airport, forecasts for based aircraft and total operations are considered consistent with the TAF if they meet the following criteria:
    - Forecasts differ by less than 10 percent in the 5-year forecast period, and 15 percent in the 10-year forecast period, or
    - Forecasts do not affect the timing or scale of an airport project, or
    - Forecasts do not affect the role of the airport as defined in the current version of FAA Order 5090.3, *Field Formulation of the National Plan of Integrated Airport Systems*.

Aviation activity can be affected by many influences on the local, regional, and national levels, making it virtually impossible to predict year-to-year fluctuations of activity over 20 years with any certainty. Therefore, it is important to remember that forecasts are to serve only as guidelines, and planning must remain flexible enough to respond to a range of unforeseen developments.

The forecast analysis for the Airport was produced following these basic guidelines. Existing forecasts are examined and compared against current and historic activity. The historical aviation activity is then examined along with other factors and trends that affect demand. The intent is to provide an updated

set of aviation demand projections for the Airport that will permit airport management to make planning decisions as necessary to maintain a viable, efficient, and cost-effective facility.

FORECASTING APPROACH

The development of aviation forecasts proceeds through both analytical and judgmental processes. A series of mathematical relationships is tested to establish statistical logic and rationale for projected activity levels. However, the judgment of the forecast analyst, based upon professional experience, knowledge of the aviation industry, and assessment of the local situation, is important in the final determination of the preferred forecast. The most reliable approach to estimating aviation demand is through the utilization of more than one analytical technique. For each aviation demand indicator (based aircraft and operations) multiple statistical methods will be employed to generate a reasonable range of future activity scenarios, which taken together are considered the planning envelope. Because the FAA requires a single forecast associated with specific years, a selected forecast will be identified within the planning envelope. Methodologies employed in this forecast include trend line/time-series projections, correlation/regression analysis, and market share analysis.

Trend line/time-series projections are probably the simplest and most familiar of the forecasting techniques. By fitting growth curves to historical data, then extending them into the future, a basic trend line projection is produced. A basic assumption of this technique is that outside factors will continue to affect aviation demand in much the same manner as in the past. As broad as this assumption may be, the trend line projection does serve as a reliable benchmark for comparing other projections.

Correlation analysis provides a measure of a direct relationship between two separate sets of historic data. Should there be a reasonable correlation between the data sets, further evaluation using regression analysis may be employed. While important to illustrate relationships, correlation analysis does not always equate to causation.

Regression analysis measures statistical relationships between dependent and independent variables, yielding a "correlation coefficient." The correlation coefficient (Pearson's "r") measures the association between the changes in the dependent variable and the independent variable(s). If the "r^2" value (coefficient determination) is greater than 0.95, it indicates good predictive reliability. A value less than 0.95 may be used, but with the understanding that the predictive reliability is lower.

"Aviation activity has historically trended closely with the nature of the national economy."

Market share analysis involves a historical review of the airport activity as a percentage, or share, of a larger regional, state, or national aviation market. A historical market share trend is determined, providing an expected market share for the future. These shares are then multiplied by existing published forecasts of the larger geographical area to produce a market share projection. This method has the same limitations as trend line projections but can provide a useful check on the validity of other forecasting techniques.

Forecasts are a useful planning tool, but they do have limitations. The more time between a forecast and the base year, the less reliable the forecast becomes. Changing local and national conditions can also

decrease reliability. Nonetheless, the FAA indicates that a Master Plan include a 20-year forecast for an airport. Facility and financial planning usually require at least a ten-year view, since it often takes more than five years to complete a major facility development program. However, it is important to use forecasts which do not overestimate revenue-generating capabilities or understate demand for facilities to meet public (user) needs.

A wide range of factors is known to influence the aviation industry and can have significant impacts on the extent and nature of aviation activity in both the local and national markets. Historically, the nature and trend of the national economy has had a direct impact on the level of aviation activity. Recessionary periods have been closely followed by declines in aviation activity. Over time, trends emerge and provide the basis for airport planning.

Future facility requirements, such as hangar and apron needs, are derived from projections of various aviation demand indicators. Using a broad spectrum of local, regional, and national socioeconomic and aviation information, and analyzing the most current aviation trends, forecasts are presented for the following aviation demand indicators:

- Based Aircraft
- Based Aircraft Fleet Mix
- General Aviation Operations
- Air Taxi and Military Operations
- Operational Peaks

This forecasting effort was completed in May 2017 utilizing a base year of 2016. A 20-year forecast extending to 2036 has been developed.

SOCIOECONOMIC TRENDS

Local and regional forecasts of key socioeconomic variables, such as population, employment, households, and income, provide an indication of the potential for growth in aviation activities at an airport. **Table 3A** summarizes the socioeconomic history and projections for the Portland Metropolitan Statistical Area (MSA). The primary source is Portland Metro, which is the area Metropolitan Planning Organization (MPO). MPOs are a valuable resource for region-wide information because part of their congressional mandate is to coordinate regional transportation planning, which includes socioeconomic forecasts.

Since 2000, the MSA population has grown steadily at an annual compound rate of 1.32 percent. Population is forecast to grow at an annual rate of 1.10 percent through 2036. By 2036, the total population is forecast to reach nearly three million, an increase of approximately 584,000 people.

Employment from 2000–2016 grew at an annual rate of 0.91 percent. In 2010, total employment was lower than it was in 2000, a common observation across the country primarily due to the 2007-2009 national recession. Since 2010, employment has grown at an annual compound rate of 2.15 percent and is forecast to grow at 1.46 percent annually through 2036.

The number of households grew at an annual rate of 1.26 percent from 2000 through 2016. It is forecast to grow at an annual rate of 1.37 percent through 2036.

Income, as measured in per capita personal income (PCPI), grew at an annual rate of 0.91 percent from 2000-2016. Woods & Poole Economics projects PCPI to increase slightly on an annual basis by 1.16 percent through 2036.

TABLE 3A
Historic and Forecast Socioeconomic Data
Portland MSA

Year	Population[2]	Employment (Non-farm)[2]	Households[2]	Income (PCPI)[3]
2000	1,927,881	973,230	746,625	$37,407
2010	2,226,009	968,830	857,379	$39,087
2011[1]	2,248,834	993,756	865,041	$40,178
2012[1]	2,271,894	1,019,323	872,771	$41,366
2013[1]	2,295,190	1,045,548	880,571	$40,921
2014[1]	2,318,725	1,072,448	888,440	$41,973
2015	2,342,501	1,100,040	896,379	$42,658
2016[1]	2,376,813	1,124,544	912,674	$43,266
CAGR 2000-2016	**1.32%**	**0.91%**	**1.26%**	**0.91%**
2021	2,548,972	1,244,391	995,454	$46,274
2026	2,699,646	1,328,758	1,069,579	$49,286
2036	2,960,377	1,501,433	1,198,444	$54,520
CAGR 2016-2036	**1.10%**	**1.46%**	**1.37%**	**1.16%**

[1]Interpolated figures for population, employment, and households
[2]*Metro Research Center (2014 update)*
[3]Woods & Poole Economics
CAGR: Compound Annual Growth Rate
PCPI: Per Capita Personal Income

NATIONAL AVIATION TRENDS

Each year, the FAA updates and publishes a national aviation forecast. Included in this publication are forecasts for the large air carriers, regional/commuter air carriers, general aviation, and FAA air traffic control workload. The forecasts are prepared to the meet budget and planning needs of the FAA and to provide information that can be used by state and local authorities, the aviation industry, and the general public. The current edition when this chapter was prepared was FAA *Aerospace Forecasts – Fiscal Years 2017-2037*, published in March 2017. The FAA primarily uses the economic performance of the United States as an indicator of future aviation industry growth. Similar economic analyses are applied to the outlook for aviation growth in international markets. The following discussion is summarized from the FAA Aerospace Forecasts.

Since its deregulation in 1978, the U.S. commercial air carrier industry has been characterized by boom-to-bust cycles. The volatility that was associated with these cycles was thought by many to be a structural feature of an industry that was capital intensive but cash poor. However, the Great Recession of 2007-09 marked a fundamental change in the operations and finances of U.S. airlines. Air carriers fine-tuned their business models to minimize losses by lowering operating costs, eliminating unprofitable routes, and grounding older, less fuel-efficient aircraft. To increase operating revenues, carriers initiated new services that customers were willing to purchase and started charging separately for services that were historically bundled in the price of a ticket. The industry experienced an unprecedented period of consolidation with four major mergers in five years. These changes, along with capacity discipline exhibited by carriers, have resulted in a seventh consecutive year of profitability for the industry in 2016. Looking ahead, there is optimism that the industry has been transformed from that of a boom-to-bust cycle to one of sustainable profits.

With increasing numbers of regional and business jets in the nation's skies, fleet mix changes, and carriers consolidating operations in their large hubs, FAA expects increased activity growth. Operations at FAA and contract towers are forecast to increase 0.8 percent a year over the forecast period with commercial activity growing at five times the rate of non-commercial activity. The growth in U.S. airline and corporate general aviation activity are the primary drivers. Large and medium hubs will see much faster increases than small and non-hub airports, largely due to the commercial nature of their operations.

The FAA forecasts are built upon certain economic assumptions because history has shown that aviation activity, especially general aviation activity, tends to closely follow the state of the national economy. In fact, most aviation demand indicators, nationally and for individual airports, realized steep declines during the 2007-2009 recession, which also saw a spike in the price of aviation fuels. The FAA has assumed a 2.1 percent annual increase in gross domestic product (GDP) for their forecasts. The FAA has also forecast the price of oil starting at $39 a barrel in 2015, increasing to $131 per barrel in 2037.

GENERAL AVIATION TRENDS

The FAA forecasts the fleet mix and hours flown for single engine piston aircraft, multi-engine piston aircraft, turboprops, business jets, piston and turbine helicopters, light sport, experimental, and others (gliders and balloons). The FAA forecasts "active aircraft," not total aircraft. An active aircraft is one that is flown at least one hour during the year. From 2010 through 2013, the FAA undertook an effort to have all aircraft owners re-register their aircraft. This effort resulted in a 10.5 percent decrease in the number of active general aviation aircraft, mostly in the piston category.

The long-term outlook for general aviation is stable to optimistic, as growth at the high end offsets continuing retirements at the traditional low end of the segment. The active general aviation fleet is forecast to increase 0.1 percent a year between 2016 and 2037, equating to an absolute increase in the fleet of about 3,400 units. While steady growth in both gross domestic product (GDP) and corporate profits results in continued growth of the turbine and rotorcraft fleets. The largest segment of the fleet, fixed wing piston aircraft, continues to shrink over the forecast. Although fleet growth is minimal, the number of general aviation hours flown is projected to increase an average of 0.9 percent per year through 2037,

as growth in turbine, rotorcraft, and experimental hours more than offset a decline in fixed wing piston hours.

In 2016, the FAA estimated there were 140,020 piston-powered aircraft in the national fleet. The total number of piston-powered aircraft in the fleet is forecast to decline by 0.8 percent from 2016-2037, resulting in 117,520 by 2037. This includes declines of 0.9 percent annually for single engine pistons and 0.5 percent for multi-engine pistons.

Total turbine aircraft are forecast to grow at an annual growth rate of 1.9 percent through 2037. The FAA estimates there were 30,595 turbine-powered aircraft in the national fleet in 2016, and there will be 45,305 by 2037. This includes annual growth rates of 1.4 percent for turboprops, 2.3 percent for business jets, and 1.8 percent for turbine helicopters.

"FAA forecasts the total general aviation fleet to increase 0.1% annually, with turboprops increasing 1.4% and jets increasing 2.3%."

While comprising a much smaller portion of the general aviation fleet, experimental aircraft, typically identified as home-built aircraft, are projected to grow annually by 2.3 percent through 2037. The FAA estimates there were 28,475 experimental aircraft in 2016, and these are projected to grow to 35,310 by 2037. Sport aircraft are forecast to grow 4.1 percent annually through the long term, growing from 2,530 in 2016 to 5,885 by 2037.

"FAA forecast total operations to increase 0.3% annually."

The FAA also forecasts total operations based upon activity at control towers across the U.S., including Hillsboro. For these forecasts, operations are further broken down into categories of aircraft as well as whether operations are locally flown. Operations are categorized as air carrier, air taxi/commuter, general aviation, and military. General aviation operations, both local and itinerant, declined significantly as a result of the 2007-2009 recession and subsequent slow recovery. Through 2037, total general aviation operations are forecast to grow 0.3 percent annually. Air taxi/commuter operations are forecast to decline by 3.0 percent through 2026, and then increase slightly through the remainder of the forecast period. Overall, air taxi/commuter operations are forecast to decline by 0.9 percent annually from 2016 through 2037. **Exhibit 3A** presents the FAA forecasts for U.S. active general aviation aircraft and operations.

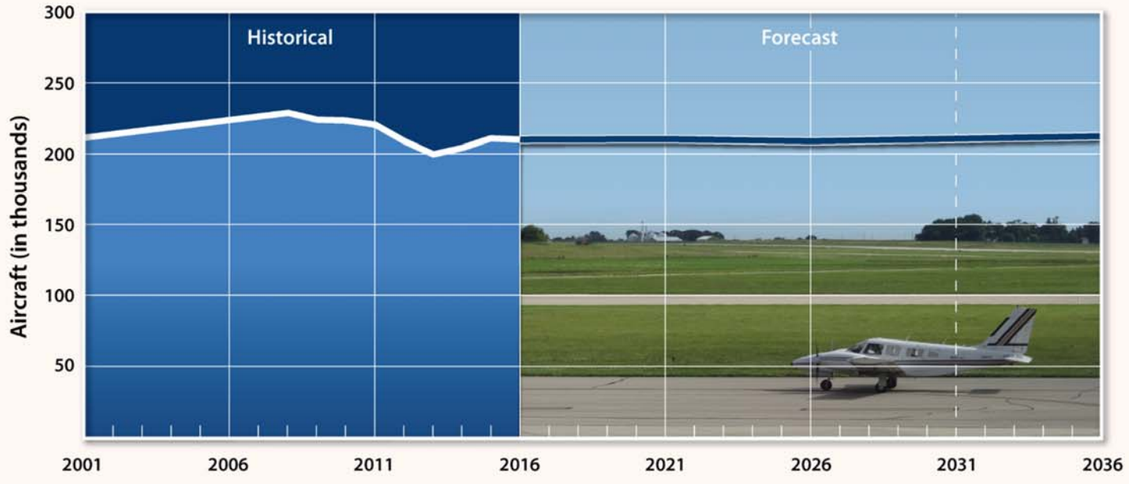
According to the FAA, total hours flown is forecast to increase by 0.9 percent annually through 2037.

"FAA forecasts total hours flown to increase 0.9% annually with increases in helicopters and turbine and a decrease in fixed wing piston."

While utilization of fixed wing piston aircraft is forecast to decline by 0.8 percent annually, increases in in turbine (jet and turboprop) and helicopters more than offset the loss. Utilization rates for all aircraft are forecast to be higher. Turbine hours flown is forecast to increase 2.5 percent annually (jets 3.0 percent and turboprops 1.6 percent annually). Helicopter hours flown is forecast to increase 2.0 percent annually.

U.S. ACTIVE GENERAL AVIATION AIRCRAFT

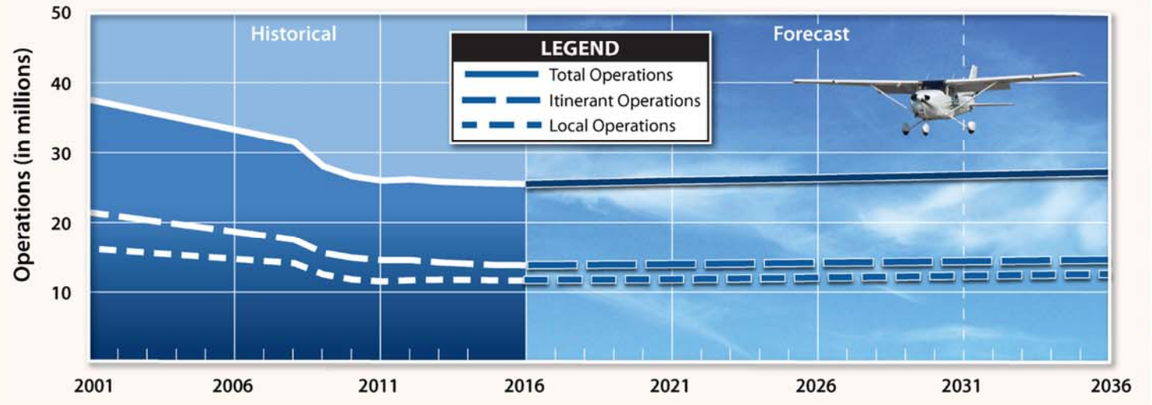
	2016E	2021	2026	2036	CAGR[1] 2016-2036
Fixed Wing					
Piston					
Single Engine	126,820	121,645	116,335	106,350	-0.9%
Multi-Engine	13,200	13,005	12,765	12,045	-0.5%
Turbine					
Turboprop	9,460	9,075	9,570	12,150	1.4%
Turbojet	13,770	15,480	17,345	21,570	2.3%
Rotorcraft					
Piston	3,335	3,560	3,785	4,325	1.3%
Turbine	7,365	8,055	8,775	10,475	1.8%
Experimental					
	28,475	30,640	32,065	35,015	1.0%
Sport Aircraft					
	2,530	3,315	4,125	5,730	4.1%
Other					
	4,950	4,950	4,970	5,010	0.1%
Total Pistons	143,355	138,210	132,885	122,720	-0.8%
Total Turbines	30,595	32,610	35,690	44,195	1.9%
Total Fleet	**209,905**	**209,725**	**209,735**	**212,670**	**0.1%**



[1]CAGR - Compound Annual Growth Rate
Note: An active aircraft is one that has a current registration and was flown at least one hour during the calendar year.
Source: FAA Aerospace Forecast - Fiscal Years 2017-2037

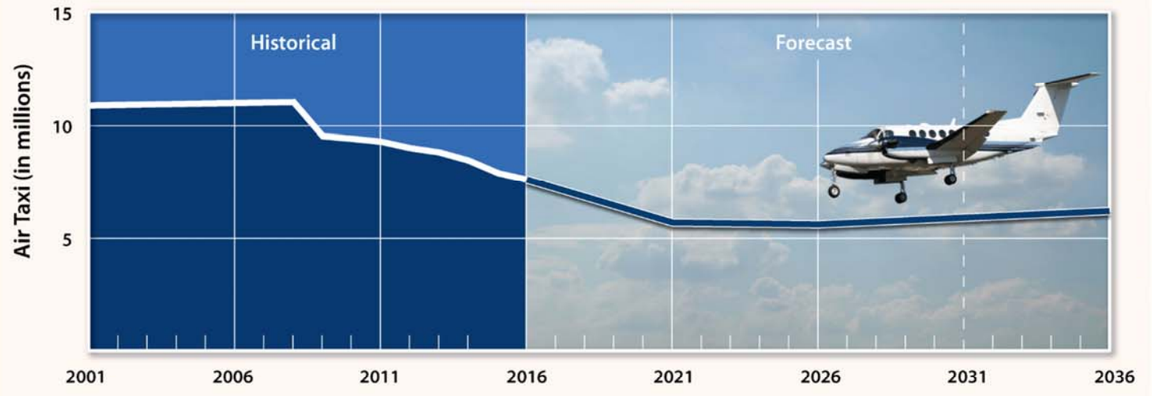
U.S. GENERAL AVIATION OPERATIONS

	2016E	2021	2026	2036	CAGR[1] 2016-2036
Itinerant					
	13,904,000	14,084,000	14,273,000	14,672,000	0.3%
Local					
	11,632,000	11,831,000	12,046,000	12,501,000	0.4%
Total GA Operations	**25,536,000**	**25,915,000**	**26,320,000**	**27,174,000**	**0.3%**



U.S. GENERAL AVIATION AIR TAXI

	2016E	2021	2026	2036	CAGR[1] 2016-2036
Air Taxi/Commuter Operations					
Itinerant	7,580,000	5,687,000	5,593,000	6,193,000	-0.9%



There is currently a transition occurring in the type of pilot certificates that pilots are achieving. Student pilot certifications are forecast to increase 0.4 percent annually through 2037. Part of this increase is due to a 2010 regulatory change that extended the term of a student certificate to 60 months from 36 months. Commercial pilot certificates are forecast to decrease by 0.6 percent annually while air transport pilot (ATP) certificates are forecast to increase by 0.5 percent annually. This change is primarily attributable to a regulatory change in 2013 that requires cockpit crew to both have an ATP certificate, which requires 1,500 more flight hours of experience than previously required. Overall, total pilots are forecast to increase 0.1 percent annually. **Exhibit 3B** shows the FAA forecasts for general aviation hours flown and pilots.

"Student pilots are forecast to increase 0.4% annually."

FAA Terminal Area Forecast (TAF)

On an annual basis, the FAA publishes the *Terminal Area Forecast* (TAF) for each airport included in the *National Plan of Integrated Airport Systems* (NPIAS). The TAF is a generalized forecast of airport activity distilled from national trends rather than local factors and may not always reflect current activity levels in the base year. The TAF is used by FAA for internal planning purposes and is available to airports and consultants to use as a baseline projection and important point of comparison while developing local forecasts.

Table 3B presents the 2017 TAF for the Hillsboro Airport. Itinerant operations are forecast to grow at a compound annual rate of 1.14 percent, while local operations grow at a rate of 0.17 percent. Based aircraft are forecast to grow at an annual rate of 1.56 percent.

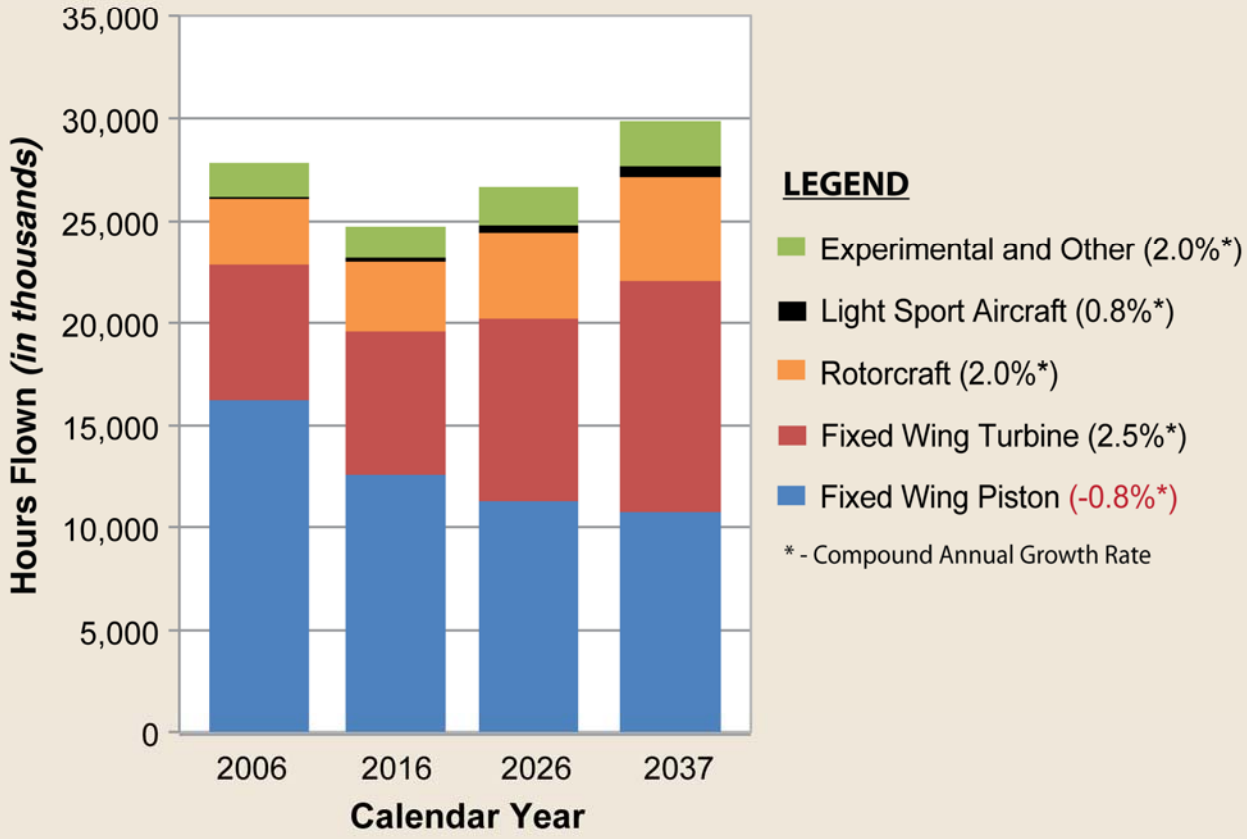
TABLE 3B
2017 FAA Terminal Area Forecast
Hillsboro Airport

	2016	2021	2026	2031	2036	CAGR
ITINERANT OPERATIONS						
General Aviation	78,101	87,808	89,133	90,476	91,839	0.81%
Air Taxi	4,352	5,579	7,156	9,171	11,762	5.10%
Military	266	266	266	266	266	0.00%
Air Carrier	14	14	14	14	14	0.00%
Total Itinerant	**82,733**	**93,667**	**96,569**	**99,927**	**103,881**	1.14%
LOCAL OPERATIONS						
General Aviation	113,321	114,504	115,371	116,244	117,123	0.17%
Military	7	7	7	7	7	0.00%
Total Local	**113,328**	**114,511**	**115,378**	**116,251**	**117,130**	0.17%
Total Operations	**196,061**	**208,178**	**211,947**	**216,178**	**221,011**	0.60%
Based Aircraft	**256**	**277**	**299**	**324**	**349**	1.56%

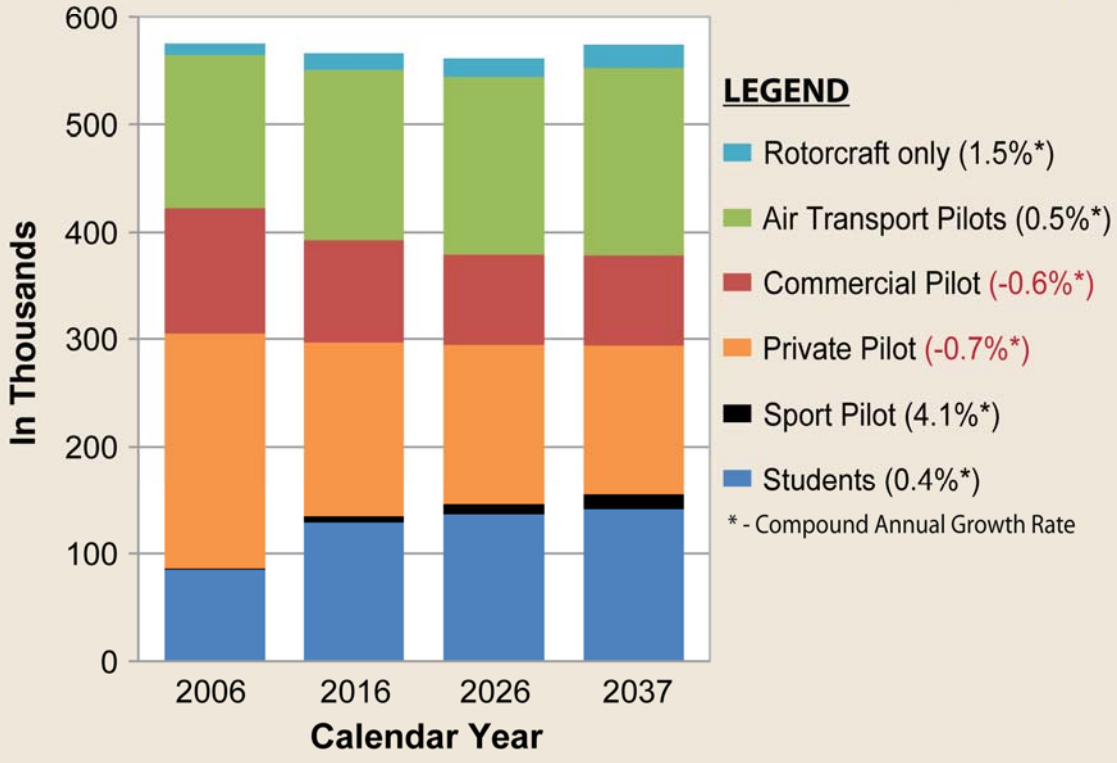
CAGR: Compound annual growth rate

Source: FAA Terminal Area Forecast (Jan. 2017)

U.S. GENERAL AVIATION HOURS FLOWN FORECAST



U.S. PILOTS BY TYPE OF CERTIFICATE FORECAST (FAA)



Source: FAA Aerospace Forecast FY2017-2037

Exhibit 3B: FAA HOURS FLOWN AND PILOTS FORECASTS

The FAA TAF is an aviation forecast for the Airport developed at FAA headquarters in Washington D.C. using a top down distribution method. One of the purposes of the TAF is to distribute overall aviation activity to all airports so that the FAA can better plan workload measures. The TAF forecast for commercial service airports consider many variables, while the TAF for most general aviation airports take into consideration few, if any, local factors. For these reasons, the TAF is only one data point, and is used as a point of comparison for evaluating the reasonableness of the master plan forecasts.

One area of note is the 2016 based aircraft count of 256 included in the TAF. It is known that there are 326 aircraft based at the Airport currently. This count is included in the FAA's based aircraft database (www.basedaircraft.com), which is updated by the Airport and verified by the FAA. It is likely that the 2016 based aircraft numbers simply have not been transferred to the TAF. The total operations counts, however, are reasonably accurate for the base year of 2016. It should be noted that the TAF provides a fiscal year count and master plan forecasts provide a calendar year forecast, so there will likely always be a slight discrepancy.

General Aviation Aircraft Shipments and Revenue

As previously discussed, the 2007-2009 economic recession had a negative impact on general aviation aircraft production and the industry has been slow to recover. Aircraft manufacturing declined for three straight years from 2008-2010. The number of general aviation aircraft manufactured showed modest growth, year-over-year from 2011-2014. Both 2015 and 2016 saw slight declines in manufacturing. According to the General Aviation Manufacturers Association (GAMA), there is optimism that aircraft manufacturing will stabilize and return to growth. **Table 3C** presents historical data related to general aviation aircraft shipments and net billings.

Worldwide shipments of general aviation airplanes decreased in 2016 with a total of 2,262 units delivered compared to 2,331 units in 2015. Worldwide general aviation billings were also lower than the previous year. In 2016, $20.7 billion in new general aviation aircraft were shipped, but year-end results were mixed across the market segments. Results were impacted by economic uncertainty in key markets, including Brazil, Europe, and China; however, the U.S. experienced stronger delivery numbers, which is cause for cautious optimism.

Business Jets: General aviation manufacturers' business jet deliveries declined from 718 units in 2015 to 661 units in 2016. Business jet deliveries were strongest in the North American market at 62.0 percent, an increase in market share compared to 2015.

Turboprops: In 2016, there were 582 turboprop shipments, a slight increase from 557 in 2015. The share of turboprop shipments in 2016 in North America increased slightly compared to the prior year, 57.8 percent compared to 56.2 percent.

Pistons: In 2016, piston airplane shipments fell to 1,019 units compared to 1,056 units the prior year, a 4.9 percent decrease. The North American market share, however, retained its position and increased to 69.6 percent, which is its largest share of total deliveries in the past decade.

TABLE 3C
Annual General Aviation Airplane Shipments
Manufactured Worldwide and Factory Net Billings

Year	Total	SEP	MEP	TP	J	Net Billings ($millions)
2000	3,147	1,877	103	415	752	13,496
2001	2,998	1,645	147	422	784	13,868
2002	2,677	1,591	130	280	676	11,778
2003	2,686	1,825	71	272	518	9,998
2004	2,962	1,999	52	319	592	12,093
2005	3,590	2,326	139	375	750	15,156
2006	4,054	2,513	242	412	887	18,815
2007	4,277	2,417	258	465	1,137	21,837
2008	3,974	1,943	176	538	1,317	24,846
2009	2,283	893	70	446	874	19,474
2010	2,024	781	108	368	767	19,715
2011	2,120	761	137	526	696	19,042
2012	2,164	817	91	584	672	18,895
2013	2,353	908	122	645	678	23,450
2014	2,454	986	143	603	722	24,499
2015	2,331	946	110	557	718	24,129
2016	2,262	890	129	582	661	20,719

SEP - Single Engine Piston; MEP - Multi-Engine Piston; TP - Turboprop; J - Turbofan/Turbojet

Source: General Aviation Manufacturers Association *2016 General Aviation Statistical Databook & 2017 Industry Outlook*

REVIEW OF PREVIOUS FORECASTS

An important step in the preparation of new aviation demand forecasts is to examine previous forecasting efforts. These previous efforts should be examined in terms of assumption made at the time and the actual projections. The more time that has passed since the last forecasts were made, the more variability that is introduced, and the less reliable they become. It is for this reason that the FAA recommends updating master plan and the associated forecasts every seven to ten years or as necessary to address unanticipated changes in the aviation industry on both the local and national levels.

The previous master plan for Hillsboro Airport was completed in 2005. The base year for the forecasts was 2003 for based aircraft and 2002 for operations. In 2003, the tower began a different method of tracking helicopter operations which only counted an entry and an exit to the traffic pattern (two operations) and did not count the circuits in the traffic pattern. Therefore, 2003 data was not used in this forecast and 2002 data was used. Following a period of approximately 18 months, the tower returned to counting all helicopter operations, including circuits within the traffic pattern.

Tracking helicopter operations is inherently challenging for air traffic controllers because helicopters do not follow a traditional and defined traffic pattern like fixed wing aircraft. Because helicopter operations are a significant portion of Airport activity and the Port is committed to having a more complete picture

of activity at the Airport for noise monitoring purposes, the FAA tower returned to counting circuits in the helicopter traffic pattern as local operations.

The 2005 Master Plan forecasts were utilized for the 2010 Environmental Assessment (EA) developed in in support of the construction of the parallel training runway. Due to legal challenges and the interval since the original forecasts were developed, a Supplemental Environmental Assessment (SEA) was completed in 2014 that included revised forecasts.

The SEA forecasts included baseline and induced demand scenarios. The baseline included an unconstrained (with parallel runway) and constrained (no parallel runway) forecast, which were the same. Both the Port and FAA believed that activity generated by the availability of a parallel runway was already included in the forecast. The induced forecast was undertaken at the direction of the courts. For each of these, a 10-year forecast was developed covering a base year of 2011 and a forecast year of 2021. **Figure 1** presents those previous forecasts as sourced from the SEA as well as the actual operations figures.

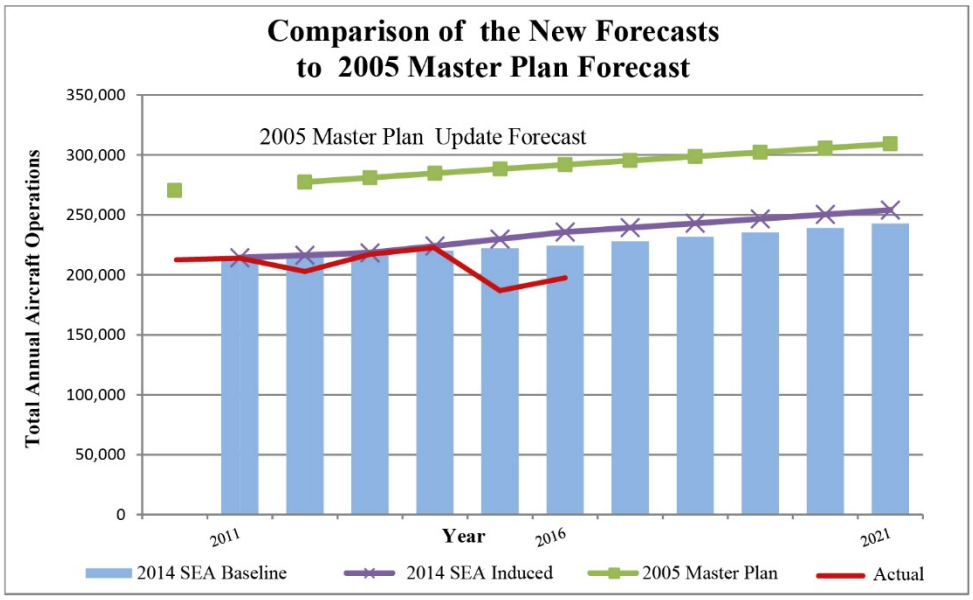


Figure 1: Previous Forecasts

Since 2003, there have been several significant impacts on aviation activity. In addition to the aircraft re-registration process and pilot certificate changes, the national recession of 2007-2009 had an immediate negative impact. The relatively slow recovery was also unusual, and it stunted growth in the industry for many years. In fact, some aviation demand indicators, such as operations, have only recently begun to grow again. Finally, the previous forecasts are simply too old to be considered reliable. Because of the significant changes to the aviation industry since 2003, and the fact that FAA prefers that master plans (and forecasts) be updated every 7-10 years, now is a good time to develop a new set of aviation demand forecasts.

The most useful data point from these previous forecasts is the projected annual growth rates. Having this understanding provides a check on the reasonableness of the forecasts to be developed in this chapter. From the 2005 master plan, it was estimated that there were 363 based aircraft in 2003. These were forecast to grow to 465 by 2025 for an annual growth rate of 1.13 percent. In 2002, total operations were estimated at 253,847 and were forecast to grow to 323,000 by 2025 for an annual growth rate of 1.05 percent. From the 2011 SEA, total operations were forecast to grow 1.25 percent for the unconstrained/constrained forecast and 1.71 percent for the induced forecast.

GENERAL AVIATION FORECASTS

General aviation encompasses all portions of civil aviation except commercial service and military operations. To determine the types and sizes of facilities that should be planned to accommodate general aviation activity at the Airport, certain elements of this activity must be forecast. These indicators of general aviation demand include based aircraft, aircraft fleet mix, operations, and peak periods.

REGISTERED AIRCRAFT FORECAST

The number of based aircraft is the most basic indicator of general aviation demand. By first developing a forecast of based aircraft for the Airport, other demand indicators can be projected. The process of developing forecasts of based aircraft begins with an analysis of aircraft ownership in the primary general aviation service area. The primary general aviation service area for the purpose of this forecast includes Washington, Clackamas, Multnomah, and Yamhill Counties. Certainly, some aviation activity and based aircraft will originate from outside these areas, but generally, most based aircraft will come from these counties. Aircraft ownership trends for the service area are typically an indicator of the based aircraft trends for an airport.

Table 3D presents the history of registered aircraft in the four-county service area from 2007 through 2016. These figures are derived from the FAA aircraft registration database that categorizes registered aircraft by county based on the zip code of the registered aircraft. Although this information generally provides a correlation to based aircraft, it is not uncommon for some aircraft to be registered in a specific county but based at an airport outside the county or vice versa.

In 2016, there were 2,493 aircraft in the FAA aircraft registration database from the four-county area. This represented the first year-over-year increase in registered aircraft since 2008, when there were 3,250 registered aircraft. The number of registered aircraft in 2008 also represented the high-water mark since 1990 (the first year of record keeping using the current process). The decline in registered aircraft since 2008 is attributable to two primary factors: the impact of the 2007-2009 recession and FAA's re-registration process between 2010 and 2013 that saw an overall 10.5 percent decline in active aircraft. This trend is similarly represented across the country. Now that the actual number of registered aircraft has been identified, several projections of future registered aircraft are considered for the 20-year planning horizon using common forecasting methodologies.

TABLE 3D
Historical Registered Aircraft
Washington, Clackamas, Multnomah, and Yamhill Counties

Year	Single Engine Piston	Multi-engine Piston	Turboprop	Jet	Helicopter	Other	Total
2007	2,272	257	84	155	303	171	3,242
2008	2,234	216	127	191	312	170	3,250
2009	2,229	215	129	194	311	171	3,249
2010	2,156	201	121	182	302	174	3,136
2011	2,143	198	121	190	310	153	3,115
2012	1,917	164	124	200	303	146	2,854
2013	1,751	154	117	178	275	156	2,631
2014	1,708	145	102	177	260	134	2,526
2015	1,671	147	97	174	245	132	2,466
2016	1,682	143	101	190	232	145	2,493

Source: FAA aircraft registration database.

Time Series and Regression Analysis

A time-series and several regression analyses were considered. Time series analysis is a statistical process that essentially "fits" a line over historical data, in this case registered aircraft, and extends that line into the future. The regression analysis conducted considered the following independent variables: year, U.S. active aircraft as projected by the FAA, and population, employment and income for the Portland MSA. The historical data utilized was from 2007–2016. A total of 31 different regressions were run which ranged from a single variable to all five variables.

Neither the time series nor the 31 regressions resulted in a reliable statistical forecast of future registered aircraft. This is primarily due to the fact that registered aircraft declined in the four counties each year from 2009 through 2015. In fact, one of the regressions resulted in a long term forecast of only 280 registered aircraft. Because of the poor results of this statistical method, none of the results are considered further in a determination of the registered aircraft forecast and other methods are employed.

Market Share Analysis

Table 3E presents several market share projections of registered aircraft for the four-county service area. The first two projections consider the relationship between U.S. active aircraft, as projected by the FAA, to registered aircraft in the four-county area. The first of these considers maintaining a constant share of U.S. active aircraft. This results in a very low growth rate of 0.07 percent which results in a 2036 forecast of 2,526 registered aircraft. This level of registered aircraft was last achieved in 2014 and had been exceeded every year prior to that. This forecast is considered a low-end forecast. The second projection considers the registered aircraft in the four-county region increasing its market share of U.S.

active aircraft. The modest increase in market share results in 3,403 registered aircraft by 2036. Registered aircraft would return to the 2008 high level in 2032. The 20-year compound annual growth rate for this projection is 1.57 percent. This forecast is considered a high0end forecast.

TABLE 3E
Market Share Registered Aircraft Projections
Hillsboro Airport

Year	Four-County Registrations[1]	U.S. Active Aircraft[2]	Market Share	MSA Population[3]	Aircraft Per 1,000 Residents
2007	3,242	231,606	1.3998%	2,132,032	1.5206
2008	3,250	228,664	1.4213%	2,162,910	1.5026
2009	3,249	223,876	1.4512%	2,194,235	1.4807
2010	3,136	223,370	1.4039%	2,226,009	1.4088
2011	3,115	220,453	1.4130%	2,248,834	1.3852
2012	2,854	209,034	1.3653%	2,271,894	1.2562
2013	2,631	199,927	1.3160%	2,295,190	1.1463
2014	2,526	204,408	1.2358%	2,318,725	1.0894
2015	2,466	210,031	1.1741%	2,342,501	1.0527
2016	2,493	209,905	1.1877%	2,376,813	1.0489
Constant Market Share of U.S. Active Aircraft Projection (CAGR = 0.07%)					
2021	2,491	209,725	1.1877%	2,548,972	0.9772
2026	2,491	209,735	1.1877%	2,699,646	0.9227
2036	2,526	212,670	1.1877%	2,960,377	0.8532
Increasing Market Share of U.S. Active Aircraft Projection (CAGR = 1.57%)					
2021	2,517	209,725	1.2000%	2,548,972	0.9873
2026	2,727	209,735	1.3000%	2,699,646	1.0100
2036	3,403	212,670	1.6000%	2,960,377	1.1494
Constant Ratio of Registered Aircraft per 1,000 Four-County Residents (CAGR = 1.10%)					
2021	2,674	209,725	1.2748%	2,548,972	1.0489
2026	2,832	209,735	1.3501%	2,699,646	1.0489
2036	3,105	212,670	1.4601%	2,960,377	1.0489
Decreasing Ratio of Registered Aircraft per 1,000 Four-County Residents (CAGR = -1.01%)					
2021	2,664	209,725	1.2701%	2,548,972	1.0450
2026	2,808	209,735	1.3387%	2,699,646	1.0400
2036	3,049	212,670	1.4338%	2,960,377	1.0300
Year-over-Year Registered Aircraft Growth Rate 2015-2016 (CAGR = 1.09%)					
2021	2,632	209,725	1.2550%	2,548,972	1.0326
2026	2,778	209,735	1.3245%	2,699,646	1.0290
2036	3,097	212,670	1.4562%	2,960,377	1.0462

[1]Combined Washington, Clackamas, Multnomah, Yamhill Aircraft Registrations from FAA Registration Database
[2]U.S. Active Aircraft from FAA Aerospace Forecasts – Fiscal Years 2017-2037
[3]Portland MSA population from Portland Metro
CAGR: Compound annual growth rate

The next two projections consider registered aircraft in relation to the MSA population. The first considers the number of registered aircraft per 1,000 people to remain constant at the 2016 level. This

results in an annual growth rate of 1.10 percent and a 2036 projection of 3,105 registered aircraft. The second of these considers the number of registered aircraft per 1,000 people to decline over time, which is common for areas where the population is growing. The number of registered aircraft rarely keeps constant with population growth. This forecast results in an annual growth rate of 1.01 percent and a 2036 forecast of 3,049 registered aircraft.

The last market share projection considers the year-over-year growth rate of 1.09 percent experienced from 2015-2016. This forecast results in 3,097 registered aircraft in 2036.

Registered Aircraft Summary

Exhibit 3C presents the several registered aircraft forecasts and the selected forecast. The group of registered aircraft forecasts create the planning envelope. Over time, it is difficult to predict what may influence trends in registered aircraft, but it is reasonable to consider a selected planning forecast within the planning envelope. The selected planning forecast is an approximate average of the five market share forecasts considered. **Table 3F** summarizes in numerical form the five forecasts of registered aircraft for the four-county area and the selected forecast. The selected forecast will be utilized as an input to the based aircraft forecast for Hillsboro Airport.

TABLE 3F
Registered Aircraft Summary
Washington, Clackamas, Multnomah, and Yamhill Counties

Method	2021	2026	2036	CAGR
Market Share of US Active Aircraft (Constant)	2,491	2,491	2,526	0.07%
Market Share of US Active Aircraft (Increasing)	2,517	2,727	3,403	1.57%
Ratio of Population to Registered Aircraft (Constant)	2,674	2,832	3,105	1.10%
Ratio of Population to Registered Aircraft (Decreasing)	2,664	2,808	3,049	1.01%
Year-over-year (2015-2016) Growth Rate	2,632	2,778	3,097	1.09%
Selected Registered Aircraft Forecast	**2,600**	**2,700**	**3,000**	0.93%

CAGR: Compound annual growth rate
Source: Coffman Associates analysis

BASED AIRCRAFT FORECAST

Forecasts of based aircraft may directly influence needed facilities and the applicable design standards. The needed facilities may include hangars, aprons, taxilanes, etc. The applicable design standards may include separation distances and object clearing surfaces. The size and type of based aircraft are also an important consideration. The addition of numerous small aircraft may have no effect on design standards, while the addition of a few larger business jets can have a substantial impact on applicable design standards.

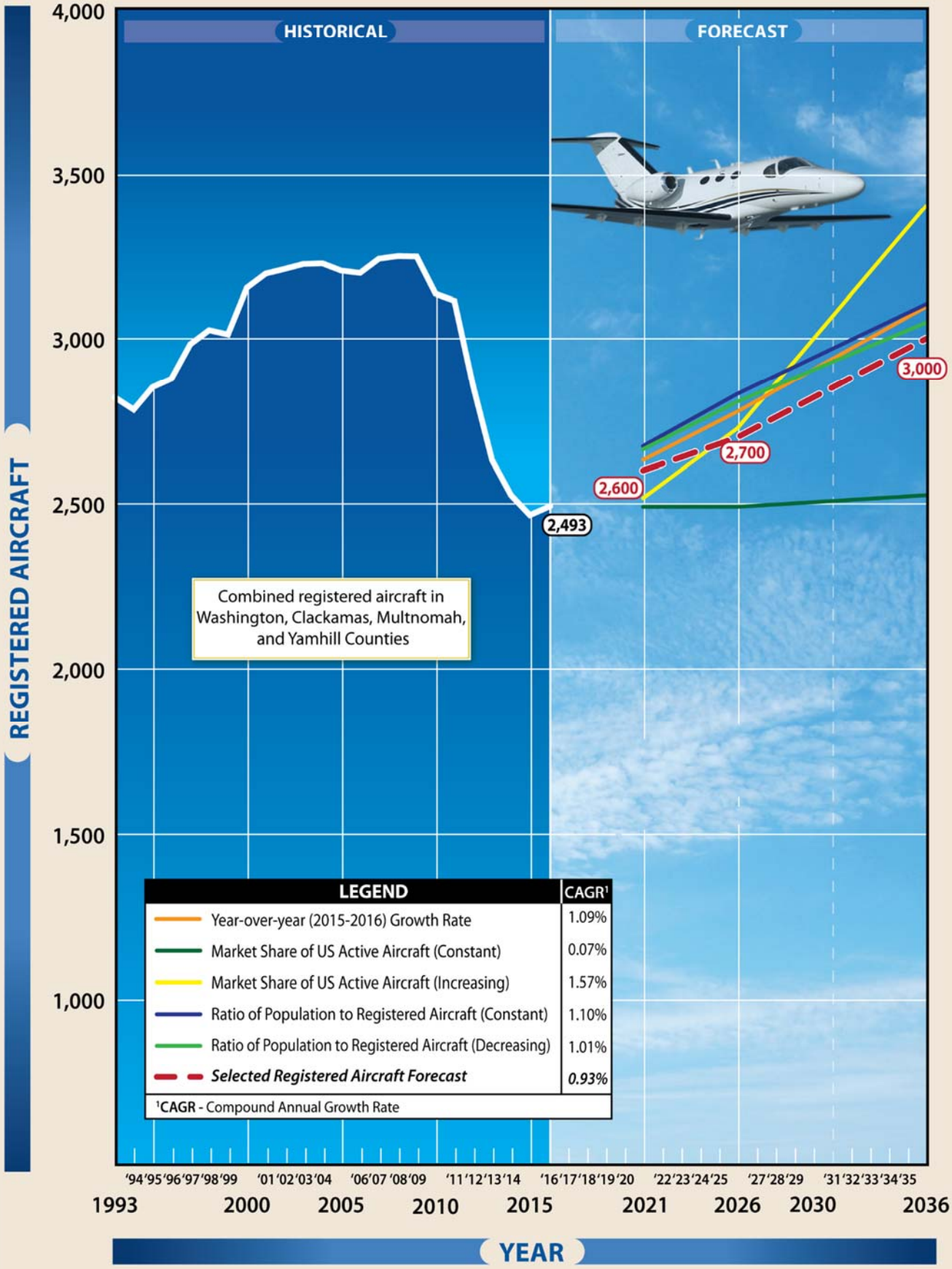


Exhibit 3C
REGISTERED AIRCRAFT FORECAST

Because of the numerous variables known to influence aviation demand, several separate forecasts of based aircraft are developed. Each of the forecasts is then examined for reasonableness and any outliers are discarded or given less weight. The remaining forecasts collectively will create a planning envelope. A single planning forecast is then selected for use in developing facility needs for the Airport. The selected forecast of based aircraft can be one of the several forecasts developed or, based on the experience and judgment of the forecaster, be a blend of the forecasts.

Based Aircraft History

For many years, FAA did not require airports to report the number of based aircraft. It is only in recent years that the FAA has established a based aircraft inventory in which it is possible to cross-reference based aircraft claimed by one airport with other airports. The FAA is now utilizing this based aircraft inventory as a baseline for determining how many and what type of aircraft are based at any individual airport. This database evolves daily as aircraft are added or removed, and it does not provide an annual history of based aircraft. It is the responsibility of the sponsor (owner) of each airport to input based aircraft information into the FAA database (www.basedaircraft.com). As part of this master plan, a detailed count of based aircraft was undertaken, and it is established that there are 354 based aircraft. The FAA based aircraft database is being updated with this starting point.

The previous master plan documented a history of based aircraft from 2003 and before. This history was compiled by airport staff through contacts with aviation tenants and based upon management knowledge of actual based aircraft at the Airport. In 2003, a total of 363 based aircraft were identified and the previous high total was 399 in 1995.

Other sources of based aircraft history have been unreliable. For example, the current FAA TAF for the Airport does not appear to have been updated recently as it shows only 256 based aircraft for 2016. Another source is the Airport Master Record (Form 5010) that sponsors submit to FAA annually. The current 5010 for the Airport identifies 248 based aircraft.

Because a reliable history of based aircraft is not available, several potential forecasting methods, such as time-series analysis and regression analysis, will not return usable data. Therefore, several other methods are employed to arrive at a based aircraft forecast.

Market Share Forecast

Several market share forecasts of based aircraft have been developed. The first two consider the relationship between historical based aircraft and registered aircraft. The next two consider the relationship of based aircraft to population. **Table 3G** presents these based aircraft forecasts.

In 2016, the 354 based aircraft at the Airport represented 14.2 percent of the registered aircraft in the four-county area. By maintaining this ratio and extending it to the forecast plan years, a based aircraft forecast emerges. This forecast results in 369 based aircraft by 2021, 383 by 2026, and 426 by 2036. The compound annual growth rate of this forecast is 0.93 percent.

The second forecast considers the Airport receiving an increasing share of the four-county registered aircraft. This forecast results in 377 based aircraft by 2021, 400 by 2026, and 462 by 2036. The annual growth rate of this forecast is 1.34 percent.

Table 3G
Market Share Based Aircraft Forecast
Hillsboro Airport

Year	Four-County Registered Aircraft	Based Aircraft	Market Share	MSA Population[1]	Based Aircraft Per 1,000 Population
2016	2,493	354	14.2%	2,376,813	0.1489
Constant Share of Four-County Registered Aircraft (CAGR = 0.93%)					
2021	2,600	369	14.2%	2,548,972	0.1488
2026	2,700	383	14.2%	2,699,646	0.1420
2036	3,000	426	14.2%	2,960,377	0.1439
Increasing Share of Four-County Registered Aircraft (CAGR = 1.34%)					
2021	2,600	377	14.5%	2,548,972	0.1479
2026	2,700	400	14.8%	2,699,646	0.1480
2036	3,000	462	15.4%	2,960,377	0.1561
Constant Share of Population to Based Aircraft (CAGR = 1.10%)					
2021	2,600	380	14.6%	2,548,972	0.1489
2026	2,700	402	14.9%	2,699,646	0.1489
2036	3,000	441	14.7%	2,960,377	0.1489
Decreasing Share of Population to Based Aircraft (CAGR = 0.68%)					
2021	2,600	370	14.2%	2,548,972	0.1450
2026	2,700	381	14.1%	2,699,646	0.1410
2036	3,000	406	13.5%	2,960,377	0.1370

[1]Combined Washington, Clackamas, Multnomah, Yamhill Aircraft Registrations from FAA Registration Database
[2]U.S. Active Aircraft from FAA Aerospace Forecasts – Fiscal Years 2017-2037
[3]Portland MSA population from Portland Metro
CAGR: Compound annual growth rate

The next market share forecast considers the Airport maintaining a constant share of based aircraft per 1,000 people in the MSA. This forecast results in 380 based aircraft by 2021, 402 by 2026, and 441 by 2036. The annual growth rate of this forecast is 1.10 percent. The last market share forecast considers a declining ratio of the population to based aircraft. This forecast results in 370 based aircraft by 2021, 381 by 2026, and 406 by 2036. The annual growth rate of this forecast is 0.68 percent.

FAA TAF Growth Rate Forecast

As discussed previously the TAF is an annual forecast developed by FAA headquarters that can be used by local airports as a supplement to development of local forecasts. The TAF forecasts for general aviation airports rarely take into consideration local factors and are to be examined in that light.

Statewide TAF Growth Rate

One method of projecting based aircraft is to apply the based aircraft growth rate from the statewide TAF. The 2016 TAF for all NPIAS airports in Oregon projects an increase in based aircraft from 4,070 in 2016 to 5,022 by 2036. This represents an average annual growth rate of 1.06. By then applying this growth rate to the 354 based aircraft at the Airport, a forecast emerges. This forecast results in 373 based aircraft by 2021, 394 by 2026, and 438 by 2036.

Local TAF Growth Rate

The TAF for the Airport shows 256 based aircraft in 2016 and 354 in 2036 for an annual growth rate of 1.62 percent. An acceptable forecast method is to apply the TAF growth rate to the actual 2016 based aircraft figure of 354. This results in 384 based aircraft by 2021, 416 by 2026, and 489 by 2036. This forecast may be somewhat aggressive as the previous high for based aircraft was 399 in 1995; therefore, this represents the high range of the forecast planning envelope. **Table 3H** summarizes the TAF growth rate forecasts and additional data is provided as a check on the reasonableness of the projections.

Table 3H
FAA TAF Based Aircraft Growth Rate Forecasts
Hillsboro Airport

Year	Four-County Registered Aircraft	Based Aircraft	Market Share	MSA Population[1]	Based Aircraft Per 1,000 Population
2016	2,493	354	14.2%	2,376,813	0.1489
TAF Statewide Based Aircraft Growth Rate (CAGR = 1.06%)					
2021	2,600	373	14.3%	2,548,972	0.1463
2026	2,700	394	14.6%	2,699,646	0.1459
2036	3,000	438	14.6%	2,960,377	0.1580
TAF HIO Based Aircraft Growth Rate (CAGR = 1.62%)					
2021	2,600	384	14.8%	2,548,972	0.1506
2026	2,700	416	15.4%	2,699,646	0.1541
2036	3,000	489	16.3%	2,960,377	0.1520

[1]Combined Washington, Clackamas, Multnomah, Yamhill Aircraft Registrations from FAA Registration Database
[2]U.S. Active Aircraft from FAA Aerospace Forecasts – Fiscal Years 2017-2037
[3]Portland MSA population from Portland Metro
CAGR: Compound annual growth rate

Based Aircraft Forecast Summary

Exhibit 3D presents a comparison of the six based aircraft forecasts developed to create the planning envelope for consideration. A selected forecast is also included in the graph. Because the planning envelope appears reasonable and no individual forecast appears to stand out above the others, the selected forecast is an approximate average of the six forecasts.

The forecast of based aircraft should be considered unconstrained, which is commonly used for master plans so that airport management can prepare and plan for a range of possibilities. For example, some of the based aircraft forecasts indicate a long-term potential for nearly 490 based aircraft. Many local

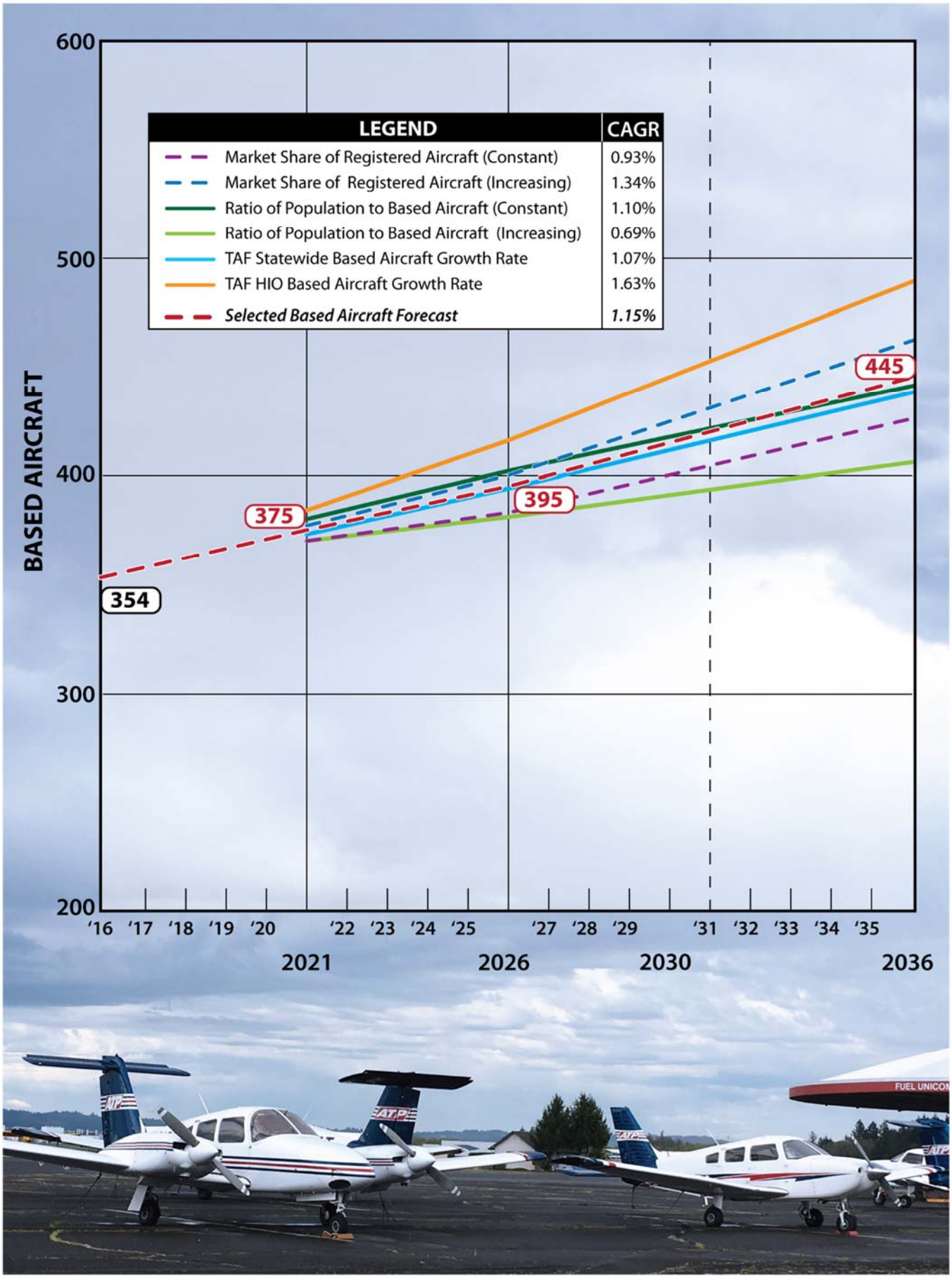


Exhibit 3D
BASED AIRCRAFT FORECAST

factors such as growth in population, employment, and income growth may lead to a selected forecast on the higher range of the planning envelope. However, there are other factors such as the historical high of 399 based aircraft and the fact that there is currently hangar space available at the Airport. These facts lead to a more conservative forecast. **Table 3J** summarizes the based aircraft forecasts and the selected forecasts in tabular format.

TABLE 3J
Based Aircraft Forecast Summary
Hillsboro Airport

Method	2021	2026	2036	CAGR
Market Share of Registered Aircraft (Constant)	369	383	426	0.93%
Market Share of Registered Aircraft (Increasing)	377	400	462	1.34%
Ratio of Population to Based Aircraft (Constant)	380	402	441	1.10%
Ratio of Population to Based Aircraft (Decreasing)	370	381	406	0.68%
TAF Statewide Based Aircraft Growth Rate	373	394	438	1.06%
TAF HIO Based Aircraft Growth Rate	384	416	489	1.62%
Selected Based Aircraft Forecast (354 baseline)	**375**	**395**	**445**	**1.15%**

CAGR: Compound annual growth rate
Source: Coffman Associates analysis

BASED AIRCRAFT FLEET MIX FORECAST

It is important to have an understanding of the current and projected based aircraft fleet mix at an airport to ensure the planning of proper facilities in the future. For example, the addition of one or several larger turboprop or business jet aircraft to the airfield can have a significant impact on the separation requirements and the various obstacle clearing surfaces.

"The based aircraft fleet mix (aircraft type) forecast is based on national trends as defined by the FAA."

The current based aircraft fleet mix consists of 223 single engine piston aircraft, 25 multi-engine piston aircraft, 17 turboprops, 49 business jets, 35 helicopters, and 5 others (gliders, balloons). The role of the Airport is expected to remain as a general aviation reliever facility; therefore, a significant departure from the current fleet mix is not anticipated. The future fleet mix is expected to continue to be dominated by single engine piston aircraft with moderate increases in turboprops, jets, and helicopters. Multi-engine piston aircraft are projected to remain constant but decline as a percentage of total based aircraft. These forecast growth trends in the based aircraft mix are consistent with FAA projections of the national general aviation fleet mix. **Table 3K** presents the forecast fleet mix for based aircraft at Hillsboro Airport.

The 2005 master plan, with a base forecast year of 2003, made similar assumptions for growth in turboprops, jets and helicopters. Jets, turboprops, and helicopters each currently account for a larger percentage of the total. Piston aircraft are accounting for a smaller percentage of the total.

TABLE 3K
Based Aircraft Fleet Mix Forecast
Hillsboro Airport

	EXISTING[1]		FORECAST					
Aircraft Type	**2016**	**%**	**2021**	**%**	**2026**	**%**	**2036**	**%**
Single Engine Piston	223	62.99%	234	62.40%	245	62.03%	275	61.8%
Multi-Engine Piston	25	7.06%	25	6.67%	25	6.33%	24	5.39%
Turboprop	17	4.80%	20	5.33%	22	5.57%	28	6.29%
Jet	49	13.84%	52	13.87%	55	13.92%	62	13.93%
Helicopter	35	9.89%	38	10.13%	41	10.38%	47	10.56%
Other	5	1.41%	6	1.60%	7	1.77%	9	2.02%
Totals	**354**	**100.00%**	**375**	**100.00%**	**395**	**100.00%**	**445**	**100.00%**

[1]*Oregon Department of Aviation*

OPERATIONS FORECAST

Aviation operations are classified as air carrier, air taxi, military, and general aviation. Air carrier aircraft are generally those with 60 or more passenger seats. Hillsboro Airport is not currently, nor planned to be, an air carrier airport; therefore, forecasts of air carrier activity are not necessary. It should be noted that, on occasion, the Airport may have operations by aircraft classified as air carrier, but these totals have been less than 50 annually and, in most years, are zero.

Air taxi operations are generally those conducted by aircraft operating in a "for-hire" or "on-demand" capacity with 59 or fewer seats. In some cases, private charter operations may be classified as air taxi. Air taxi operations typically include commuter, air cargo, air ambulance, and many fractional ownership operations. Military operations include those operations conducted by various branches of the U.S. military. General aviation operations include a wide range of activity from recreational use to business and corporate uses.

Aircraft operations are further classified as local and itinerant. A local operation is a takeoff or landing performed by an aircraft that operates within sight of an airport, or which executes simulated approaches or touch-and-go operations at an airport. Generally, local operations are characterized by training activity. Itinerant operations are those performed by aircraft with a specific origin or destination away from an airport. Typically, itinerant operations increase with business and commercial use since business aircraft are used primarily to transport passengers from one location to another.

The following sections present several new general aviation operations forecasts. Once a forecast of general aviation operations has been selected, they will be combined with air taxi and military operations forecasts to provide a total operations forecast for use in determining facility requirements for the Airport. Several methods for determining general aviation operations have been employed to develop a reasonable planning envelope.

Historical Operations

Hillsboro Airport has an airport traffic control tower. Tower personnel collect operational data when the tower is open between the hours of 6:00 a.m. and 10:00 p.m. **Exhibit 3E** presents the historical operations at the Airport since 1990. Over this period, total annual operations have ranged from a low of approximately 186,000 in 2015 to a high of approximately 261,000 operations, which occurred in 2008. Year-over-year from 2015 to 2016, operations increased by 6.09 percent to 197,763. Local operations have been more volatile than itinerant operations. In 2008, there were 176,818 local operations, which had declined to 110,451 by 2015. In 2016, local operations began to return to growth with 115,353 operations.

This pattern is similar to those at most airports across the country. High water marks for aviation operations occurred around 2008, followed by a national recession, which had an immediate and significant impact on aviation activity, especially local activity. The relatively slow recovery from the recession tempered the return to growth. The historical operations trend at Hillsboro Airport followed this national pattern and are an indication of how closely aviation activity tends to follow the national economy.

Local General Aviation Operations Forecast

Local general aviation operations are associated with training activity or touch-and-go activity. Nationally, the FAA forecasts local general aviation activity to grow at an annual average rate of 0.4 percent from 2016-2037.

Time-Series and Regression Analysis

Neither time-series nor regression analysis of local operations returned results of predictive value. This is primarily due to the volatile nature of aviation activity at the Airport and especially the declining trend since the 2007-2009 recession and subsequent slow recovery. As a result, neither of these methods are employed to arrive at a local operations forecast.

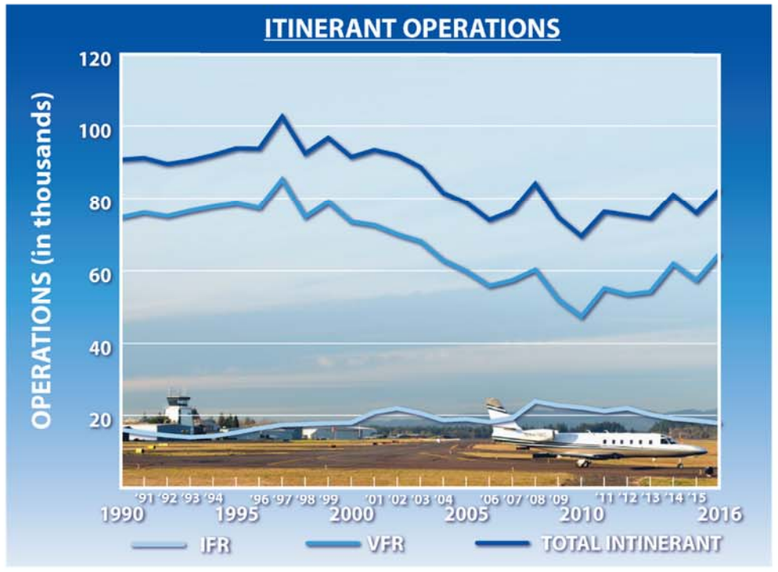
Market Share Analysis

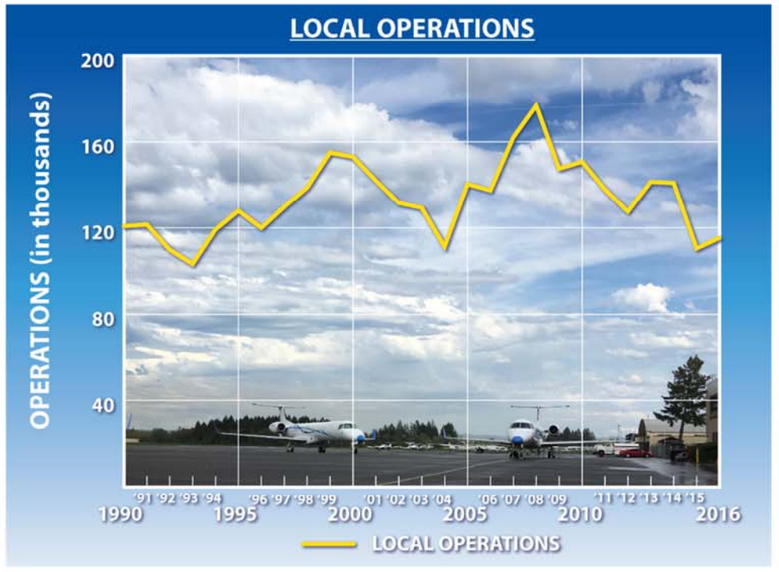
Market share analysis compares several known historical data points. Local general aviation operations are sourced from the control tower. Total local general aviation operations in the U.S. is sourced from the FAA forecasts. The number of based aircraft at the Airport is sourced from Port of Portland records. **Table 3L** presents a summary of the market share forecasts.

The first market share forecast considers the Airport maintaining a constant share of national local general aviation operations (0.9915 percent). This results in 117,305 local general aviation operations by 2021, 119,437 by 2026, and 123,948 by 2036. The average annual growth rate is 0.36 percent. Because local operations have historically shown large changes in relatively short periods of time, this is likely a low-end forecast.

	IFR ITINERANT					VFR ITINERANT					TOTAL ITINERANT					LOCAL			
Year	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	Total
1990	0	135	15,709	217	16,061	0	1,811	72,270	686	74,767	0	1,946	87,979	903	90,828	120,015	766	120,781	211,609
1991	0	419	14,586	136	15,141	0	2,620	72,893	576	76,089	0	3,039	87,479	712	91,230	121,054	499	121,553	212,783
1992	0	521	13,832	120	14,473	0	2,378	72,132	586	75,096	0	2,899	85,964	706	89,569	109,124	748	109,872	199,441
1993	0	494	13,334	128	13,956	0	2,618	73,463	506	76,587	0	3,112	86,797	634	90,543	102,632	628	103,260	193,803
1994	0	663	13,492	126	14,281	0	2,899	74,254	629	77,782	0	3,562	87,746	755	92,063	118,523	724	119,247	211,310
1995	0	835	14,207	212	15,254	0	2,536	75,260	856	78,652	0	3,371	89,467	1,068	93,906	127,233	715	127,948	221,854
1996	0	1,304	15,024	91	16,419	0	2,871	73,124	1,400	77,395	0	4,175	88,148	1,491	93,814	119,630	378	120,008	213,822
1997	0	1,724	15,468	153	17,345	0	3,907	80,816	582	85,305	0	5,631	96,284	735	102,650	129,381	364	129,745	232,395
1998	0	1,705	15,815	61	17,581	0	4,005	69,804	1,072	74,881	0	5,710	85,619	1,133	92,462	138,105	599	138,704	231,166
1999	0	2,029	15,710	53	17,792	0	4,524	73,676	818	79,018	0	6,553	89,386	871	96,810	154,123	824	154,947	251,757
2000	0	2,334	15,571	58	17,963	0	4,896	67,630	1,045	73,571	0	7,230	83,201	1,103	91,534	151,645	1,332	152,977	244,511
2001	1	4,195	16,486	158	20,840	11	3,736	68,153	715	72,615	12	7,931	84,639	873	93,455	141,880	48	141,928	235,383
2002	0	5,490	16,348	104	21,942	6	3,588	66,145	322	70,061	6	9,078	82,493	426	92,003	131,495	91	131,586	223,589
2003	0	5,603	14,977	54	20,634	0	3,783	63,965	396	68,144	0	9,386	78,942	450	88,778	129,141	199	129,340	218,118
2004	0	5,062	13,579	35	18,676	0	3,225	58,865	799	62,889	0	8,287	72,444	834	81,565	111,250	18	111,268	192,833
2005	0	5,277	13,633	57	18,967	0	4,412	55,307	170	59,889	0	9,689	68,940	227	78,856	140,311	60	140,371	219,227
2006	0	5,546	12,576	47	18,169	0	3,227	52,432	215	55,874	0	8,773	65,008	262	74,043	137,421	29	137,450	211,493
2007	0	5,242	13,855	80	19,177	3	1,329	55,900	139	57,371	3	6,571	69,755	219	76,548	162,032	25	162,057	238,605
2008	0	5,305	18,502	59	23,866	0	2,310	57,754	209	60,273	0	7,615	76,256	268	84,139	176,791	27	176,818	260,957
2009	0	5,140	17,518	69	22,727	0	609	51,206	226	52,041	0	5,749	68,724	295	74,768	147,478	25	147,503	222,271
2010	0	5,349	16,762	64	22,175	0	389	46,857	112	47,358	0	5,738	63,619	176	69,533	149,579	1,101	150,680	220,213
2011	4	5,690	15,408	87	21,189	0	545	54,362	243	55,150	4	6,235	69,770	330	76,339	137,822	82	137,904	214,243
2012	5	6,013	15,802	133	21,953	11	270	52,894	250	53,425	16	6,283	68,696	383	75,378	127,555	34	127,589	202,967
2013	4	3,717	16,389	146	20,256	1	167	53,798	230	54,196	5	3,884	70,187	376	74,452	141,387	22	141,409	215,861
2014	10	4,104	14,886	100	19,100	4	218	61,567	136	61,925	14	4,322	76,453	236	81,025	140,889	18	140,907	221,932
2015	11	4,201	14,225	139	18,576	24	204	56,919	228	57,375	35	4,405	71,144	367	75,951	110,446	5	110,451	186,402
2016	3	4,046	13,668	124	17,841	9	306	64,110	144	64,569	12	4,352	77,778	268	82,410	115,332	21	115,353	197,763

Source: Hillsboro Control Tower





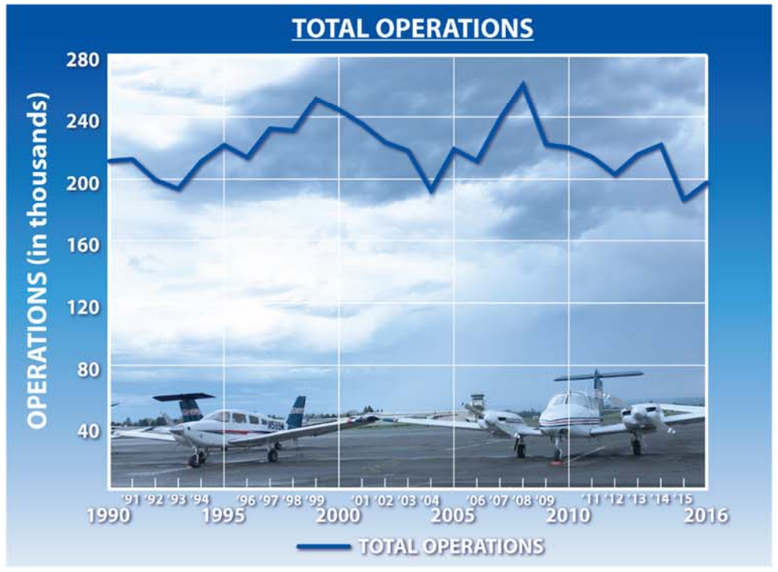


Exhibit 3E
GENERAL AVIATION OPERATIONS HISTORY

TABLE 3L
Local General Aviation Operations – Market Share Forecasts
Hillsboro Airport

Year	HIO Local GA Operations[1]	U.S. ATCT Local GA Operations[2]	HIO Market Share	HIO Based Aircraft	Local GA Ops per Based Aircraft
2008	176,791	14,081,000	1.2555%		
2009	147,478	12,448,000	1.1848%		
2010	149,579	11,716,000	1.2767%		
2011	137,822	11,437,000	1.2051%		
2012	127,555	11,608,000	1.0989%		
2013	141,387	11,688,000	1.2097%		
2014	140,889	11,675,000	1.2068%		
2015	110,446	11,691,000	0.9447%		
2016	115,332	11,632,000	0.9915%	354	326
Constant Market Share of National Local GA Operations (CAGR = 0.36%)					
2021	117,305	11,831,000	0.9915%	375	313
2026	119,437	12,046,000	0.9915%	395	302
2036	123,948	12,501,000	0.9915%	445	279
Increasing Market Share of National Local GA Operations (CAGR = 1.73%)					
2021	118,310	11,831,000	1.0000%	375	315
2026	132,506	12,046,000	1.1000%	395	335
2036	162,513	12,501,000	1.3000%	445	365
Constant Local GA Operations Per Based Aircraft (CAGR = 1.15%)					
2021	122,174	11,831,000	1.0327%	375	326
2026	128,690	12,046,000	1.0683%	395	326
2036	144,979	12,501,000	1.1597%	445	326
Increasing Local GA Operations Per Based Aircraft (CAGR = 1.80%)					
2021	134,250	11,831,000	1.1347%	375	358
2026	142,990	12,046,000	1.1870%	395	362
2036	164,650	12,501,000	1.3171%	445	370

[1]Tower operations
[2]FAA Aerospace Forecasts – Fiscal Years 2017-2037
HIO = Hillsboro Airport; GA = General Aviation; ATCT = Airport Traffic Control Tower

The next market share forecast considers the Airport realizing an increasing share of national local general aviation operations. This results in 118,310 local general aviation operations by 2021, 132,506 by 2026, and 162,513 by 2036 for an average annual growth rate of 1.73 percent. While this forecast represents a somewhat aggressive forecast, in the long term, local general aviation operations are still less than the 2008 peak.

The next market share forecast considered the historical relationship between local general aviation operations and based aircraft. In 2016, there were 354 based aircraft which equated to 326 local general aviation operations per based aircraft. By maintaining a constant 326 local general aviation operations per based aircraft, a forecast emerges. This results in 122,174 local general aviation operations by 2021, 128,690 by 2026, and 144,979 by 2036 for an average annual growth rate of 1.15 percent.

The last market share forecast considers an increasing number of local operations per based aircraft. This results in 123,750local general aviation operations by 2021, 131,930 by 2026, and 152,190 by 2036 for an average annual growth rate of 1.40 percent.

Additional Local General Aviation Forecasts

An additional forecast of local general aviation operations has been developed and is presented in **Table 3M**. The table includes additional information in order to provide a check of this forecast in comparison to the previously presented market share forecasts. This forecast considers applying the national growth rate for local general aviation operations as forecast by the FAA, which is 0.4 percent annually. This results in a 2036 forecast of 124,918 local operations.

TABLE 3M
Local General Aviation Operations – National Growth Rate Forecast
Hillsboro Airport

Year	HIO Local GA Operations[1]	U.S. ATCT Local GA Operations[2]	HIO Market Share	HIO Based Aircraft	Local GA Ops per Based Aircraft
National Growth Percent (CAGR = 0.40%)					
2021	117,657	11,831,000	0.9945%	375	314
2026	120,029	12,046,000	0.9964%	395	304
2036	124,918	12,501,000	0.9993%	445	281

[1]Tower operations
[2]FAA Aerospace Forecasts – Fiscal Years 2017-2037
HIO = Hillsboro Airport; GA = General Aviation; ATCT = Airport Traffic Control Tower

Local General Aviation Operations Forecast Summary

Table 3N presents the five forecasts of local general aviation operations that comprise the planning envelope. The FAA Terminal Area Forecast for local operations at the Airport is also included as a point of comparison. The five forecasts appear to provide a reasonable planning envelope from which a selected forecast can be made. Because of the historical volatility of local general aviation operations and the fact that there are multiple flight schools at the Airport, it is recommended that the selected forecast fall on the higher range of the planning envelope. By utilizing a selected forecast that is slightly higher than the average of the five forecasts, airport management will be better positioned to plan for the potential increase in activity. As with all forecasts, if increased activity does not materialize, then additional facilities may not be required.

The selected forecast of local general aviation operations results in an annual growth rate of 1.24 percent. By the long term 2036 planning horizon, a total of 147,500 local general aviation operations are forecast.

TABLE 3N
Local General Aviation Operations Planning Forecast Envelope
Hillsboro Airport

Method	2021	2026	2036	CAGR[1]
Market Share of US Local GA Operations (Constant)	117,305	119,437	123,948	0.36%
Market Share of US Local GA Operations (Increasing)	118,310	132,506	162,513	1.73%
Operations per Based Aircraft (Constant)	122,174	128,690	144,979	1.15%
Operations per Based Aircraft (Increasing)	123,750	131,930	152,190	1.40%
National Growth Trend Forecast	117,657	120,029	124,918	0.40%
FAA Terminal Area Forecast (for comparison)	114,504	115,371	117,123	0.08%
Selected Local General Aviation Operations Forecast	**121,800**	**130,000**	**147,500**	1.24%

[1]Compound annual growth rate

The selected forecast considers an annual growth rate of 1.24 percent. Local general aviation operations are forecast at 121,800by 2021, 130,000 by 2026, and 147,500 by 2036. The top half of **Exhibit 3F** presents the local general aviation operations forecast in graphic form.

General Aviation Itinerant Operations Forecast

Itinerant general aviation operations are associated with aircraft arriving from or departing to another airport and do not include training or touch-and-go operations. This segment of activity has been fairly steady at Hillsboro over the last 10 years. In 2008, there were 76,256 itinerant general aviation operations, and in 2016 there were 77,778. There was a 9.32 percent increase in itinerant general aviation operations from 2015 to 2016. Nationally, the FAA forecasts itinerant general aviation activity to grow at an annual average rate of 0.3 percent. The historic high for itinerant general aviation operations occurred in 1997 when there were 96,284.

Time-Series and Regression Analysis

Neither time-series nor regression analysis of itinerant general aviation operations returned results of predictive value. This is primarily due to the relatively flat level of itinerant general aviation operations at the Airport since 2008. As a result, neither of these methods is employed to arrive at an itinerant general aviation operations forecast.

Market Share Analysis

The market share analysis compares several known historical data points. Itinerant general aviation operations are sourced from the tower data since 2008. Total itinerant general aviation operations in the U.S. is sourced from the FAA forecasts. **Table 3P** presents the market share forecasts.

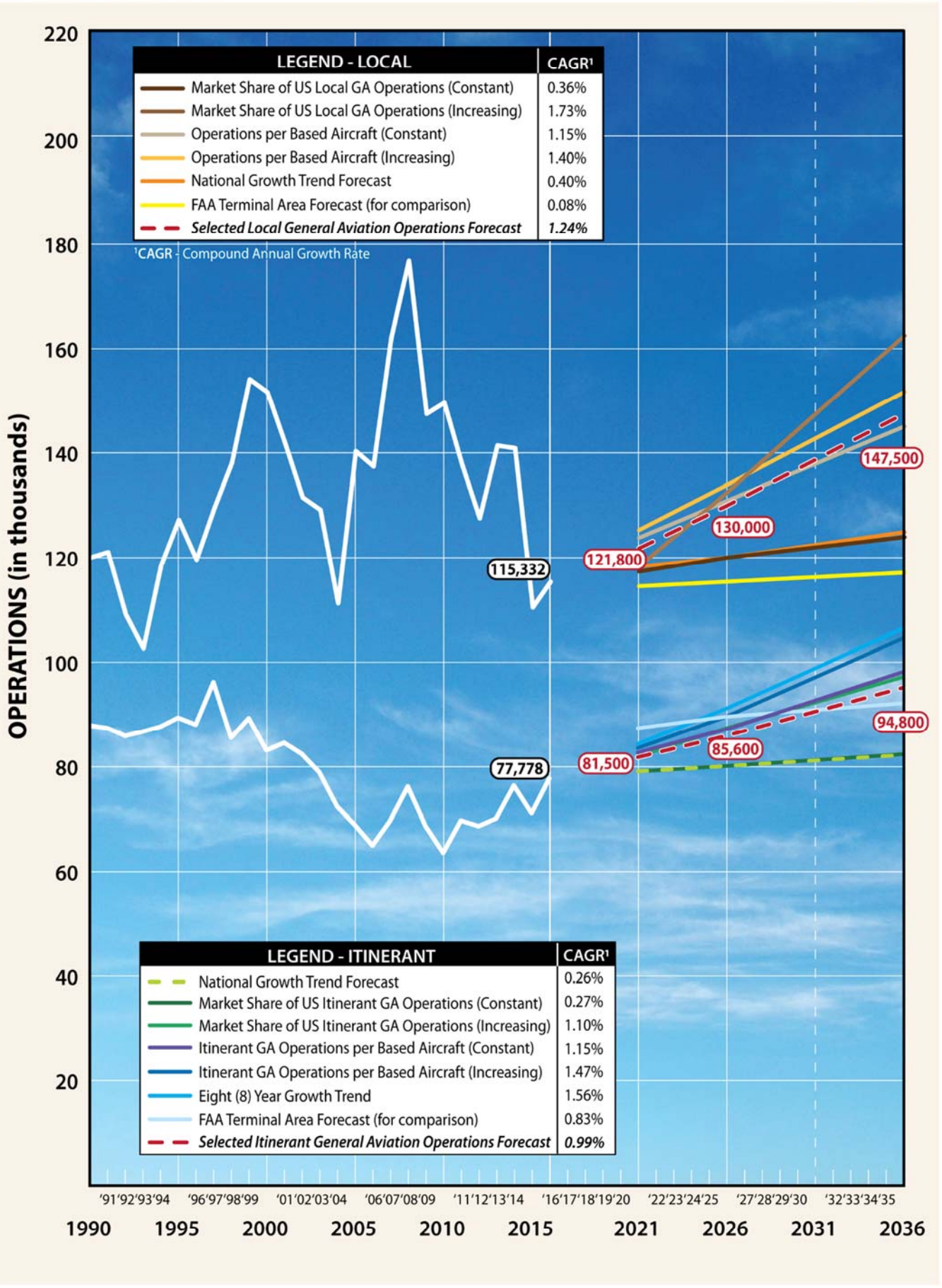


Exhibit 3F
GENERAL AVIATION OPERATIONS FORECAST

TABLE 3P
Itinerant General Aviation Operations - Market Share Forecasts
Hillsboro Airport

Year	HIO Itinerant GA Operations[1]	U.S. ATCT Itinerant GA Operations[2]	HIO Market Share	HIO Based Aircraft	Itinerant GA Ops per Based Aircraft
2008	76,256	17,493,000	0.4359%		
2009	68,724	15,571,000	0.4414%		
2010	63,619	14,864,000	0.4280%		
2011	69,770	14,528,000	0.4802%		
2012	68,696	14,522,000	0.4730%		
2013	70,187	14,117,000	0.4972%		
2014	76,453	13,979,000	0.5469%		
2015	71,144	13,887,000	0.5123%		
2016	77,778	13,904,000	0.5594%	354	220
Constant Market Share of National Itinerant GA Operations (CAGR = 0.27%)					
2021	78,785	14,084,000	0.5594%	375	210
2026	79,842	14,273,000	0.5594%	395	202
2036	82,074	14,672,000	0.5594%	445	184
Increasing Market Share of National Itinerant GA Operations (CAGR = 1.10%)					
2021	81,687	14,084,000	0.5800%	375	218
2026	87,065	14,273,000	0.6100%	395	220
2036	96,835	14,672,000	0.6600%	445	218
Constant Itinerant GA Operations Per Based Aircraft (CAGR = 1.15%)					
2021	82,392	14,084,000	0.5850%	375	220
2026	86,786	14,273,000	0.6080%	395	220
2036	97,772	14,672,000	0.6664%	445	220
Increasing Itinerant GA Operations Per Based Aircraft Projection (CAGR = 1.47%)					
2021	83,250	14,084,000	0.5911%	375	222
2026	89,270	14,273,000	0.6254%	395	226
2036	104,130	14,672,000	0.7097%	445	234

[1]Tower operations
[2]FAA Aerospace Forecasts – Fiscal Years 2017-2037
HIO = Hillsboro Airport; GA = General Aviation; ATCT = Airport Traffic Control Tower

The first market share forecast considers the Airport maintaining a constant share of national itinerant general aviation operations (0.5594 percent). This results in 78,785 itinerant general aviation operations by 2021, 79,842 by 2026, and 82,074 by 2036. The average annual growth rate is 0.27 percent.

The next market share forecast considers the Airport realizing an increasing share of national itinerant general aviation operations following the actual trend at the Airport over the past several years. This results in 81,687 itinerant general aviation operations by 2021, 87,065 by 2026, and 96,835 by 2036 for an average annual growth rate of 1.10 percent.

The next market share forecast considered the historical relationship between itinerant general aviation operations and based aircraft. In 2016, there were 354 based aircraft which equated to 220 operations

per based aircraft. By maintaining a constant 220 itinerant general aviation operations per based aircraft, a forecast emerges. This results in 82,392 itinerant general aviation operations by 2021, 86,786 by 2026, and 97,772 by 2036 for an average annual growth rate of 1.15 percent.

The last market share forecast considers an increasing number of itinerant operations per based aircraft. This results in 83,250 local general aviation operations by 2021, 89,270 by 2026, and 104,130 by 2036 for an average annual growth rate of 1.47 percent.

Additional Itinerant General Aviation Forecasts

Two additional forecasts of itinerant general aviation operations have been developed and are presented in **Table 3Q**. The table includes additional information to provide a check of these forecasts in comparison to the previously presented market share forecasts. The first additional forecast considers applying the national growth rate for local general aviation operations as forecast by the FAA, which is 0.3 percent annually. This results in a 2036 forecast of 81,924 itinerant general aviation operations. The second additional forecast considers the growth trend over the last eight years, which was 1.56 percent annually. This results in in 84,037 local general aviation operations by 2021, 90,800 by 2026, and 106,001 by 2036.

TABLE 3Q
Additional Itinerant General Aviation Operations Forecasts
Hillsboro Airport

Year	HIO Local GA Operations[1]	U.S. ATCT Local GA Operations[2]	HIO Market Share	HIO Based Aircraft	Local GA Ops per Based Aircraft
National Growth Percent (CAGR = 0.26%)					
2021	78,794	14,084,000	0.5595%	375	210
2026	79,824	14,273,000	0.5593%	395	202
2036	81,924	14,672,000	0.5584%	445	184
Eight (8) Year Growth Trend (CAGR = 1.56%)					
2021	84,037	14,084,000	0.5967%	375	224
2026	90,800	14,273,000	0.6362%	395	230
2036	106,001	14,672,000	0.7225%	445	238

[1]Tower operations
[2]FAA Aerospace Forecasts – Fiscal Years 2017-2037
HIO = Hillsboro Airport; GA = General Aviation; ATCT = Airport Traffic Control Tower

General Aviation Itinerant Operations Forecast Summary

Table 3R presents a summary of the six forecasts of itinerant general aviation operations which comprise the planning envelope. The FAA TAF forecast is also included on the table for comparative purposes. The bottom half of **Exhibit 3F** presents the itinerant general aviation operations forecast in graphic form.

The selected forecast is an approximate average of the six new forecasts. The average was selected because none of these individual forecasts stands out as more reliable than the others and none appears to be an outlier. The selected forecast for itinerant general aviation operations is 81,500 by 2021, 85,600 by 2026, and 94,800 by 2036.

TABLE 3R
Itinerant General Aviation Operations Planning Forecast Envelope
Hillsboro Airport

Method	2021	2026	2036	CAGR[1]
Market Share of US Itinerant GA Operations (Constant)	78,785	79,842	82,074	0.27%
Market Share of US Itinerant GA Operations (Increasing)	81,687	87,065	96,835	1.10%
Itinerant GA Operations per Based Aircraft (Constant)	82,392	86,786	97,772	1.15%
Itinerant GA Operations per Based Aircraft (Increasing)	83,250	89,270	104,130	1.47%
National Growth Trend Forecast	78,794	79,824	81,924	0.26%
Eight (8) Year Growth Trend	84,037	90,800	106,001	1.56%
FAA Terminal Area Forecast (for comparison)	87,080	89,133	91,839	0.83%
Selected Itinerant General Aviation Operations Forecast	**81,500**	**85,600**	**94,800**	0.99%

[1]Compound annual growth rate

Air Taxi Operations Forecast

Air taxi operations are those with authority to provide "on-demand" or "for-hire" transportation of persons or property via aircraft with fewer than 60 passenger seats. Air taxi includes a broad range of operations, including some smaller commercial service aircraft, some charter aircraft, air cargo aircraft, many fractional ownership aircraft, and air ambulance services. For purposes of this forecast element, the occasional operations categorized as air carrier are included in the air taxi category.

Air taxi operations at the Airport have been on a declining trend in recent years although they appear to have stabilized at approximately 4,400 since 2014. In 2016, there were 4,364 air taxi operations and in 2005, there were 9,689 air taxi operations, which was the high-level mark. Because of the declining trend nationally, time-series and regression analysis did not have predictive value.

Table 3S presents the air taxi operations forecasts which consider the Airport's market share of national air taxi operations as forecast by the FAA. The FAA forecast shows a decline in air taxi operations nationally through 2026 and then a return to growth thereafter. This category includes regional airline aircraft with fewer seats than 60 seats which are rapidly being retired from the national fleet and replaced by aircraft with more seats. It should also be noted that air taxi operations at the Airport have remained relatively steady since 2013, while at the same time, national air taxi operations have declined.

The first forecast considers the Airport maintaining a constant share of national air taxi operations. This results in a negative growth rate of -1.01 percent. This is considered the low-end forecast because it is not reflective of the trend in the past few years. The second forecast considers an increasing market share of national air taxi operations. This forecast results in relatively flat annual growth of 0.04 percent.

TABLE 3S
Air Taxi Operations – Market Share Forecasts
Hillsboro Airport

Year	HIO Air Taxi Operations[1]	FAA Air Taxi Forecast[2]	HIO Market Share
2007	6,574	11,667,000	0.05635%
2008	7,615	11,032,000	0.06903%
2009	5,749	9,521,000	0.06038%
2010	5,738	9,410,000	0.06098%
2011	6,239	9,279,000	0.06724%
2012	6,299	8,994,000	0.07004%
2013	3,889	8,803,000	0.04418%
2014	4,336	8,440,000	0.05137%
2015	4,440	7,895,000	0.05624%
2016	4,364	7,580,000	0.05757%
Constant Share of National Air Taxi Operations (CAGR = -1.01%)			
2021	3,274	5,687,000	0.05757%
2026	3,220	5,593,000	0.05757%
2036	3,565	6,193,000	0.05757%
Increasing Share of National Air Taxi Operations (CAGR = 0.04%)			
2021	3,412	5,687,000	0.06000%
2026	3,580	5,593,000	0.06400%
2036	4,397	6,193,000	0.07100%
FAA 2017 TAF - Air Taxi Operations (CAGR - 5.09%)			
2021	5,593	5,687,000	0.09835%
2026	7,170	5,593,000	0.12820%
2036	11,776	6,193,000	0.19015%

[1]Hillsboro control tower
[2]*FAA Aeronautical Forecasts 2017-2037*
CAGR: Compound annual growth rate

The FAA Terminal Area Forecast is also included in the table as a point of comparison. As can be seen, the TAF shows an aggressive annual growth rate of 5.09 percent through 2036. In the long term, the TAF projects 11,776 air taxi operations. The FAA may have been considering the potential for an added air taxi operator, such as another business shuttle or a nine-seat air carrier operator. The TAF forecast may be considered an outlier because its long term forecast far exceeds the previous high level.

Other Air Taxi Operations Factors

Intel operates a corporate shuttle that provides service at Hillsboro and locations in California and Arizona. They have a fleet of Embraer 145 regional jets, each with a seating capacity for 50 passengers. Each of the operations by Intel is categorized as air taxi based upon the federal regulations under which they operate. **Table 3T** presents the historical number of operations Intel shuttle aircraft have conducted annually since 2008. With this information, it is known that the Intel shuttles account for approximately 65 percent of all air taxi operations at the Airport. Interviews with Intel representatives indicate

that they do not anticipate any major changes in their operation for the foreseeable future. Over the last four years, Intel has averaged approximately 2,900 operations. This figure can be expected to remain steady. Therefore, the forecast of future air taxi operations is focused on the remaining 35 percent of "other air taxi" operations, of which there were 1,508 in 2016.

TABLE 3T
Intel Shuttle Operations
Hillsboro Airport

Year	Intel Shuttle Air Taxi Operations[2]	Percent Share	"Other Air Taxi" Operations	Percent Share	Total Air Taxi Operations[1]
2008	4,016	52.74%	3,599	47.26%	7,615
2009	4,028	70.06%	1,721	29.94%	5,749
2010	4,006	69.82%	1,732	30.18%	5,738
2011	4,022	64.47%	2,217	35.53%	6,239
2012	4,066	64.55%	2,233	35.45%	6,299
2013	3,176	81.67%	713	18.33%	3,889
2014	2,750	63.42%	1,586	36.58%	4,336
2015	2,726	61.40%	1,714	38.60%	4,440
2016	2,856	65.44%	1,508	34.56%	4,364
Average	**3,516**	**65.02%**	**1,891**	**34.98%**	**5,408**
AIR TAXI FORECAST					
2021	2,900	65.91%	1,500	34.09%	4,400
2026	2,900	63.04%	1,700	36.96%	4,600
2036	2,900	58.00%	2,100	42.00%	5,000
CAGR[3]			1.67%		0.68%

[1]Hillsboro control tower
[2]Port of Portland
[3]Compound annual growth rate

The fact that national air taxi operations are declining is not expected to have a negative impact on air taxi operations at Hillsboro for three specific reasons:

1. The decline in air taxi operations nationally is primarily attributable to the retirement of regional passenger aircraft with less than 60 seats.
2. Intel shuttle air taxi operations, which represent a significant portion of total air taxi operations, are not anticipated to change significantly over the term of the master plan.
3. As a reliever airport, Hillsboro is an attractive facility, in terms of both location and capabilities, to serve these operations.

Because of these factors, air taxi operations are forecast to increase moderately over time. In the next five years, air taxi operations are projected to remain relatively flat. In the 10 to 20-year time frame, air taxi operations are projected to return to a growth pattern. By 2021, 4,400 air taxi operations are projected, by 2026, 4,600 are projected, and by 2026, 5,000 total air taxi operations are projected.

Military Operations Forecast

Military aircraft can and do utilize civilian airports across the country. Hillsboro Airport does on occasion have activity by military aircraft. Forecasts of military activity is inherently difficult because of the national security nature of their operations and the fact that missions can change without notice. Thus, it is typical for the FAA to utilize a flat line number for military operations. For Hillsboro Airport, the FAA TAF has 273 annual military operations for every year. For consideration in this master plan, a flat 400 military operations will be projected for each year through 2036. Of this total, 100 are considered local in nature and 300 are considered itinerant.

Total Operations Forecast Summary

Operations at general aviation airports experienced an immediate and significant decline during the national recession of 2007-2009. The recovery from the recession was slow and prolonged as compared to previous recessions post World War II. Many airports are only now beginning to see the declining trend reverse. This is the case at Hillsboro, where total operations were up 2.8 percent from 2015 to 2016. The FAA forecasts of operational demand nationally also reflect a reversal with a return to growth beginning in 2016.

The selected total operations forecast to be used for planning purposes is as follows:

- 2021 – 208,100 total operations
- 2026 – 220,600 total operations
- 2036 – 247,700 total operations

Table 3U presents the total operations forecast, segmented by operation type, for Hillsboro Airport. Overall, operations are forecast to grow at a compound annual rate of 1.13 percent. Local operations reflect the strongest growth category with a 1.24 percent annual growth rate. Local operations, particularly training operations, are the most volatile category. There can be large swings in local operations depending on the business of local flight schools. For example, just a few years ago, in 2008, there were nearly 177,000 local operations at Hillsboro, which was the highest level since before 1990. In 2015, there were approximately 111,000 local operations, which represented the lowest level since 1993.

Itinerant operations at Hillsboro have been far more consistent over time. As a reliever general aviation airport, itinerant operations tend to be more stable than local operations because the Airport is a destination for business aviation. The forecast of itinerant operations projects an annual growth rate of 0.98 percent. In the long term, 100,100 itinerant operations are forecast.

TABLE 3U
Total Operations Forecast
Hillsboro Airport

	Local Operations			Itinerant Operations				Grand Total
Year	General Aviation	Military	Local Total	General Aviation	Air Taxi	Military	Itinerant Total	
2016	115,332	21	115,353	77,778	4,364	268	82,410	197,763
2021	121,800	100	121,900	81,500	4,400	300	86,200	208,100
2026	130,000	100	130,100	85,600	4,600	300	90,500	220,600
2036	147,500	100	147,600	94,800	5,000	300	100,100	247,700
CAGR[1]	1.24%		1.24%	0.99%	0.68%		0.98%	1.13%

[1]Compound annual growth rate

FORECAST COMPARISON TO THE FAA TAF

The FAA will review the forecasts presented in this Master Plan for comparison to the *Terminal Area Forecast*. The forecasts are considered consistent with the TAF if they meet the following criteria:

- Forecasts differ by less than 10 percent in the 5-year forecast period, and 15 percent in the 10-year forecast period, or
- Forecasts do not affect the timing or scale of an airport project, or
- Forecasts do not affect the role of the airport as defined in the current version of FAA Order 5090.3, *Field Formulation of the National Plan of Integrated Airport Systems*.

If the master planning forecasts exceed these parameters, then the forecasts must be forwarded to FAA headquarters in Washington, D.C. for further review. Deviation from these thresholds will require specific local documentation, which is included in this chapter. **Table 3V** presents the direct comparison of the master planning forecasts with the TAF published in January 2017.

Total operations are within the FAA range for consistency. When utilizing the based aircraft count of 354 and applying the FAA TAF based aircraft growth rate (1.62%), the master plan forecast for based aircraft is also within the FAA range for consistency.

The forecasts are not expected to affect the timing or scale of any major airport projects, and the role of the Airport as a reliever general aviation facility is not expected to change.

TABLE 3V
Forecast Comparison to the 2016 FAA Terminal Area Forecast (TAF)
Hillsboro Airport

	2016	2021	2026	2036	CAGR 2016-2036
Total Operations					
Master Plan Forecast	197,763	208,100	220,600	247,700	1.13%
FAA TAF (2017)	196,061	208,178	211,947	221,011	0.60%
% Difference	0.9%	0.0%	4.1%	12.1%	
Based Aircraft					
Master Plan Forecast	354	375	395	445	1.15%
FAA TAF (2017)	256	277	299	349	1.56%
% Difference	38.3%	35.4%	32.1%	27.5%	
FAA TAF HIO based aircraft growth rate with current based aircraft number	354	384	416	488	1.62%
% Difference	0.00%	-2.34%	-5.05%	-8.81%	

TAF: Terminal Area Forecast (January 2017)
CAGR: Compound annual growth rate

PEAKING ACTIVITY

Many aspects of facility planning relate to levels of peaking activity – times when an airport is busiest. For example, the appropriate size of terminal facilities can be estimated by determining the number of people that could reasonably be expected to use the facility at a given time. The following planning definitions apply to the peak periods:

- **Peak Month** -- The calendar month when peak aircraft operations occur.
- **Design Day** -- The average day in the peak month.
- **Busy Day** -- The busy day of a typical week in the peak month.
- **Design Hour** -- The peak hour within the design day.

The peak month is the month with the most operations within a given year. All other peak periods (design day, busy day, and design hour) will be exceeded at various times during the year. The peak period forecasts represent reasonable planning standards that can be applied without overbuilding or being too restrictive.

Tower records at the Airport were examined for this analysis. The most recent peak month for operations over a 12-month period was August of 2016 when there were 22,085 operations which accounted for 11.17 percent of total annual operations. At Hillsboro, summer months have consistently accounted for the peak month in any given year primarily because the weather is better and more training activity

occurs. Hourly operations data for August 2016 are presented in **Table 3W**. In August of 2016, the peak operational hour was between 10:00 and 11:00 a.m., which accounted for 11.02 percent of total operations during that month.

Table 3W
Design Hour Determination
Hillsboro Airport

	ITINERANT		LOCAL	Daily Total	Percent
Hour	**IFR**	**VFR**	**VFR**		
6-7 am	71	257	621	949	4.30%
7-8 am	57	483	1,035	1,575	7.13%
8-9 am	129	497	1,143	1,769	8.01%
9-10 am	122	767	951	1,840	8.33%
10-11 am	**82**	**727**	**1,624**	**2,433**	**11.02%**
11-12 am	81	703	843	1,627	7.37%
12-1 pm	93	715	1,278	2,086	9.45%
1-2 pm	86	628	508	1,222	5.53%
2-3 pm	81	716	789	1,586	7.18%
3-4 pm	93	645	416	1,154	5.23%
4-5 pm	152	701	716	1,569	7.10%
5-6 pm	110	652	459	1,221	5.53%
6-7 pm	106	584	445	1,135	5.14%
7-8 pm	68	508	238	814	3.69%
8-9 pm	66	328	253	647	2.93%
9-10 pm	23	295	140	458	2.07%
Total	1,420	9,206	11,459	22,085	100.00%

Note: Hourly operations by type in the peak month of August 2016
IFR: Instrument Flight Rules; VFR: Visual Flight Rules
Source: Hillsboro control tower

Table 3Y presents the operational peaking characteristics at the Airport. The design day is calculated by dividing the peak month operations by 31. The busy day is determined by averaging the four busiest days of each week of the peak month and applying that factor (1.27) to the design day. Design hour operations were calculated at 11.02 percent of design day operations.

TABLE 3Y
Peak Total Operations
Hillsboro Airport

	2016	2021	2026	2036
Annual	197,763	208,100	220,600	247,700
Peak Month (11.17%)	22,085	23,245	24,641	27,668
Busy Day	903	952	1,009	1,133
Design Day	712	750	795	893
Design Hour (11.02%)	79	83	88	98

Note: Baseline peak month is August 2016.
Source: Coffman Associates analysis of ATCT records

Currently, the operational design hour is 79, meaning facility planning that considers this variable, such as airfield capacity, should be designed to accommodate 79 operations per hour. By 2036, the design hour is projected to increase to 98.

OPERATIONS BY FLEET MIX

Developing an understanding of the operational fleet mix, including the approximate volume of operations by aircraft type, is utilized in airfield capacity analysis, fuel storage capacity analysis, noise and emissions analysis, and pavement utilization determination.

The challenge when developing an operations fleet mix is that there is no single source of operations classified by aircraft type. As a result, it is necessary to pull data from a variety of sources, assimilate that data, and output a reasonable estimate of activity by aircraft type. The following sources of data have been utilized in the operations fleet mix determination:

Airport Traffic Control Tower: The tower counts aircraft operations as either itinerant or local and general aviation, air taxi, and military. Local operations account for approximately 58 percent of activity and itinerant operations account for 42 percent. Local operations include training operations; however, it is not possible to know with precision how many training operations occur annually as they are not counted this way. Utilizing the in-house ANOMS (see definition below) system, the Port of Portland examines the flight patterns of helicopters utilizing the three helicopter training pattern locations (Alpha, Bravo, and Delta). With this data, it is estimated that helicopter operations currently account for approximately 30 percent of overall operations.

Traffic Flow Management System Count (TFMSC): This FAA database captures a portion of operations by aircraft type utilizing flight plan data that is supplemented with flights captured by the national airspace system, usually through radar. Most flights are not required to file a flight plan and, therefore, this database represents a minimum level of activity. This database tends to be relatively reliable for capturing operations by aircraft that typically file a flight plan. Most air taxi operators (including the Intel shuttle) and business jets will file a flight plan and are thus captured in the database. Turboprop operators also tend to file flight plans but to a lesser degree than business jets. Helicopter operators rarely file flight plans.

Airport Noise Monitoring and Management System (ANOMS): The Airport maintains the ANOMS database as a tool in their on-going noise mitigation efforts. The data in this system is sourced primarily from the radar facility at Portland International Airport (PDX). This data is supplemented with other publicly available flight tracking data. Most of the operations captured in ANOMS reflect an aircraft type and a flight track.

Public Flight Tracking Sources: There are several companies, including GCR, Inc. and Flight Aware, that sell flight track information. While there is a great deal of overlap of this data with the TFMSC data, these companies provide a value add by offering different segmentation of the data. For example, the GCR data provides N-numbers, aircraft owner information, and if the aircraft is a fractional operator.

Other Data Sources: There are a variety of other sources that may be used to enhance fleet mix estimates. Some of these include landing reports for airports that charge a landing fee, fuel records, interviews with tenants such as flight schools, historical records, previous planning studies. For example, the landing report for Intel combined with their flight schedule helped to determine what portion of air taxi operations are Intel shuttle operations.

Operations by Type Estimates: Analysis across many general aviation airports provides a general guideline for estimating the number of operations by aircraft type per based aircraft. Total operations by multi-engine piston aircraft may be estimated at 200 operations per based multi-engine piston aircraft. This figure represents total operations by that aircraft type, not just the operations by those based at the Airport. Similarly, turboprops can be estimated at 250 operations per based, jets at 300 operations, and helicopters, which typically have higher utilization rates, at 400 operations per based helicopter. These are broad estimates and should be adjusted as necessary.

Table 3Z presents the fleet mix operations forecast for the Airport.

TABLE 3Z
Fleet Mix Operations Forecast
Hillsboro Airport

	2016	%	2021	%	2026	%	2036	%
Local Operations								
Piston	62,438	54.1%	66,193	54.3%	71,058	54.6%	81,477	55.2%
Multi-Piston	2,916	2.5%	2,916	2.4%	2,916	2.2%	2,800	1.9%
Turboprop	400	0.3%	600	0.5%	800	0.6%	1,200	0.8%
Helicopter	49,599	43.0%	52,191	42.8%	55,326	42.5%	62,123	42.1%
Total Local	**115,353**	**100.0%**	**121,900**	**100.0%**	**130,100**	**100.0%**	**147,600**	**100.0%**
Itinerant Operations								
Single Piston	54,446	66.1%	56,277	65.3%	58,762	64.9%	64,213	64.1%
Multi-Piston	2,084	2.5%	2,084	2.4%	2,084	2.3%	2,000	2.0%
Turboprop	3,850	4.7%	4,400	5.1%	4,700	5.2%	5,800	5.8%
Jet	12,300	14.9%	13,200	15.3%	14,100	15.6%	15,900	15.9%
Helicopters	9,730	11.8%	10,239	11.9%	10,854	12.0%	12,187	12.2%
Total Itinerant	**82,410**	**100.0%**	**86,200**	**100.0%**	**91,500**	**100.0%**	**100,100**	**100.0%**
Total Operations	**197,763**		**208,100**		**220,600**		**247,700**	

Source: Coffman Associates analysis

The fleet mix operations forecast will be input into the noise and emission model later in the master plan. Each category of aircraft type will be further segmented into specific aircraft types. The segmented data is also utilized in the airfield capacity model.

FORECAST SUMMARY

This chapter has outlined the various activity levels that might reasonably be anticipated over the 20-year planning period. **Exhibit 3G** presents a summary of the aviation demand forecasts prepared in this chapter. Actual activity is included for 2016, which is the base year for these forecasts. The primary aviation demand indicators forecast is based aircraft and operations.

Based aircraft are forecast to increase from 354 in 2016 to 445 by 2036. Total operations are forecast to increase from 197,763 in 2016 to 247,700 by 2036. Several forecasts for each aviation demand indicator were developed to create a planning envelope, or a range of reasonable forecasts. The selected forecast for both based aircraft and operations should be considered unconstrained, meaning if facilities were in place, the forecast growth could be accommodated.

Projections of aviation demand will be influenced by unforeseen factors and events in the future. In the recent past, events such as terrorist attacks and economic recessions have impacted aviation demand. Therefore, it is not reasonable to assume that future demand will follow the exact projection line, but over time, forecasts of aviation demand tend to fall within the planning envelope. The forecasts developed for this master planning effort are considered reasonable for planning purposes. The need for additional facilities will be based upon these forecasts; however, if demand does not materialize as projected, then implementation of facility construction should be slowed. Likewise, if demand exceeds these forecasts, then implementation of facility construction should be accelerated.

AIRPORT/AIRCRAFT/RUNWAY CLASSIFICATION

The FAA has established several aircraft classification systems that group aircraft types based on their performance (approach speed in landing configuration) and design characteristics (wingspan and landing gear configuration). These classification systems are used to determine the appropriate airport design standards for specific airport elements such as runways, taxiways, taxilanes, and aprons.

AIRCRAFT CLASSIFICATION

The selection of appropriate FAA design standards for the development and location of airport facilities is based primarily upon the characteristics of the aircraft which are currently using or are expected to use an airport. The critical aircraft is used to define the design parameters for an airport. The critical aircraft may be a single aircraft type or a composite aircraft representing a collection of aircraft with similar characteristics. The design aircraft is classified by three parameters: Aircraft Approach Category (AAC), Airplane Design Group (ADG), and Taxiway Design Group (TDG). FAA AC 150/5300-13A,

	BASE YEAR	FORECAST			CAGR[1]
	2016	2021	2026	2036	2016-36
ANNUAL OPERATIONS					
Itinerant Operations					
Air Taxi	4,364	4,400	4,600	5,000	0.68%
General Aviation	77,778	81,500	85,600	94,800	0.99%
Military	268	300	300	300	0.57%
Total Itinerant Operations	***82,410***	***86,200***	***90,500***	***100,100***	***0.98%***
Local Operations					
General Aviation	115,332	121,800	130,000	147,500	1.24%
Military	21	100	100	100	8.12%
Total Local Operations	***115,353***	***121,900***	***130,100***	***147,600***	***1.24%***
TOTAL OPERATIONS	**197,763**	**208,100**	**220,600**	**247,700**	**1.13%**
BASED AIRCRAFT					
Single Engine Piston	223	234	245	275	
Multi-Engine Piston	25	25	25	24	
Turboprop	17	20	22	28	
Jet	49	52	55	62	
Helicopter	35	38	41	47	
Other	5	6	7	9	
TOTAL BASED AIRCRAFT	**354**	**375**	**395**	**445**	**1.15%**
PEAKING OPERATIONS					
Annual	197,763	208,100	220,600	247,700	
Peak Month (11.17%)	22,085	23,245	24,641	27,668	
Busy Day	903	952	1,009	1,133	
Design Day	712	750	795	893	
Design Hour (11.02%)	79	83	88	98	

[1]CAGR: Compound annual growth rate

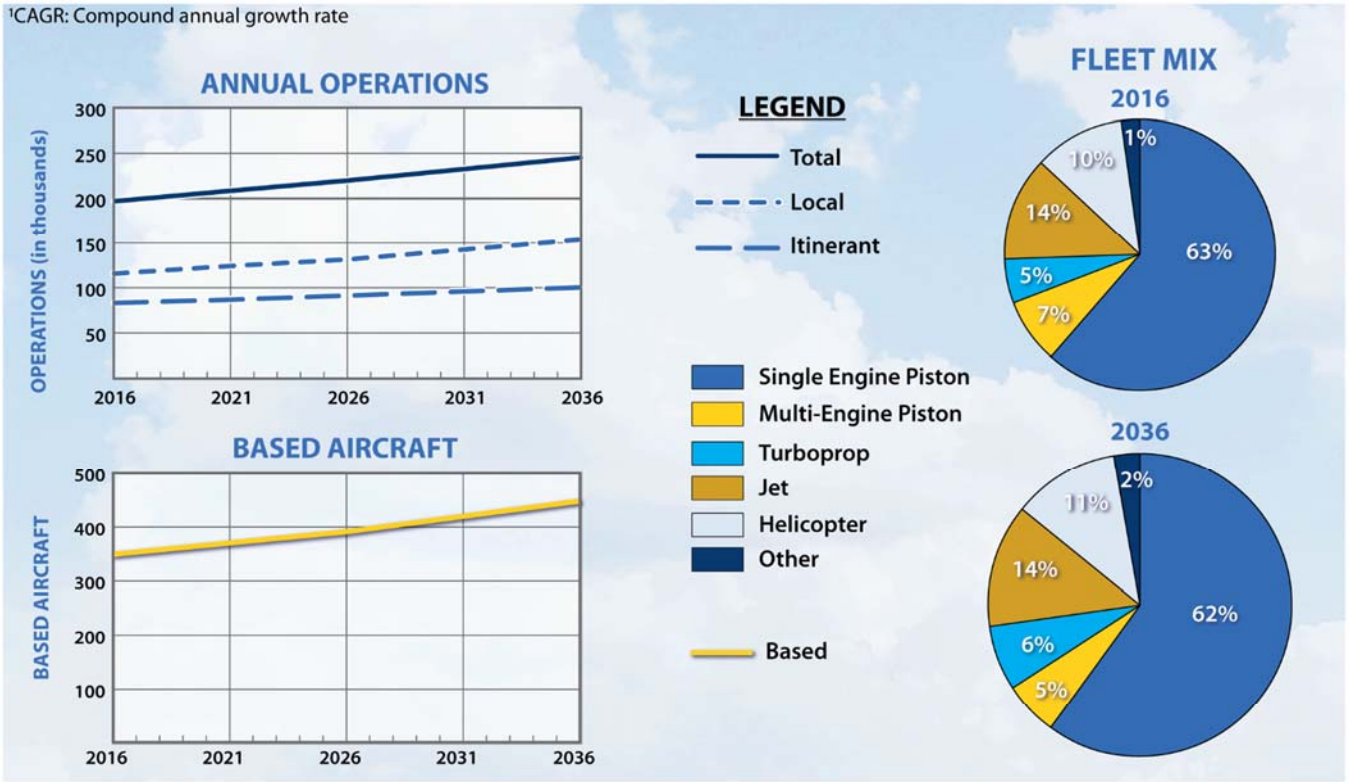


Exhibit 3G
FORECAST SUMMARY

Airport Design, describes the following airplane classification systems, the parameters of which are presented on **Exhibit 3H**.

Aircraft Approach Category (AAC): A grouping of aircraft based on a reference landing speed (V_{REF}), if specified, or if V_{REF} is not specified, 1.3 times stall speed (V_{SO}) at the maximum certificated landing weight. V_{REF}, V_{SO}, and the maximum certificated landing weight are those values as established for the aircraft by the certification authority of the country of registry.

The AAC generally refers to the approach speed of an aircraft in landing configuration. The higher the approach speed, the more restrictive the applicable design standards. The AAC, depicted by a letter A through E, is the aircraft approach category and relates to aircraft approach speed (operational characteristic). The AAC generally applies to runways and runway-related facilities such as runway width, runway safety area (RSA), runway object free area (ROFA), runway protection zone (RPZ), and separation standards.

Airplane Design Group (ADG): The ADG, depicted by a Roman numeral I through VI, is a classification of aircraft which relates to aircraft wingspan or tail height (physical characteristic). When the aircraft wingspan and tail height fall in different groups, the higher group is used. The ADG influences design standards for taxiway safety area (TSA), taxiway object free (TOFA), taxilane object free area, apron wingtip clearance, and various separation distances.

Taxiway Design Group (TDG): A classification of airplanes based on outer-to-outer Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance. The TDG relates to the undercarriage dimensions of the design aircraft. The TDG is classified by an alphanumeric system: 1A, 1B, 2, 3, 4, 5, 6, and 7. The taxiway design elements determined by the application of the TDG include the taxiway width, taxiway edge safety margin, taxiway shoulder width, taxiway fillet dimensions, and, in some cases, the separation distance between parallel taxiways/taxilanes. Other taxiway elements such as the taxiway safety area (TSA), taxiway/taxilane object free area (TOFA), taxiway/taxilane separation to parallel taxiway/taxilanes or fixed or movable objects, and taxiway/taxilane wingtip clearances are determined solely based on the wingspan (ADG) of the design aircraft utilizing those surfaces. It is appropriate for taxiways to be planned and built to different TDG standards based on expected use.

Exhibit 3J summarizes the classification of the most common aircraft in operation today. Generally, recreational and business piston and turboprop aircraft will fall in AAC A and B and ADG I and II. Business jets typically fall in ACC B and C, while the larger commercial aircraft will fall in AAC C and D.

AIRPORT AND RUNWAY CLASSIFICATION

Airport and runway classifications, along with the aircraft classifications defined previously, are used to determine the appropriate FAA design standards to which the airfield facilities are to be designed and built.

Runway Design Code (RDC): A code signifying the design standards to which the runway is to be built. The RDC is based upon planned development pand has no operational component.

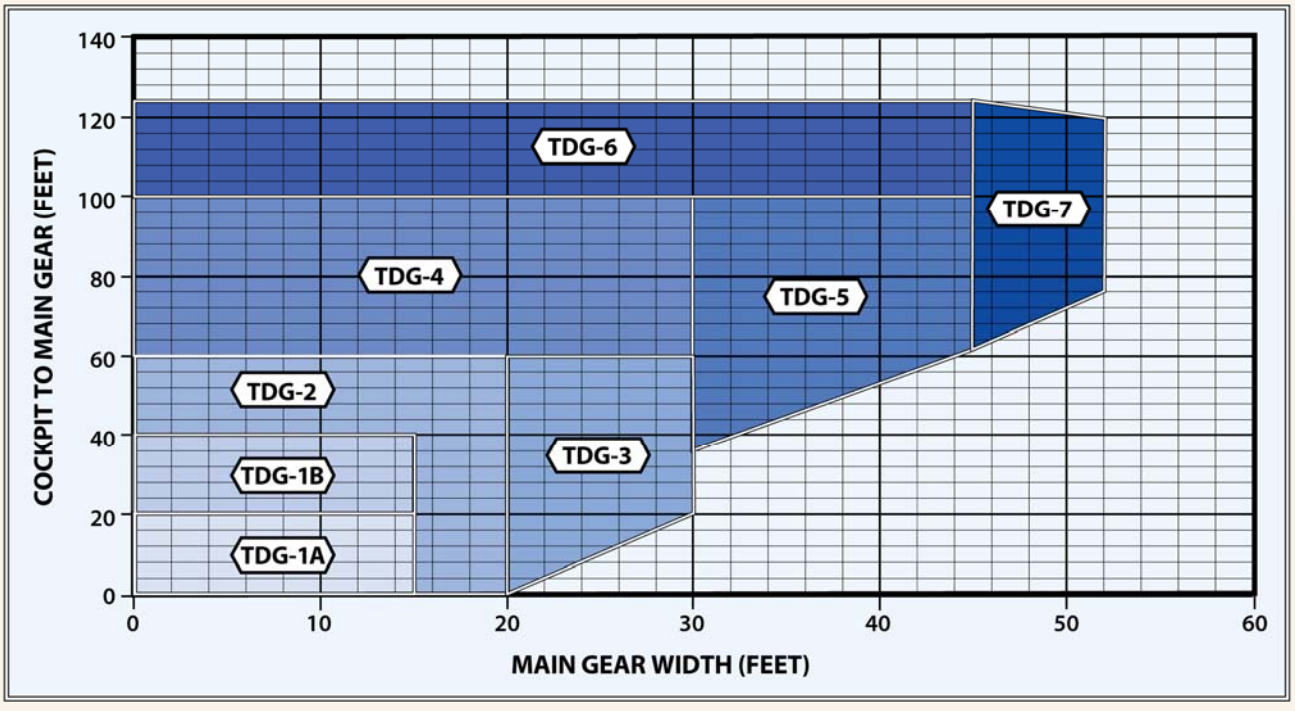
AIRCRAFT APPROACH CATEGORY (AAC)	
Category	**Approach Speed**
A	less than 91 knots
B	91 knots or more but less than 121 knots
C	121 knots or more but less than 141 knots
D	141 knots or more but less than 166 knots
E	166 knots or more

AIRPLANE DESIGN GROUP (ADG)		
Group #	**Tail Height (ft)**	**Wingspan (ft)**
I	<20	<49
II	20-<30	49-<79
III	30-<45	70-<118
IV	45-<60	118-<171
V	60-<66	171-<214
VI	66-<80	214-<262

VISIBILITY MINIMUMS	
RVR* (ft)	**Flight Visibility Category (statute miles)**
VIS	3-mile or greater visibility minimums
5,000	Not lower than 1-mile
4,000	Lower than 1-mile but not lower than ¾-mile
2,400	Lower than ¾-mile but not lower than ½-mile
1,600	Lower than ½-mile but not lower than ¼-mile
1,200	Lower than ¼-mile

***RVR**: Runway Visual Range

TAXIWAY DESIGN GROUP (TDG)



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

Exhibit 3H
AIRCRAFT CLASSIFICATION PARAMETERS

A-I

- Beech Baron 55
- **Beech Bonanza**
- Cessna 150
- Cessna 172
- Cessna Citation Mustang
- Eclipse 500/550
- Piper Archer
- Piper Seneca

B-I

- Beech Baron 58
- Beech King Air A90/100
- Cessna 402
- **Cessna 421**
- Piper Navajo
- Piper Cheyenne
- Swearingen Metroliner
- Cessna Citation I (525)

B-II

- Super King Air 200
- Cessna 441
- DHC Twin Otter
- Super King Air 350
- Beech 1900
- Citation Excel (560), Sovereign (680)
- Falcon 50, 900, 2000
- **Citation Bravo (550)**
- Embraer 120

A-III, B-III

- DHC Dash 7
- **DHC Dash 8**
- DC-3
- Convair 580
- Fairchild F-27
- ATR 72
- ATP

C-I, D-I

- Beech 400
- **Lear 31, 35,** 45, 60
- Israeli Westwind

C-II, D-II

- **Cessna Citation X (750)**
- Gulfstream 100, 200,300
- Challenger 300/600
- ERJ-135, 140, 145
- CRJ-200/700
- Embraer Regional Jet
- Lockheed JetStar
- Hawker 800

C-III, D-III *less than 150,000 lbs.*

- ERJ-170
- CRJ 705, 900
- Falcon 7X
- **Gulfstream 500**, 550, 650
- Global Express, Global 5000
- Q-400

C-III, D-III *over 150,000 lbs.*

- ERJ-90
- Boeing Business Jet
- B-727
- **B-737**-300, **700,** 800
- MD-80, DC-9
- A319, A320

C-IV, D-IV

- **B-757**
- B-767
- C-130 Hercules
- DC-8-70
- MD-11

D-V

- **B-747-400**
- B-777
- B-787
- A-330, A-340

Note: Aircraft pictured is identified in bold type.

Exhibit 3J

The AAC, ADG, and runway visual range (RVR) are combined to form the RDC of a particular runway. The RDC provides the information needed to determine certain design standards that apply. The first component, depicted by a letter, is the AAC and relates to aircraft approach speed (operational characteristics). The second component, depicted by a Roman numeral, is the ADG and relates to either the aircraft wingspan or tail height (physical characteristics), whichever is most restrictive. The third component relates to the available instrument approach visibility minimums expressed by RVR values in feet of 1,200 (⅛-mile), 1,600 (¼-mile), 2,400 (½-mile), 4,000 (¾-mile), and 5,000 (1-mile). The RVR values approximate standard visibility minimums for instrument approaches to the runways. The third component reads "VIS" for runways designed for visual approach use only.

Approach Reference Code (APRC): A code signifying the current operational capabilities of a runway and associated parallel taxiway with regard to landing operations. Like the RDC, the APRC is composed of the same three components: the AAC, ADG, and RVR. The APRC describes the current operational capabilities of a runway under particular meteorological conditions where no special operating procedures are necessary, as opposed to the RDC which is based upon planned development with no operational component. The APRC for a runway is established based upon the minimum runway to taxiway centerline separation.

Departure Reference Code (DPRC): A code signifying the current operational capabilities of a runway and associated parallel taxiway with regard to takeoff operations. The DPRC represents those aircraft that can takeoff from a runway while any aircraft are present on adjacent taxiways, under particular meteorological conditions with no special operating conditions. The DPRC is similar to the APRC, but is composed of two components, ACC and ADG. A runway may have more than one DPRC depending on the parallel taxiway separation distance.

***Airport Reference Code (ARC)*:** An airport designation that signifies the airport's highest Runway Design Code (RDC), minus the third (visibility) component of the RDC. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely at an airport. The current Airport Layout Plan (ALP) for the Airport, which will be updated as part of this master planning effort, identifies an ARC of C-III currently and D-III in the future.

CRITICAL AIRCRAFT

The selection of appropriate FAA design standards for the development and location of airport facilities is based primarily upon the characteristics of the aircraft which are currently using or are expected to use an airport. The critical aircraft is used to define the design parameters for an airport and is classified by the three parameters: AAC, ADG, and TDG. In the case of an airport with multiple runways, a critical aircraft is selected for each runway.

The critical aircraft is defined as the most demanding aircraft type, or grouping of aircraft with similar characteristics, that make regular use of the airport. Regular use is 500 annual operations, excluding touch-and-go operations. Planning for future aircraft use is of particular importance since the design

standards are used to plan separation distances between facilities. These future standards must be considered now to ensure that short term development does not preclude the reasonable long range potential needs of the airport.

The first consideration is the safe operation of aircraft likely to use an airport. Any operation of an aircraft that exceeds the design criteria of an airport may result in either an unsafe operation or a lesser safety margin; however, it is not the usual practice to base the airport design on an aircraft that uses the airport infrequently.

According to FAA AC 150/5300-13A, *Airport Design*, "airport designs based only on existing aircraft can severely limit the ability to expand the airport to meet future requirements for larger, more demanding aircraft. Airport designs that are based on large aircraft never likely to be served by the airport are not economical." Selection of the current and future critical aircraft must be realistic in nature and supported by current data and realistic projections.

CRITICAL AIRCRAFT DETERMINATION

The FAA maintains the Traffic Flow Management System Count (TFMSC) database which documents certain aircraft operations at airports. Information is added to the TFMSC database when pilots file flight plans and/or when flights are detected by the National Airspace System, usually via radar. It includes documentation of commercial traffic (air carrier and air taxi), general aviation, and military aircraft. Due to factors such as incomplete flight plans, limited radar coverage, and VFR operations, TFMSC data does not account for all aircraft activity at an airport by a given aircraft type. Therefore, there are more operations at an airport than are captured by this methodology. The TFMSC database is effective at capturing IFR operations and operators of jets and turboprops flying under IFR at a high rate. TFMSC data is available for activity at Hillsboro Airport and was utilized in this analysis.

Exhibit 3K presents the TFMSC annual activity for jets at HIO from 2007 through 2016. Only jets were examined because they are the largest and most sophisticated aircraft currently operating at the Airport and would thus represent the critical aircraft if their operations exceed the FAA threshold. Operations by aircraft in AAC C have exceeded the 500 operations threshold for the last seven consecutive years. Aircraft in ADG III have exceeded the 500 operations threshold for the last eight consecutive years. Operations by aircraft in AAC E and/or ADG IV are very rare and are not likely to ever meet the 500 operations threshold. Therefore, the current critical aircraft for the airport is best described as D-III and is represented by the Gulfstream 650.

"The current critical aircraft is described as D-III and is best represented by the Gulfstream 650."

The critical aircraft for an airport is also the critical aircraft for the primary runway. Therefore, the critical aircraft for primary Runway 13R-31L is also the D-III Gulfstream 650.

ARC	Aircraft	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A-I	Cessna Citation Mustang	0	4	28	75	79	73	474	663	645	770
	Eclipse 400/500	0	9	19	28	24	26	33	50	36	86
	TOTAL	*0*	*13*	*47*	*103*	*103*	*99*	*507*	*713*	*681*	*856*
B-I	Aero L-29	0	0	3	0	0	0	0	0	0	0
	Beechjet 400	103	51	26	73	36	42	27	23	74	82
	Canadair Silver Star	0	0	0	0	0	0	1	0	2	0
	Cessna Citation I/SP	14	22	21	49	64	32	20	21	52	13
	Cessna CJ1	163	95	119	91	80	98	110	173	162	155
	Citation M2	0	0	0	0	0	0	0	0	0	2
	Dassault Falcon/Mystère 10	16	10	5	10	0	2	7	0	14	33
	Embraer Phenom 100	0	0	8	17	28	52	36	39	38	11
	Fouga Magister Jet Trainer	0	1	1	0	0	0	0	0	0	0
	Hawker 400/MU-300	0	0	0	0	0	0	0	2	0	0
	Honda Jet	0	0	0	0	0	0	0	0	0	6
	L-39 Albatross	0	1	0	1	0	0	0	0	0	2
	Mig -17	0	4	1	2	0	0	0	0	0	0
	N. American Rockwell Sabre 40/60	2	6	0	2	0	2	4	26	12	2
	Raytheon Premier I	12	20	16	10	12	12	10	2	8	12
	TOTAL	*310*	*210*	*200*	*255*	*220*	*240*	*215*	*286*	*362*	*318*
B-II	Cessna Citation Bravo/SP	129	136	76	83	90	69	122	59	95	67
	Cessna Citation Excel/XLS	64	52	49	56	46	56	69	115	126	211
	Cessna Citation III/VI/VII	25	22	38	43	32	43	40	34	31	11
	Cessna Citation Sovereign	10	37	14	9	18	19	47	95	80	54
	Cessna Citation V/Encore/Ultra	134	116	100	109	124	115	155	174	176	215
	Cessna CJ2, CJ3, CJ4	79	128	110	26	73	96	97	202	299	426
	Dassault Falcon 20/50	170	68	39	55	38	6	12	25	16	20
	Dassault Falcon 2000	353	349	347	383	360	322	250	215	218	84
	Dassault Falcon 900	117	97	57	81	73	98	119	85	80	52
	Dornier 328	0	0	0	0	0	2	0	0	2	0
	Embraer Phenom 300	0	0	0	0	8	22	34	25	48	72
	TOTAL	*1,081*	*1,005*	*830*	*845*	*862*	*848*	*945*	*1,029*	*1,171*	*1,212*
C-I	AV-8B Harrier	0	0	0	2	0	2	0	3	0	0
	BAE HS 125-1/2/3/125/400/600	403	335	208	302	259	278	310	257	302	237
	Bae Systems Hawk	0	0	0	0	2	0	0	0	1	0
	F-86 Sabre	0	0	5	0	0	0	0	1	0	0
	Fuji T-1	2	1	0	0	0	0	0	0	0	0
	IAI 1121 Commodore	0	0	0	2	2	0	2	0	0	0
	IAI 1124/1125 Westwind	336	199	142	130	114	69	103	30	30	35
	Learjet 20 Series	22	26	45	115	67	13	4	0	0	0
	Learjet 30 Series	981	1,037	816	672	918	986	749	706	712	631
	Learjet 40/45/60	267	391	306	278	247	260	275	286	307	258
	Learjet 55	14	17	0	2	13	15	12	20	44	9
	T-45 Goshawk	2	2	0	0	0	0	0	0	0	0
	TOTAL	*2,027*	*2,008*	*1,522*	*1,503*	*1,622*	*1,623*	*1,455*	*1,303*	*1,396*	*1,170*
C-II	A-6 Intruder	0	1	0	0	0	0	0	0	0	0
	Bombardier CRJ 100/200/700	0	0	0	0	0	0	0	1	0	2
	Cessna Citation X	55	41	42	44	41	62	76	96	82	72
	Challenger 300/600	260	377	281	301	224	281	364	389	327	385
	Embraer ERJ 135/140/145/Legacy	2,697	2,768	2,823	2,825	2,913	2,948	2,816	2,777	2,810	2,802
	Fairchild A-10	3	0	3	3	3	3	0	1	0	0
	Gulfstream 300	63	29	38	25	45	22	31	21	16	9
	Hawker 800/1000/4000	8	6	7	11	6	4	7	6	14	21
	IAI 1126 Galaxy	51	62	46	38	49	56	54	103	122	117
	Lockheed L-1329 Jetstar	0	0	2	0	0	0	0	0	6	0
	TOTAL	*3,137*	*3,284*	*3,242*	*3,247*	*3,281*	*3,376*	*3,348*	*3,394*	*3,377*	*3,408*
C-III	Boeing 727/737 Series	1	4	2	0	3	2	0	0	6	6
	Bombardier CRJ 900	0	0	2	0	0	0	0	0	0	0
	Bombardier Global 5000	106	132	245	317	380	335	215	193	171	330
	Dassault Falcon 7X	0	0	0	0	0	14	12	0	10	2
C-III (cont.)	McDonnell Douglas DC-9/MD-80 series	0	0	0	0	0	1	3	18	17	32
	TOTAL	*438*	*468*	*541*	*685*	*743*	*707*	*558*	*782*	*804*	*1,010*
C-IV	Boeing 707	2	0	0	0	0	0	0	0	0	0
	C-17 Globemaster	0	2	5	2	0	0	1	0	0	0
	TOTAL	*2*	*2*	*5*	*2*	*0*	*0*	*1*	*0*	*0*	*0*
D-I	A-7 Corsair	0	1	0	0	0	0	0	0	0	0
	F/A-18 Hornet	15	3	1	5	2	2	3	3	9	5
	F-15 Eagle	3	4	3	2	3	4	0	0	2	1
	F-2 Banshee	1	0	0	0	0	0	0	0	0	0
	F-22 Raptor	0	0	0	1	0	0	0	0	0	0
	T-38 Talon	0	1	1	1	0	0	1	0	0	0
	TOTAL	*19*	*9*	*5*	*9*	*5*	*6*	*4*	*3*	*11*	*6*
D-II	Gulfstream 200/400	150	157	85	79	72	69	48	58	96	72
	Gulfstream G-150	129	171	105	125	124	119	123	131	122	82
	TOTAL	*279*	*328*	*190*	*204*	*196*	*188*	*171*	*189*	*218*	*154*
D-III	Boeing 737-800/900	0	0	0	0	0	0	0	1	0	2
	Gulfstream G550/650	331	332	292	368	360	355	328	571	600	640
	TOTAL	*331*	*332*	*292*	*368*	*360*	*355*	*328*	*572*	*600*	*642*
D-V	Airbus A350/360	0	2	0	0	0	0	0	0	0	0
	Boeing 747 Series	1	0	0	0	0	0	0	0	0	0
	TOTAL	*1*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
E-I	Dornier Alpha Jet	4	6	2	0	2	0	0	0	0	0
	F-16 Falcon	0	1	2	0	1	0	0	0	1	0
	TOTAL	*4*	*7*	*4*	*0*	*3*	*0*	*0*	*0*	*1*	*0*

SOURCE: Traffic Flow Management System Count (FAA Database)

ARC CODE SUMMARY

ARC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A-I	0	13	47	103	103	99	507	713	681	856
B-I	310	210	200	255	220	240	215	286	362	318
B-II	1,081	1,005	830	845	862	848	945	1,029	1,171	1,212
C-I	2,027	2,008	1,522	1,503	1,622	1,623	1,455	1,303	1,396	1,170
C-II	3,137	3,284	3,242	3,247	3,281	3,376	3,348	3,394	3,377	3,408
C-III	107	131	249	317	383	352	230	211	204	370
C-IV	2	2	5	2	0	0	1	0	0	0
D-I	19	9	5	9	5	6	4	3	11	6
D-II	279	328	190	204	196	188	171	189	218	154
D-III	331	332	292	368	360	355	328	572	600	642
D-V	1	2	0	0	0	0	0	0	0	0
E-I	4	7	4	0	3	0	0	0	1	0
TOTAL	*7,298*	*7,336*	*6,586*	*6,853*	*7,035*	*7,087*	*7,204*	*7,700*	*8,021*	*8,136*

APPROACH CATEGORY

AC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A	0	13	47	103	103	99	507	713	681	856
B	1,391	1,215	1,030	1,100	1,082	1,088	1,160	1,315	1,533	1,530
C	5,273	5,430	5,018	5,069	5,286	5,351	5,034	4,908	4,977	4,948
D	630	671	487	581	561	549	503	764	829	802
E	4	7	4	0	3	0	0	0	1	0
TOTAL	*7,298*	*7,336*	*6,586*	*6,853*	*7,035*	*7,087*	*7,204*	*7,700*	*8,021*	*8,136*

DESIGN GROUP

DG	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I	2,360	2,247	1,778	1,870	1,953	1,968	2,181	2,305	2,451	2,350
II	4,497	4,617	4,262	4,296	4,339	4,412	4,464	4,612	4,766	4,774
III	438	468	541	685	743	707	558	783	804	1,012
IV	2	2	5	2	0	0	1	0	0	0
V	1	2	0	0	0	0	0	0	0	0
TOTAL	*7,298*	*7,336*	*6,586*	*6,853*	*7,035*	*7,087*	*7,204*	*7,700*	*8,021*	*8,136*

To determine the critical aircraft for both crosswind Runway 2-20 and parallel Runway 13L-31R, the Port of Portland provided flight track data from their ANOMS system. ANOMS is limited in that low altitude data is very sparse and approximately 12.5 percent of operations are captured. As a result, flight tracks leading to the crosswind runway are identifiable; however, it is difficult to discern which of the parallel runways a flight track is leading to or from. Therefore, the data was manually adjusted to place B-II and above aircraft that were originally assigned to the parallel runway, 13L-31R, to the primary runway, 13R-31L. This was done because it is known from interviews with tower personnel, airport staff, and tenants that no B-II or larger aircraft operate on the parallel runway. **Table 3AA** presents the adjusted ANOMS data for calendar year 2017.

TABLE 3AA
Operations by Category and Runway
Hillsboro Airport

AAC	Primary Runway 13R-31L	Crosswind Runway 2-20	Parallel Runway 13L-31R
A	10,653	1,433	1,694
B	4,273	249	910
C	4,190	11	0
D	1,088	7	0
ADG			
I	14,052	1,632	2,532
II	5,386	66	72
III	766	2	0

AAC: Aircraft Approach Category
ADG: Airplane Design Group
Source: Airport Noise Monitoring and Management System (ANOMS)

Based on the ANOMS data, Runway 2-20 is currently classified as A-I. A representative aircraft would be the Cessna 172. Parallel Runway 13L-31R is classified as a B-I runway. A representative aircraft would be the Beech Baron 58.

TAXIWAY DESIGN GROUP

The taxiway design group (TDG) is determined by the Main Gear Width (MGW) and the Cockpit to Main Gear distance (CMG) of the critical aircraft. The taxiway design group helps determine applicable pavement fillet, taxiway width, taxiway shoulder width, and taxiway edge safety margin dimensional standards. Most of the taxiways associated with the primary runway at the Airport are at least 50 feet wide.

The TDG of the critical aircraft (Gulfstream 650) is "2." This is also the TDG of the ERJ 145, which operates as a corporate shuttle at the Airport. The future TDG is planned to be "3." This determination is based on the possibility of an aircraft with a wider wheel base operating frequently at the airport. The most likely candidate is the ERJ 170/175, a TDG "3" aircraft, which could be introduced as the corporate shuttle

sometime in the future. Planning for this aircraft is supported by information received from the corporate operator. They have indicated a desire to utilize the ERJ 175 because of its increased seating capacity and efficiency.

Taxiways and taxilanes that are not used by the critical aircraft should be designed to a width to accommodate those users. For example, taxilanes to T-hangar areas only need to be wide enough to accommodate those smaller aircraft.

RUNWAY DESIGN CODE (RDC)

Each runway is assigned an RDC. The RDC relates to specific FAA design standards that should be met in relation to each runway. The RDC takes into consideration the AAC, ADG, and the RVR. In most cases, the critical aircraft will also be the RDC for the primary runway.

Table 3BB presents the runway use percent, as estimated by tower personnel, for each runway end by aircraft type. This data will help inform a determination of the appropriate RDC for each runway.

TABLE 3BB
Runway Use Percent by Aircraft Type
Hillsboro Airport

	Runway Use Percent Estimate					
Runway	**Biz Jet**	**Turboprop**	**Piston**	**Local (Piston)**	**Military**	**Shuttle (Jets)**
Runway 13R	24	20	15	10	25	25
Runway 31L	75	70	40	25	75	75
Runway 13L	0	3	5	10	0	0
Runway 31R	0	3	20	35	0	0
Runway 2	0.5	2	10	10	0	0
Runway 20	0.5	2	10	10	0	0
Total	100%	100%	100%	100%	100%	100%

Source: Tower personnel interview.

Current RDC

Runway 13R-31L is the primary runway and should be designed to accommodate the current and future critical aircraft. This runway is 6,600 feet long and 150 feet wide and has an instrument approach with visibility minimums as low as ½-mile on the Runway 13R end. This is the only runway that can fully accommodate the large business jets that operate regularly at the Airport. As previously shown on **Exhibit 3K**, there have been more than 500 operations by D-III aircraft for several years. Therefore, the applicable RDC is **D-III-2400**.

Runway 2-20 is the crosswind runway measuring 3,821 feet long and 75 feet wide. There are no instrument approaches to this runway. The current ALP for the Airport classifies this as a B-II runway. Current adjusted ANOMS data indicates that this is an A-I runway with regular activity by small (less than 12,500 pounds) aircraft. This runway also has the capability to serve as an alternate for some aircraft, when the

primary runway is closed (typically due to maintenance/rehabilitation). The RDC for Runway 2-20 is **A-I(s)-VIS**.

Runway 13L-31R is the parallel training runway and it accounts for approximately 50 percent of all operations at the Airport. This runway primarily accommodates training operations by small piston single and twin-engine aircraft. It is 3,600 feet long and 60 feet wide. There are no instrument approach procedures to this runway. The current ALP lists this runway as **B-I(s)-VIS**, which is appropriate for this runway.

Future RDC

The future RDC for each runway determines to what standards the runways are to be planned. Primary Runway 13R-31L is already designed to the highest design standard (D-III) for a general aviation airport; therefore, no change is anticipated. **The future RDC for Runway 13R-31L is planned to remain D-III-2400.**

Crosswind Runway 2-20 was recently reconstructed to B-II standards. For planning purposes, this runway will have a future RDC of B-II; however, when it is time to reconstruct this runway, a new analysis of operations by aircraft type should be undertaken. If there is no evidence of 500 or more AAC B operations, it is understood that its FAA funding may be limited to AAC A standards. Currently, this is a visual runway. Analysis to be presented in the Facility Requirements chapter will consider the feasibility of adding non-precision instrument approaches with at least 1-mile visibility minimums. **For planning purposes, the future RDC for Runway 2-20 is B-II(s)-5000.**

Runway 13L-31R is planned and intended for small aircraft operating in visual conditions. This role is not anticipated to change; therefore, the future RDC is B-I(s)-VIS. The future RVR component for the runways could change if the visibility minimums were to change. Analysis in subsequent chapters will determine if improved instrument approaches are feasible.

APPROACH AND DEPARTURE REFERENCE CODES

The approach and departure reference codes (APRC and DPRC) describe the current operational capabilities of each runway and the adjacent parallel taxiways, where no special operating procedures are necessary. Essentially, the APRC and DPRC describe the current condition at an airport in runway classification terms when considering the parallel taxiway and the instrument approach capability.

Parallel Taxiway A is 400 feet from Runway 13R-31L, parallel Taxiway B is 250 feet from Runway 2-20, and parallel Taxiway C is 240 feet from the same runway. Taxiway D is 240 feet from Runway 13L-31R. Runway 13R has an ILS approach with visibility minimums of ½-mile. Runway 31L has a non-precision approach with visibility minimums of 1¼-mile. The APRC for Runway 13R-31L is D-IV-2400/D-V-2400. This means the separation distance between the runway and taxiway is sufficient to support operations by aircraft in D-IV and D-V without any special consideration of the parallel taxiway or the existing instrument approaches. The APRC for Runway 2-20 is B-II-VIS. Later in this master plan, analysis will be

presented to determine if an instrument approach with 1-mile visibility minimums or lower is feasible to either end of Runway 2-20. The APRC for Runway 13L-31R is B-II-VIS.

The DPRC represents those aircraft that can take off from a runway while any aircraft are present on the adjacent taxiways, under particular meteorological conditions with no special operational procedures necessary. It is similar to the APRC but is composed of the AAC and the ADG. A runway may have more than one DPRC. The DPRC for Runway 13R-31L is D-IV/D-V. For the other two runways, the DPRC is B-II. These are expected to remain the same into the future.

CRITICAL AIRCRAFT SUMMARY

Table 3CC summarizes the FAA classification of the Airport and the runways. Hillsboro Airport has an overall airport reference code of D-III now and in the future. The critical aircraft currently is best represented by the Gulfstream 650. Future planning considers a possible transition of the critical aircraft to the ERJ-175. The difference between these aircraft is the wheel base, which is important in determining the width of taxiways.

TABLE 3CC
Airport and Runway Classifications
Hillsboro Airport

	Current	Future
AIRPORT CLASSIFICATION		
Airport Reference Code (ARC)	D-III	D-III
Airport Critical Aircraft	D-III-2	D-III-3
Airport Critical Aircraft Example	Gulfstream 650	Gulfstream 650/ERJ 175
RUNWAY CLASSIFICATION		
Runway Design Code (RDC)		
Runway 13R-31L	D-III-2400	Same
Runway 2-20	A-I(s)-VIS	B-II(s)-5000
Runway 13L-31R	B-I(s)-VIS	Same
Critical Aircraft		
Runway 13R-31L	Gulfstream 650	Gulfstream 650/ERJ 175
Runway 2-20	Cessna 172	Cessna Conquest 441
Runway 13L-31R	Beech Baron 58	Same
Approach Reference Code (APRC)		
Runway 13R-31L	D-IV-2400/D-V-2400	Same
Runway 2-20	B-II-VIS	B-II-5000
Runway 13L-31R	B-II-VIS	Same
Departure Reference Code (DPRC)		
Runway 13R-31L	D-IV/D-V	Same
Runway 2-20	B-II	Same
Runway 13L-31R	B-II	Same

Source: Current Airport Layout Plan; FAA AC 150/5300-13A, Airport Design

Each runway is assigned an RDC for the current and future condition. The current and future RDC for Runway 13R-31L is D-III-2400.

The current RDC for crosswind Runway 2-20 is A-I(s)-VIS. This runway was recently reconstructed to B-II standards. Future planning will consider a return to B-II standards as well as the feasibility of adding non-precision instrument approaches. Therefore, the future RDC for Runway 2-20 is B-II(s)-5000. If it is determined to maintain this as a visual runway, then the future RDC is B-II(s)-VIS. At the time of the next major rehabilitation of this runway, the applicability of B-II standards will have to be verified.

The RDC of parallel Runway 13L-31R is planned to remain B-I(s)-VIS.

SUMMARY

This chapter has outlined the various activity levels that might reasonably be anticipated over the planning period as well as the critical aircraft for the Airport. Based aircraft are forecast to grow from 354 in 2016 to 445 by 2036 for an annual compound growth rate of 1.15 percent. Operations are forecast to grow from 197,763 in 2016 to 247,700 by 2036 for an annual compound growth rate of 1.13 percent. Peak operational times were also determined. The current peak hour is 79 operations which is forecast to grow to 98 per hour by 2036.

The critical aircraft for the Airport was determined by examining the FAA TFMSC database of flight plans to and from the Airport. The current and future critical aircraft is described as D-III-3 and is best represented by a large sized business jet such as the Gulfstream 650.

Each runway is assigned a current and future RDC based on the type and frequency of operation on that runway and the available or planned instrument approach capability. Primary Runway 13R-31L has a current and future RDC of D-III-2400. Crosswind Runway 2-20 has a current RDC of A-I(s)-VIS based on radar data captured in the Port's ANOMS flight track database. Future planning considers an RDC of B-II(s)-5000. The next major rehabilitation of this runway will require validation of the RDC at that time. Parallel Runway 13L-31R has a current and future RDC of B-I(s)-VIS.

The next step in the planning process is to assess the capabilities of the existing facilities to determine what upgrades may be necessary to meet future demands. The range of forecasts developed here will be taken forward in the next chapter as planning horizon activity levels that will serve as milestones or activity benchmarks in evaluating facility requirements.