# APPENDIX B
# AVIATION ACTIVITY FORECAST

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# Aviation Activity Forecast

Tucson International Airport

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# 1.0 BACKGROUND

This document presents comprehensive forecasts of aviation activity at Tucson International Airport (TUS or the Airport). The aviation activity forecasted includes annual enplaned passengers, air cargo tonnage, and aircraft operations as well as daily aircraft operations. The Federal Aviation Administration (FAA) is preparing an Environmental Impact Statement (EIS) to determine the potential impacts of the Proposed Airfield Safety Enhancement Project (ASEP). These forecasts were developed to provide the information required to quantify the potential environmental impacts resulting from proposed projects based on future activity levels. The forecasts may also provide support for future planning efforts at the Airport. For the purposes of this document, all annual data is provided on a U.S. Government fiscal year basis (October through September) except where implicitly indicated.

Aviation activity forecasts were prepared for the 12-year planning horizon with a base year of 2016. The two key benchmark years for the forecasts are 2023 and 2028 and as such additional detail is provided for these years.

The forecasts presented herein represent market driven demand for air service. The forecast is unconstrained and as such does not take facility constraints or other outside limiting factors into consideration. In other words, for purposes of estimated future demand, the forecast assumes facilities can be provided to meet the demand.

# 2.0 PRIOR FORECASTS

The most recent aviation activity forecast for TUS was developed as part of the most recent Master Plan Update by HNTB. The Master Plan forecast was competed in December 2011 and approved by the Federal Aviation Administration (FAA) in July 2012. The forecast included enplaned passengers and commercial, general aviation (GA), and military aircraft operations for the period between 2011 and 2030. Design day flights schedules (DDFS) based on peak month average weekday (PMAWD) for the forecast years of 2015, 2020, 2025, and 2030 were developed as part of the effort.

On an annual scale, the Master Plan forecast adopted the activity levels provided by the FAA's 2010 Terminal Area Forecast (TAF). The Master Plan forecast conducted a detailed study to validate the activity levels provided by the TAF.

In order to validate the FAA's TAF for enplaned passengers, a two-step approach was utilized. First, an econometric approach using socio-economic indicators such as population, personal income, and employment was used to test the FAA's long-term growth rates. Second, an air service approach where DDFS were developed using empirical knowledge of markets served was developed.

The results of the econometric approach showed that the long-term growth rates provided by the FAA were in-line with the independent projections. These independent projections included a range of long-term growth rates between 1.4 percent and 2.7 percent.

For the air service approach, the baseline schedule for the PMAWD was obtained from the Official Airline Guide (OAG). FAA published load factors were applied to the seat configurations in the baseline schedule and then annualized to reflect the annual enplaned passenger volumes. The baseline schedule was then modified to develop the future DDFS. New flights were added to markets at the appropriate times to the baseline schedule based on an analysis of air service trends. The existing aircraft were then replaced with suitable replacements based on aircraft orders. Finally, new entrants to TUS were included based on the growth of existing U.S. and Canadian carriers. This approach confirmed that the enplanements provided in the FAA's TAF were considered reasonable.

The results of the forecast were that by 2030 enplaned passengers would increase from 1.81 million in 2010 to 2.99 million, representing a compound annual growth rate (CAGR) of 2.5 percent. Aircraft operations were forecast to increase at a CAGR of 1.2 percent, increasing from 168,593 in 2010 to 215,988 in 2030. The results of the Master Plan forecast are presented in **Table 1**.

**Table 1 – Master Plan Update Forecast**
For Fiscal Years 2009 Through 2030

| FISCAL YEAR | ENPLANED PASSSENGERS | OPERATIONS COMMERCIAL | OTHER OPERATIONS | | TOTAL OPERATIONS |
|---|---|---|---|---|---|
| | | | GA | MILITARY | |
| **Historical** | | | | | |
| 2009 | 1,808,043 | 57,505 | 94,471 | 29,413 | 181,389 |
| **Forecast** | | | | | |
| 2010 | 1,822,212 | 58,535 | 79,363 | 30,695 | 168,593 |
| 2011 | 1,835,332 | 58,664 | 74,839 | 30,695 | 164,199 |
| 2012 | 1,882,833 | 59,954 | 75,841 | 30,695 | 166,490 |
| 2013 | 1,931,556 | 61,269 | 76,864 | 30,695 | 168,828 |
| 2014 | 1,981,561 | 62,316 | 77,902 | 30,695 | 171,210 |
| 2015 | 2,032,876 | 63,987 | 78,954 | 30,695 | 173,636 |
| 2020 | 2,310,385 | 71,325 | 84,447 | 30,695 | 186,467 |
| 2025 | 2,626,321 | 79,502 | 90,342 | 30,695 | 200,539 |
| 2030 | 2,986,074 | 88,618 | 96,675 | 30,695 | 215,988 |
| **Compound Annual Growth Rate** | | | | | |
| 2010-30 | 2.5% | 2.1% | 1.0% | 0.0% | 1.2% |

Source: HNTB, Tucson International Airport: Master Plan Update, June 2014.

High and low forecast scenarios were developed as part of the Master Plan Update. These scenarios provide a range of variance for both the enplaned passengers forecast and the aircraft operations forecast. The results of these scenarios was that by 2030 enplaned passengers would range between 2.49 million and 3.69 million and aircraft operations would range between 199,974 and 239,071. Actual enplanements for 2016 were 22.4 percent below the baseline forecast and 17.8 percent below the low forecast in the Master Plan Update. Actual aircraft operations for 2016 were 21.2 percent below the baseline forecast and 19.3 percent below the low forecast in the Master Plan Update.

# 3.0 HISTORICAL AVIATION ACTIVITY

This section provides a summary of historical activity levels and current passenger air service. The information in this section provides a context for the forecast. Although the past is not a perfect predictor of the future, analysis of historical data provides the opportunity to understand factors that have affected traffic and how those factors may influence the forecast in the future.

## 3.1 PASSENGER ACTIVITY

### 3.1.1 PASSENGER VOLUME TRENDS

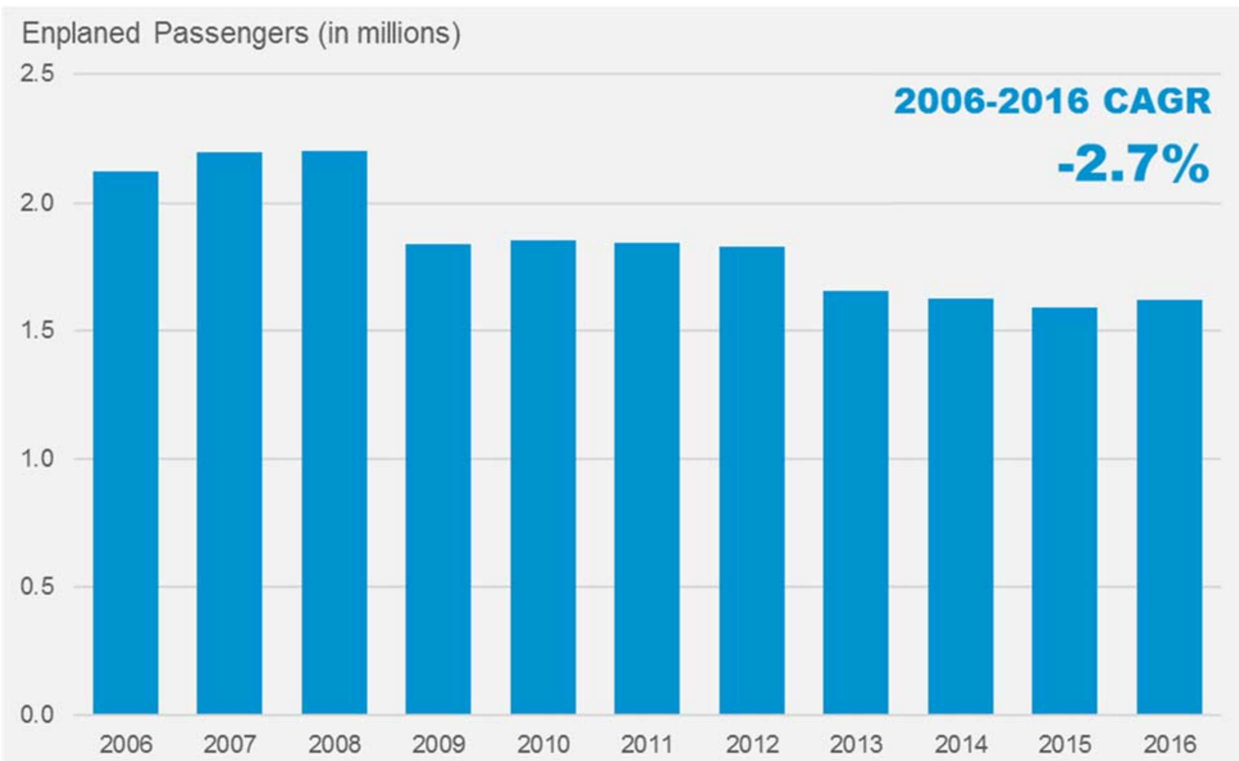
The Airport is classified by the FAA as a small-hub airport based on its percentage of nationwide enplaned passengers[1] and is the second largest airport in Arizona. In 2001, passenger enplanements at TUS reached 1.81 million, which at the time was the highest at the Airport. However, the following year passenger enplanements decreased by 8.6 percent. This decrease was the primarily the result of the September 11, 2001 terrorist attack and the economic slowdown. The Airport was able to quickly recover and continued to increase enplaned passengers through 2008 when the Airport's enplaned passengers peaked at 2.20 million. Since 2008, there have been a number of factors, which have resulted in enplaned passengers declining at a CAGR of 3.8 percent. **Exhibit 1** graphically depicts the enplaned passengers from 2006 through 2016. The factors behind the changes in enplaned passenger volumes are discussed in further detail below:

- **2008-2009:** In 2009, a recession combined with rising fuel prices had a significant impact on operations at airports, particularly at small airports. Airlines, determined to retain economic viability, reduced operations on lower performing routes. Enplaned passengers for all of the major airlines at the Airport declined during this period. JetBlue Airways ended its flights from TUS to John F. Kennedy International Airport (JFK) in March 2008 and Aeroméxico ended the only international flight at TUS in the same year. Enplaned passengers at the Airport declined 16.6 percent from 2008 to 2009.
- **2009-2012:** During this time, there were no major changes in air service at TUS and no significant change in the number of enplaned passengers at the Airport. Over this period, the Airport averaged a 0.2 percent decline in enplaned passengers per annum.
- **2012-2013:** In May 2012, Frontier Airlines discontinued its daily flights to Denver International Airport (DEN). This was the only flight at TUS for Frontier and the year prior they accounted for 4.4 percent of the passenger enplanements at TUS. Additional service cuts by all of the major airlines at TUS resulted in a total decline of 9.3 percent in enplaned passengers in 2013.

[1] To be classified as a small-hub airport, the airport must have at least 0.05 percent by less than 0.25 percent of the national annual enplaned passengers.

- **2013-2015:** Enplaned passengers at the Airport continued to decline at a CAGR of 2.0 percent. A majority of this decline was the result of Southwest Airlines continuing to reduce capacity. This was slightly offset by increased capacity by Alaska Airlines, American Airlines, and US Airways.
- **2015-2016**: In 2016, TUS experienced the highest year-over-year growth in enplaned passengers in nearly a decade with an increase of 1.8 percent. This growth in enplaned passengers corresponded to a 3.5 percent increase in capacity. Delta Air Lines had the largest increase in capacity over the past year by the start of nonstop service to LAX with three daily flights. United Airlines and Alaska Airlines increased capacity at the Airport by increasing aircraft size on existing routes. American Airlines and Southwest Airlines both had a slight decrease in capacity during this period.

**Exhibit 1 – Historical Enplaned Passengers**
For Fiscal Years 2006 Through 2016; In Millions




Note: CAGR = Compound Annual Growth Rate

Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014.Tucson Airport Authority, 10 Year Passenger Statistics; Tucson Airport Authority, Monthly Activity Overview.

A detailed summary of the enplaned passengers by airline from 2006 through 2016 is provided in **Table 2**. American Airlines, including US Airways, has consistently been the largest airline at TUS since 2006, averaging 35.6 percent of the total enplaned passengers during that span. Southwest Airlines increased its market share from 2006 through 2013 but has declined in the subsequent years. Delta Air Lines is now the third largest airline with 13.4 percent of the market share in 2016. United Airlines' market share has declined the most since 2006, dropping from 16.5 percent in 2006 to 13.3 percent in 2016. Alaska Airlines handled just 4.5 percent of the enplaned passengers in 2016.

**Table 2 – Historical Enplaned Passengers by Airline Group**
For Fiscal Years 2006 Through 2016

| FISCAL YEAR | AA | WN | DL | UA | AS | OAL | TOTAL |
|---|---|---|---|---|---|---|---|
| 2006 | 791,639 | 632,624 | 240,856 | 350,695 | 52,371 | 52,811 | 2,120,996 |
| 2007 | 732,780 | 638,929 | 236,613 | 383,032 | 53,175 | 150,964 | 2,195,493 |
| 2008 | 688,539 | 644,277 | 252,517 | 342,893 | 56,856 | 217,291 | 2,202,373 |
| 2009 | 628,514 | 594,120 | 213,295 | 271,318 | 49,490 | 80,438 | 1,837,175 |
| 2010 | 613,751 | 606,913 | 212,276 | 288,570 | 50,134 | 83,971 | 1,855,615 |
| 2011 | 626,260 | 618,007 | 199,841 | 263,890 | 52,967 | 80,869 | 1,841,834 |
| 2012 | 638,794 | 623,484 | 199,117 | 262,245 | 57,391 | 45,015 | 1,826,046 |
| 2013 | 605,261 | 592,375 | 181,950 | 222,485 | 53,546 | 0 | 1,655,617 |
| 2014 | 638,006 | 530,680 | 179,842 | 198,926 | 73,777 | 0 | 1,621,231 |
| 2015 | 628,962 | 506,260 | 181,236 | 203,459 | 70,404 | 0 | 1,590,321 |
| 2016 | 616,346 | 497,687 | 216,432 | 215,208 | 72,631 | 0 | 1,618,304 |
| **Compound Annual Growth Rate** | | | | | | | |
| 2006-16 | -2.5% | -2.4% | -1.1% | -4.8% | 3.3% | -100.0% | -2.7% |

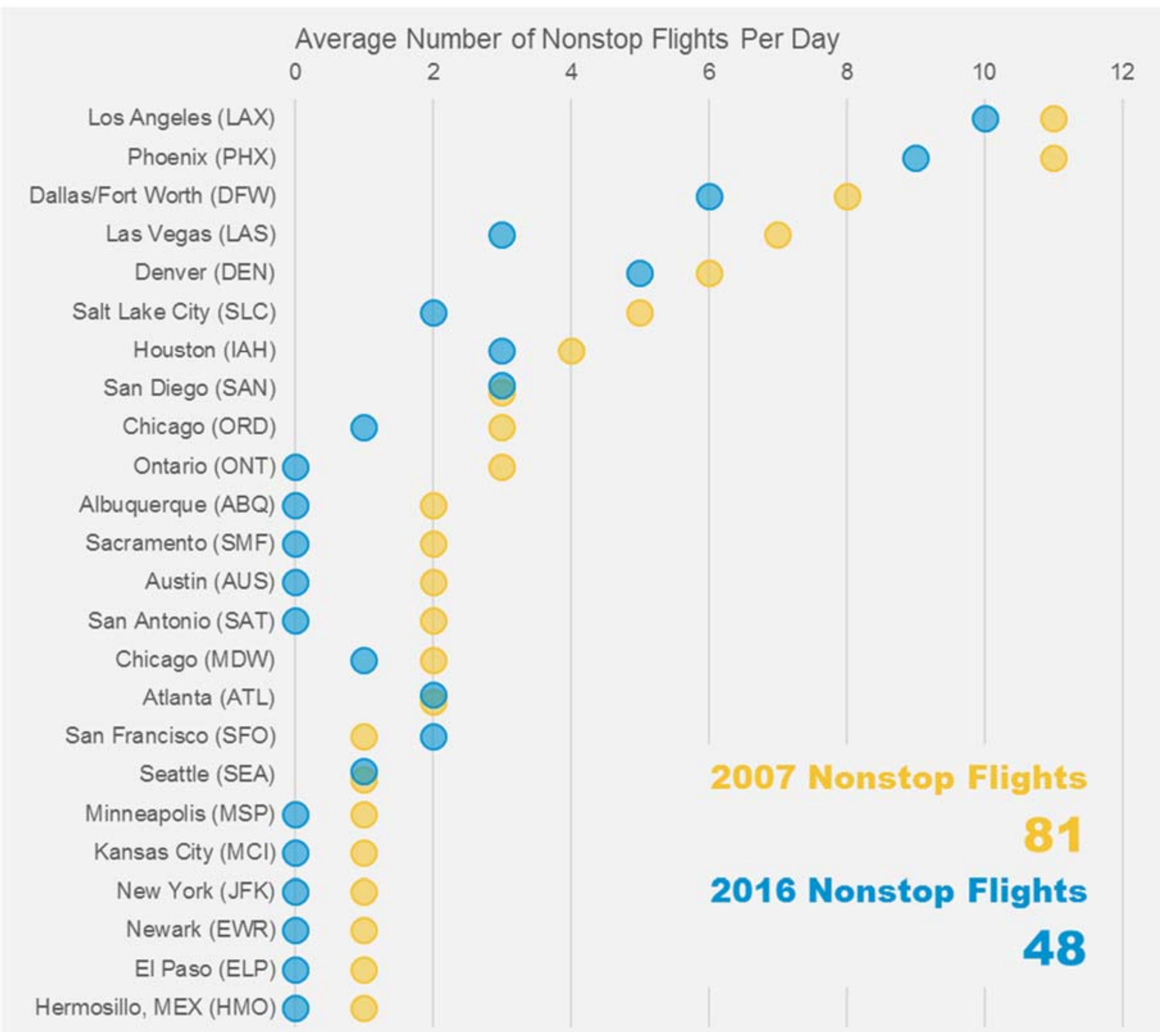
Notes: AA = American Airlines includes US Airways.
WN = Southwest Airlines
DL = Delta Air Lines
UA = United Airlines
AS = Alaska Airlines
OAL = Other Airlines includes Frontier Airlines, Aeroméxico, ExpressJet Airlines, and JetBlue Airways.

Source: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014.

### 3.1.2 PASSENGER AIR SERVICE

In September 2007, there were an average of 81 scheduled nonstop daily flights to 23 domestic and one international destination from TUS. Since then, a number of routes have been eliminated or reduced including the Airport's only international flight. In September 2016, there were an average of 48 scheduled nonstop daily flights to 13 domestic destinations from TUS. All of the remaining destinations in September 2016 were classified as either short-haul or medium-haul.[2] **Exhibit 2** compares the average number of daily flights by destination for the month of September in 2007 and 2016.

**Exhibit 2 – Scheduled Nonstop Destinations**
Month of September




Notes: Average number of nonstop flights were calculated by taking the sum of flights for the month of September and dividing by 30.

Source: OAG Aviation Worldwide Ltd, OAG Schedules Analyser.

[2] Short-haul = 0 to 600 miles, medium-haul = 601 to 1,800 miles, long-haul = greater than 1,800 miles.

## 3.2 TOP PASSENGER MARKETS

An overwhelming majority of the passenger traffic at TUS are origin and destination (O&D) passengers versus connecting passengers. **Table 3** shows the share of O&D passengers for the top 25 O&D markets for 12-months ending June 2016. The top 25 markets accounted for a combined share of 67.2 percent of the O&D passengers at TUS. The Los Angeles Basin is the largest O&D market at TUS with 10.0 percent of the O&D enplanements. Twelve of the top 25 markets have nonstop service to at least one airport in the region. However, a number of major markets do not have nonstop service from TUS at this time, particularly markets on the East Coast and in the Midwest.

**Table 3 – Top 25 O&D Markets**
For 12-Months Ending June 2016

| MARKET | AIRPORTS | NONSTOP SERVICE | SHARE OF TUS O&D ENPLANEMENTS |
|---|---|---|---|
| Los Angeles Basin | LAX / BUR / ONT / LGB / SNA | ● | 10.0% |
| Denver | DEN | ● | 5.2% |
| San Francisco Bay Area | SFO / OAK / SJC | ● | 4.8% |
| Chicago | ORD / MDW | ● | 4.7% |
| Seattle / Tacoma | SEA | ● | 4.7% |
| Las Vegas | LAS | ● | 4.2% |
| Washington / Baltimore | BWI / DCA / IAD | | 4.3% |
| San Diego | SAN | ● | 3.9% |
| New York / Newark | JFK / EWR / LGA / ISP / HPN | | 3.0% |
| Dallas / Ft. Worth | DFW / DAL | ● | 2.9% |
| Portland | PDX | | 2.5% |
| Minneapolis | MSP | | 1.7% |
| Salt Lake City | SLC | ● | 1.5% |
| Atlanta | ATL | ● | 1.7% |
| Boston | BOS | | 1.6% |
| Houston | IAH / HOU | ● | 1.4% |
| Philadelphia | PHL | | 1.3% |
| Detroit | DTW | | 1.2% |
| Sacramento | SMF | ● | 1.3% |
| South Florida | FLL / MIA / PBI | | 1.2% |
| Orlando / Sanford | MCO | | 1.3% |
| Kansas City | MCI | | 0.8% |
| St. Louis | STL | | 0.8% |
| Nashville | BNA | | 0.8% |
| Indianapolis | IND | | 0.7% |
| Top 25 Markets | | | 67.2% |
| Other Markets | | | 32.8% |
| All Markets | | | 100.0% |

Note: Nonstop service is based on September 2016. Since then, nonstop service to JFK has been added.

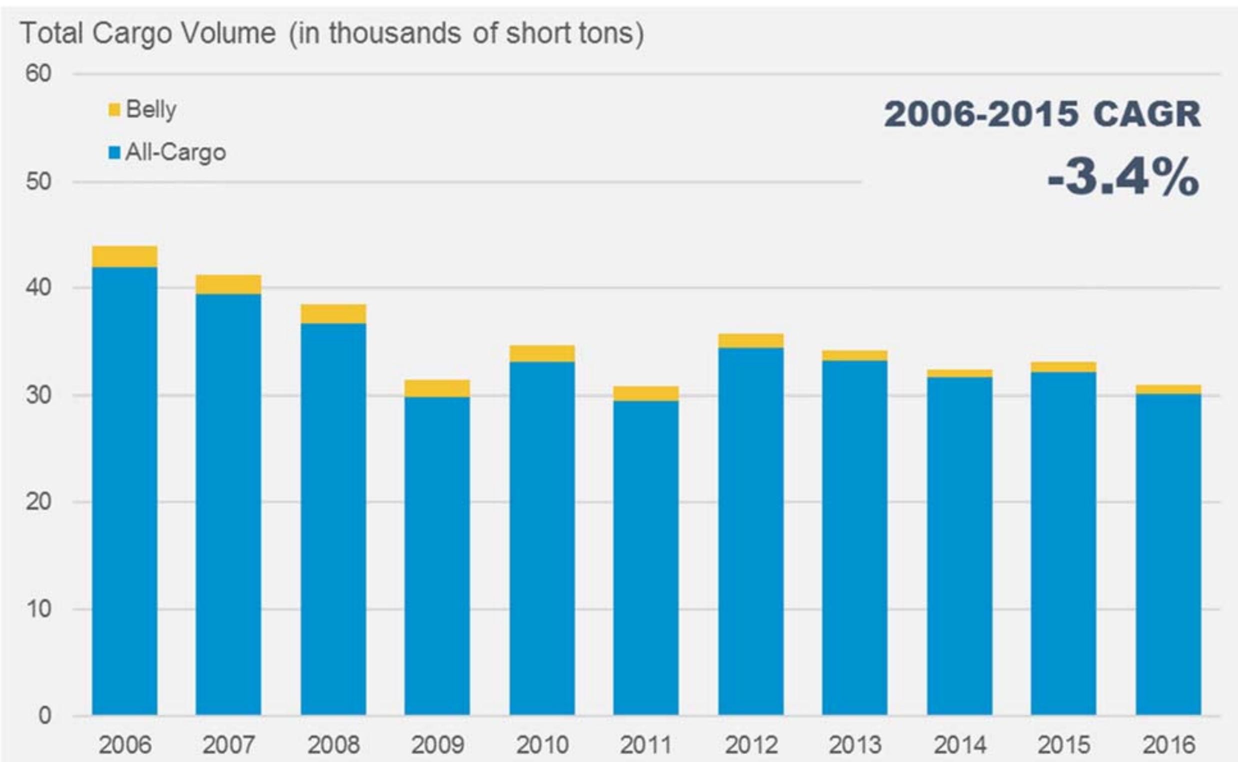
Source: U.S. Department of Transportation, Air Passenger Origin-Destination Survey.

# 3.3 CARGO ACTIVITY

## 3.3.1 AIR CARGO VOLUMES

Air cargo at airports is comprised of two segments, air mail and air freight. Air mail refers to parcels that are carried by aircraft as part of a contract with the U.S. Postal Service. Air freight refers to all air cargo that is not mail. Over the past decade only 0.1 percent of the total air cargo processed at TUS was air mail. From 2006 through 2008, air cargo at the Airport declined at an average rate of 6.4 percent per annum which is more than double the national average of decline during that span. Air cargo volumes declined 18.3 percent in 2009. Since then air cargo volumes have fluctuated year-over-year but overall has remained steady, averaging 32,913 tons between 2009 and 2016. **Exhibit 3** provides a graphical representation of the volume of air cargo at TUS since 2006.

**Exhibit 3 – Historical Air Cargo Volume**
For Fiscal Years 2006 Through 2016; In Thousands of Short Tons




Notes: CAGR = Compound Annual Growth Rate
Includes air freight and mail.

Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014; Tucson Airport Authority, Monthly Activity Overview.

### 3.3.2 MODE OF TRANSPORTATION

There are two shipping methods for transporting air cargo: (1) in the cargo compartment (belly) of commercial passenger aircraft or (2) aboard dedicated all-cargo aircraft (freighters).

Most passenger airlines accommodate air cargo as a byproduct of their primary activity of carrying passengers. Cargo fills belly space in passenger aircraft that would otherwise be empty. The incremental costs of carrying cargo in passenger aircraft are negligible, and include only ground handling expenses and a modest increase in fuel consumption.

The majority of cargo processed at TUS is handled by all-cargo carriers, primarily Federal Express (FedEx). Since 2006, 96.1 percent of all cargo processed at TUS has been handled by dedicated cargo carriers.

## 3.4 AIRCRAFT OPERATIONS

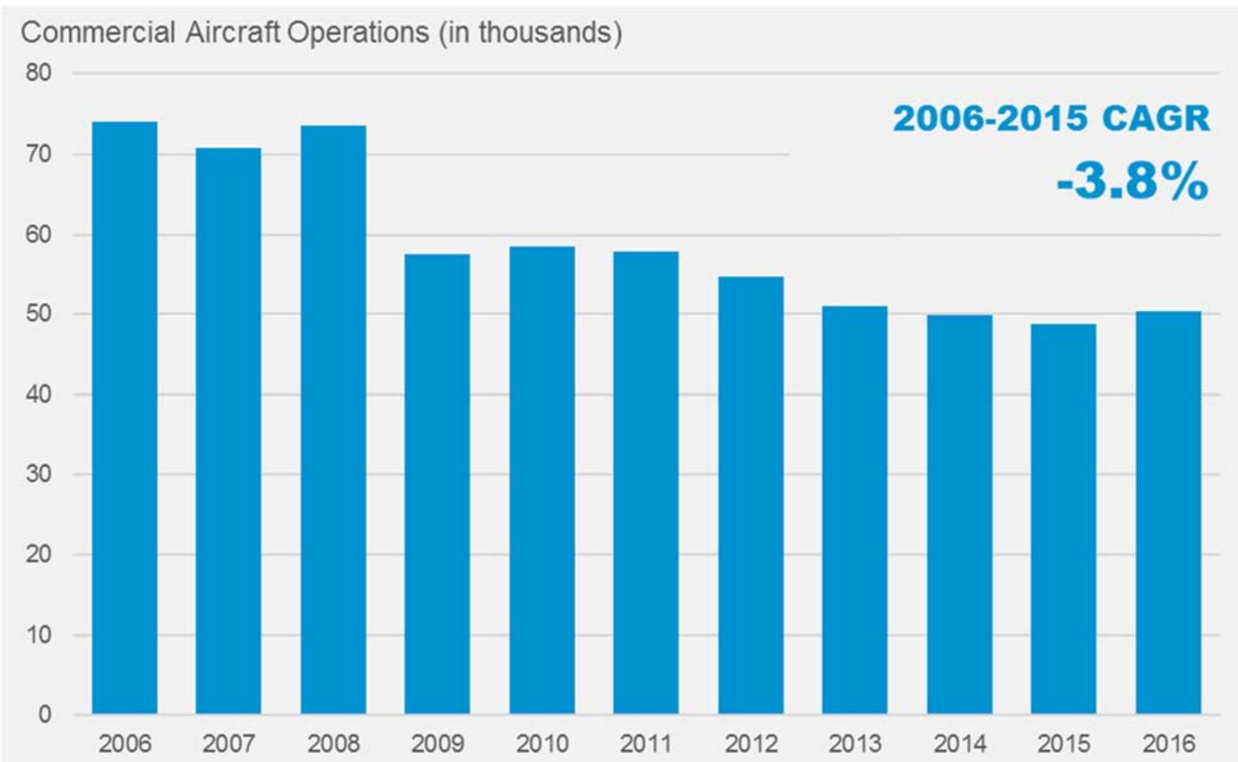
An aircraft operation consists of either a takeoff or landing. The FAA classifies aircraft operations into four key segments: (1) air carrier; (2) commuter/air taxi; (3) GA and (4) military. Air carrier operations represent operations with an aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation. Commuter/air taxi operations represent operations with an aircraft designed to have a maximum seating capacity of 60 seats or a maximum payload capacity of 18,000 pounds carrying passengers or cargo for hire or compensation. Air carrier and commuter/air taxi aircraft operations include commercial passenger operations, air taxi operations, and all-cargo operations. GA operations represent all civil aviation aircraft operations not classified as commercial, i.e. passenger or all-cargo. Military operations represent operation conducted by military or government aircraft. GA and military operations can be further classified as either local or itinerant.[3]

[3] Location operations include aircraft operating in the traffic pattern or within sight of the tower, or aircraft known to be departing or arriving from flight in local practice areas, or aircraft executing practice instrument approaches at the airport. Itinerant operations are those not classified as local, i.e. operations of aircraft going from one airport to another.

### 3.4.1 COMMERCIAL AIRCRAFT OPERATIONS

Between 2006 and 2008, commercial aircraft operations at TUS remained flat. However, the sharp decline in enplaned passengers and cargo volumes in 2009 translated to a significant decline in commercial air operations of 21.8 percent. Since then, commercial aircraft operations have continued to decline at a more modest rate of 1.9 percent per annum. This correlates with the existing trend seen with enplaned passengers over the same period at TUS. **Exhibit 4** graphically depicts the commercial aircraft operations at TUS since 2006.

**Exhibit 4 – Historical Commercial Aircraft Operations**
For Fiscal Years 2006 Through 2016; In Thousands




Notes: CAGR = Compound Annual Growth Rate
Includes commercial passenger, on-demand/limited service air taxi, and all-cargo operations

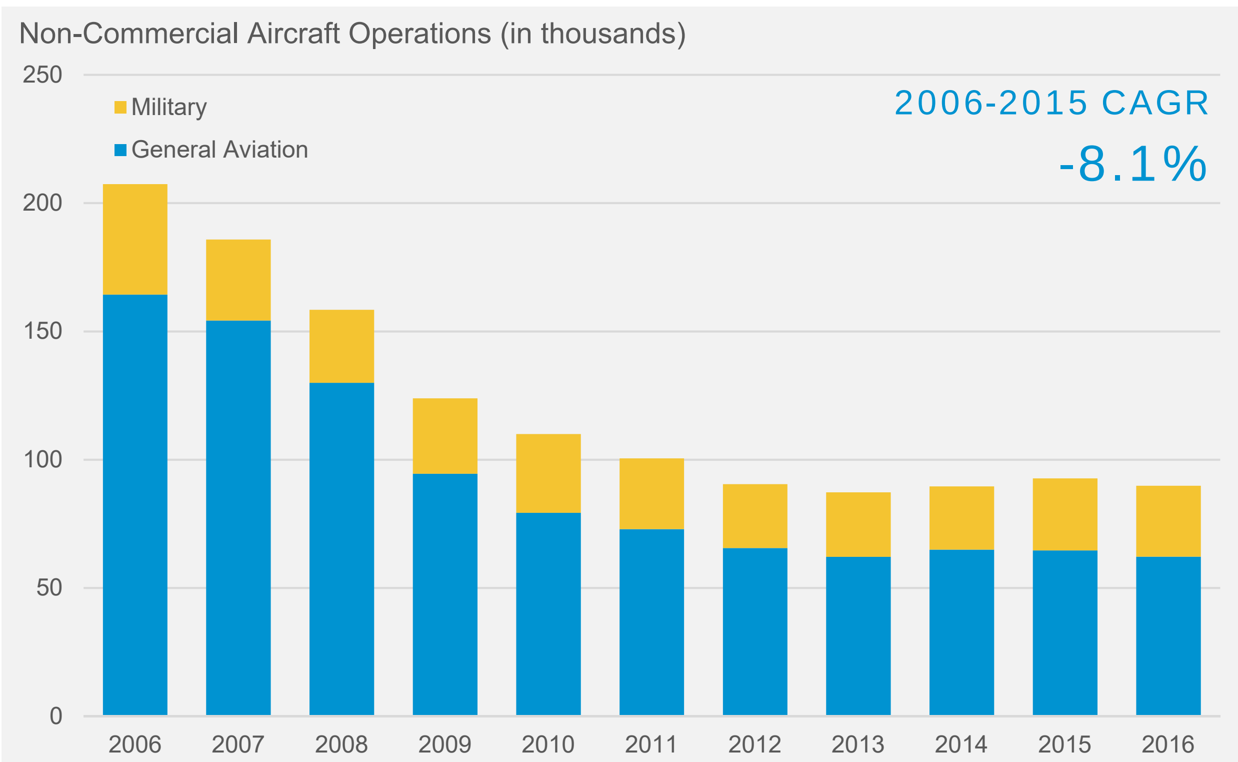
Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014; Tucson Airport Authority, Monthly Activity Overview.

A majority of the commercial aircraft operations at TUS are scheduled operations. Actual aircraft operations may differ slightly from the scheduled aircraft operations due to flight cancellations and other factors. However, the difference is typically a very small percentage of the aircraft operations. In 2016, scheduled passenger aircraft operations were within one percent of the actual passenger aircraft operations. According to data from TAA, there were 38,674 passenger aircraft operations and 2,126 cargo aircraft operations in 2016. The remaining commercial aircraft operations, 9,629 in 2016, are non-scheduled or for-hire (charter) aircraft operations. For the purpose of this document, these operations are called on-demand/limited service air taxi.

### 3.4.2 NON-COMMERCIAL AIRCRAFT OPERATIONS

In 2006, there were 207,387 total non-commercial operations, a majority of which (164,337) were GA operations. From 2006 through 2012, non-commercial aircraft operations declined at an annual rate of 12.9 percent due to a significant decline in GA aircraft operations over that period. Since 2007, military aircraft operations have fluctuated around an average of 27,750 per year. The rate of decline of GA aircraft operations have slowed over the past four years and in turn it appears that non-commercial traffic has stabilized. **Exhibit 5** graphically depicts the non-commercial aircraft operations at TUS since 2006.

**Exhibit 5 – Historical Non-Commercial Aircraft Operations**
For Fiscal Years 2006 Through 2016; In Thousands




Notes: CAGR = Compound Annual Growth Rate
Military operations for 2016 reflect the calendar year versus fiscal year per FAA direction.

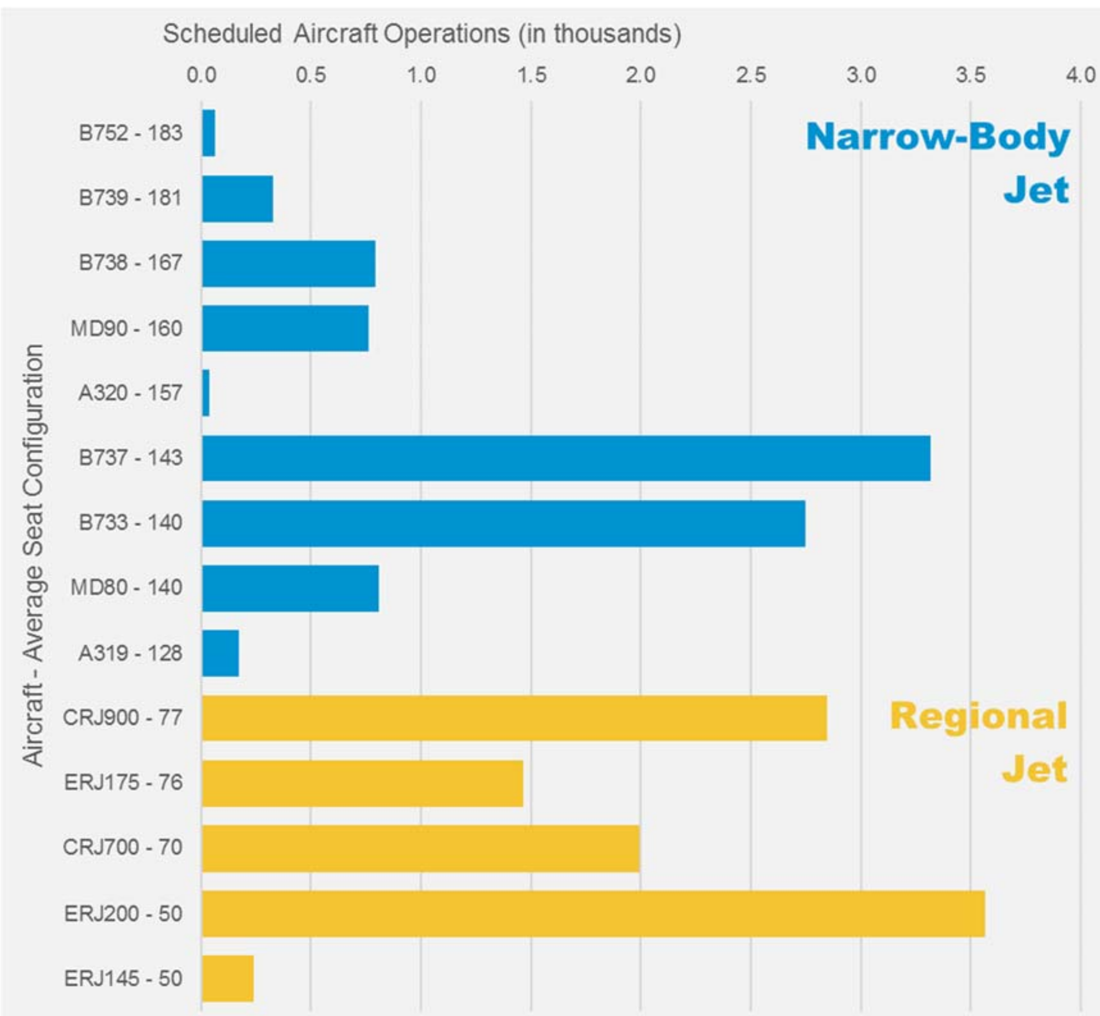
Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014; Tucson Airport Authority, Monthly Activity Overview.

# 3.5 AIRCRAFT FLEET MIX

## 3.5.1 PASSENGER AIRCRAFT OPERATIONS

Airlines providing scheduled passenger air service at TUS deploy a relatively even mix of narrow-body and regional jet aircraft. In 2016, regional jet aircraft accounted for 52.8 percent of the total scheduled passenger aircraft operations compared to 47.2 percent by narrow-body aircraft. The 50-seat small regional jet Canadair CRJ200 was the most commonly used aircraft for scheduled service at TUS in 2016. However, the push to eliminate small regional jets has become the industry trend. In 2016, the CRJ200 accounted for 18.6 percent of the scheduled aircraft operations, which was down from 25.6 percent for the year prior. The 143-seat Boeing 737-700 aircraft is the most common aircraft in Southwest Airline's fleet and is the most used narrow-body aircraft for scheduled passenger service. **Exhibit 6** graphically depicts the number of scheduled passenger aircraft operations by aircraft type for 2016.

**Exhibit 6 – Scheduled Passenger Aircraft Operations by Aircraft Type**
For Fiscal Year 2016; In Thousands




Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser.

### 3.5.2 CARGO AIRCRAFT OPERATIONS

A majority of the cargo operations are handled by Ameriflight. In 2016, Ameriflight accounted for 54.1 percent of the all-cargo operations. The carrier utilizes a number of commuter aircraft to handle all of its air cargo needs. Although Ameriflight has a majority of the aircraft cargo operations, the size of the aircraft limits the carrier's ultimate capacity. Federal Express (FedEx) handles all of the remaining scheduled cargo service primarily with the Boeing 767-300 aircraft.

## 3.6 BASED AIRCRAFT

The FAA's Form 5010-1 states the previous year's count of operations broken down by category, as well as the number of the based aircraft for the Airport by category. The FAA TAF uses the 5010-1 forms as a basis for defining historical and forecast traffic data. **Table 4** provides a summary of the aircraft based at TUS from the FAA Form 5010-1.

**Table 4 – Based Aircraft Fleet Mix**
For 12-Months Ending January 31, 2016

| CATEGORY | NUMBER OF AIRCRAFT |
|---|---|
| Single Engine | 169 |
| Multi-Engine | 26 |
| Jet | 18 |
| Helicopters | 10 |
| Gliders | 0 |
| Military | 72 |
| Ultra-Light | 0 |
| Total | 295 |

Note: Single-engine and multi-engine include piston and turboprop aircraft.
Source: Federal Aviation Administration, Form 5010-1, 2016.

# 4.0 DRIVERS OF AIR TRAFFIC

The link between the level of aviation activity and socio-economic growth are well documented. Simply put, growth in population, employment, income, and tourism activity typically lead to increased demand for air travel both for business and leisure purposes. An individual's demand for air travel is often referred to as "underlying demand" in that it cannot be realized without the presence of air service at a price that results in the decision to fly. This section discusses the socio-economic factors as well as changes in the strategies of airlines that affect aviation demand at TUS. All annual values pertaining to the socio-economic indicators provided in this section are in calendar year (CY) versus fiscal year.

## 4.1 AIR SERVICE AREA

According to the Airport's Comprehensive Annual Financial Report[4] (CAFR), TUS is the principal air carrier airport serving metropolitan Tucson, southern Arizona, and northern Sonora, Mexico. The Tucson Airport Authority (TAA or the Authority) considers Pima County as its primary airport service area. This area is where most of the Airport's passenger base is located. Tucson is the county seat of Pima County and, according to the U.S. Census Bureau, the Tucson Metropolitan Statistical Area (MSA) is comprised entirely of Pima County.

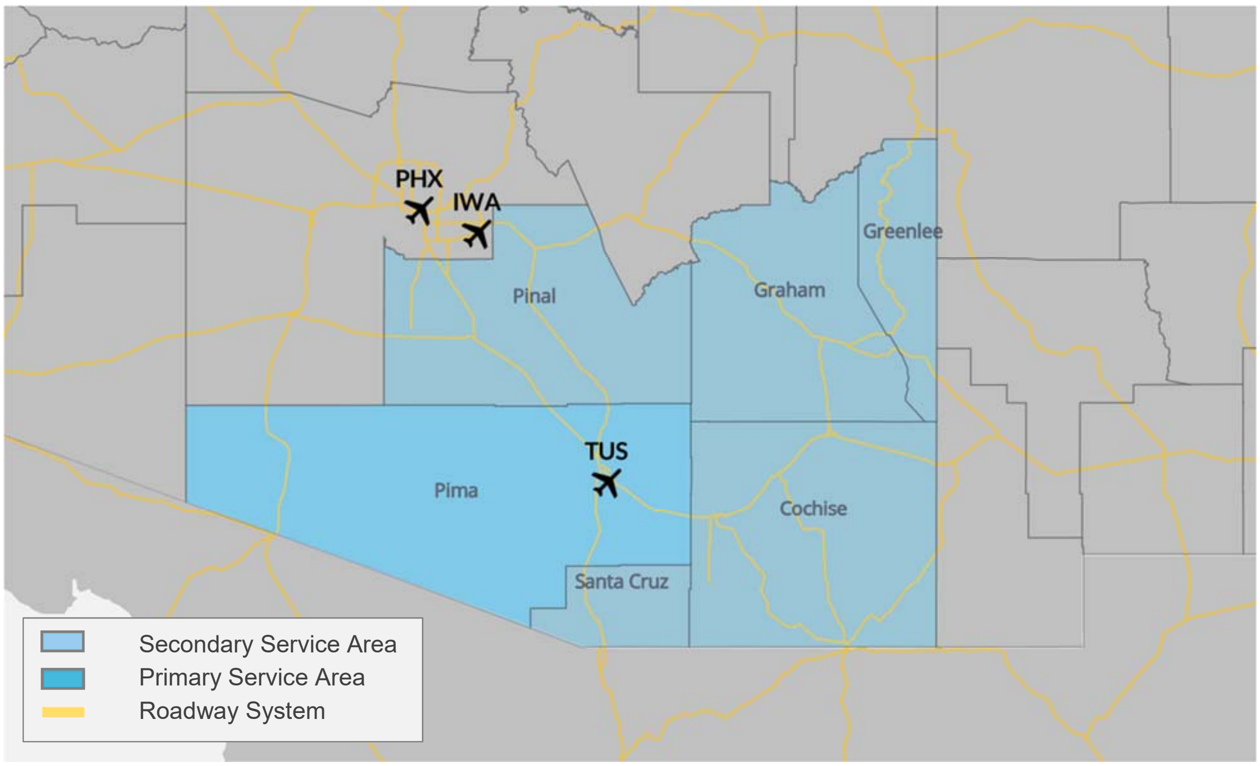
In June 2015, a True Market/Leakage Study (Market Study) was conducted to determine the size and characteristics of the Airport's catchment area. In addition to Pima County, the Market Study used a study area that included the following Arizona counties: Cochise County, Graham County, Greenlee County, Pinal County, and Santa Cruz County. The TAA identifies these counties as a secondary airport service area. This area is the space that is met with increased competition from other airports in the region, particularly the Phoenix Sky Harbor International Airport (PHX) and Phoenix-Mesa Gateway Airport (IWA). **Exhibit 7** graphically depicts the primary and secondary airport service areas and the location of the nearby airports. The study was able to determine two important details of the Airport's air service areas: (1) the number of passengers per county; and (2) the retention of passengers by county.

According to the Market Study, Pima County, the primary service area, accounted for the majority of originating passengers with 86.0 percent. Cochise County provided the second most passengers with 9.4 percent of the originating passengers. The remaining counties combined accounted for just 4.6 percent of the originating passengers, half of which are from Santa Cruz.

4 Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014, April 25, 2016.

The study was able to determine that TUS was able to retain a majority of the passengers from Cochise County, Pima County, and Santa Cruz County with 73.1 percent, 71.6 percent, and 65.8 percent retention rates respectively. However, the Airport was only able to retain less than a third of the passengers from Greenlee County, Graham County, and Pinal County. This is not surprising considering there are more options for commercial service due to the proximity to PHX and IWA.

**Exhibit 7 – Map of Air Service Area**
Primary and Secondary




Source: Landrum & Brown.

## 4.2 PASSENGER PROFILE

In August 2016, Strongpoint Marketing completed a passenger survey for the Airport (2016 Survey). This survey is an update to others that have been conducted over the past two years. Passenger surveys include valuable data such as the makeup, or profile, of the passengers that utilize an airport which can be used to determine which indicators are worth exploring. An intercept survey of departing passengers at TUS was executed from July 6 through July 14, 2016 and included a sample size of 603 passengers.

Over the past three years, the surveys have shown that approximately 6 out of 10 passengers surveyed were residents of Tucson. It is noted that the summertime data collection may have influenced this ratio in favor of residents. A majority of the passengers surveyed listed that the reason for choosing the Airport is because it is close to home which coincides with the results of in the Market Study. Only 8.1 percent said that competitive airfare is the reason for using the Airport. The 2016 Survey also showed that less than a third of the passengers in each of the past three years are traveling for business.

## 4.3 ECONOMIC BASE FOR AIR TRAVEL

### 4.3.1 UNITED STATES ECONOMY

Historically, the U.S. economy, as measured by Gross Domestic Production (GDP), has grown at a relatively steady rate, averaging 3.1 percent per annum between CY1960 and CY2015. The rate of growth has been remarkably stable reflecting both the size and maturity of the U.S. economy. Individual years have fluctuated around the long-term trend for a variety of reasons including pure macro-economic factors, fuel shocks, war, and terrorist attacks.

There have been two official economic recessions in the U.S. thus far in the 21st century. The first occurred between March and November of 2001 and was compounded by the September 11, 2001 terrorist attacks. The negative impact of these events on the airline industry is well documented. The recession itself was short-lived by historical standards and the economy returned to positive growth rates quickly, fueled in part by a gradual but prolonged reduction in interest rates.

The second recession, often referred to as the 'Great Recession', occurred between December 2007 and June 2009.[5] This was the worst financial crisis to affect the U.S. since the Great Depression; and it was the longest recession since the time the airline industry was deregulated[6] in CY1978. The nation's unemployment rate rose from 5.0 percent in December of 2007 to a high of 10.0 percent in October 2009.[7]

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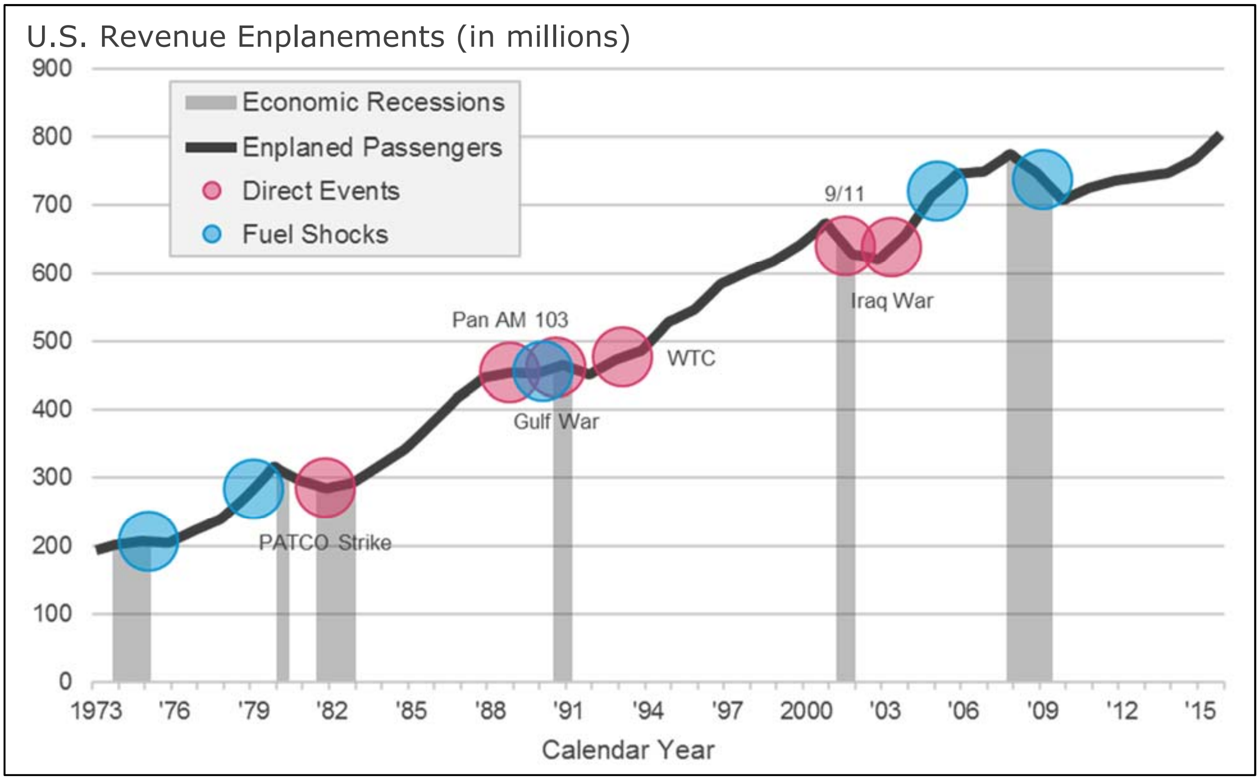
5 National Bureau of Economic Research, U.S. Business Cycle Expansions and Contractions, September 20, 2010.

6 Deregulation refers to the Airline Deregulations Act of 1978, which reduced government control over the commercial aviation industry.

7 National Bureau of Economic Research, U.S. Business Cycle Expansions and Contractions, September 20, 2010.

**Exhibit 8** shows how strongly passenger traffic in the U.S. has historically been correlated with the nation's economy. During economic contractions, there is a notable decline in passenger volumes while during the subsequent economic expansions there is significant growth in passenger volumes. Additionally, it is clear that shocks such as terrorist attacks have a short but significant impact to the passenger volumes.

**Exhibit 8 – U.S. Aviation System Shocks & Recoveries**
Calendar Years 1973 Through 2015




Source: U.S. Department of Transportation, Air Carrier Statistics database (T100).

### 4.3.2 REGIONAL ECONOMY

From CY2007 to CY2015, the Tucson MSA's gross regional product (GRP) decreased at a CAGR of 0.2 percent, while the State of Arizona experienced annual GRP growth at an average of 0.1 percent. Over the next 12 years, Tucson MSA's GRP is forecast to increase at a CAGR of 2.4 percent, which is above the national average of 2.2 percent but below the 2.9 percent expected for the State of Arizona. **Table 5** provides the historical and forecast growth of the nation's GDP and the GRP the State of Arizona, the Tucson MSA, and the Airport's secondary air service region.

**Table 5 – Historical and Forecast Gross Domestic/Regional Product**
For Calendar Years 2007 Through 2028; In Billions of 2009 U.S. Dollars

| CALENDAR YEAR | UNITED STATES | STATE OF ARIZONA | TUCSON, AZ MSA/ PIMA COUNTY, AZ | SECONDARY AIR SERVICE REGION |
|---|---|---|---|---|
| **Historical** | | | | |
| 2007 | 14,820,647.4 | 270,039.8 | 36,470.6 | 12,064.7 |
| 2008 | 14,617,099.9 | 258,684.9 | 35,574.9 | 12,153.6 |
| 2009 | 14,320,111.0 | 242,918.0 | 34,205.7 | 11,672.7 |
| 2010 | 14,618,135.2 | 244,075.4 | 34,421.9 | 12,195.9 |
| 2011 | 14,792,275.5 | 246,295.2 | 33,925.4 | 12,766.5 |
| 2012 | 15,116,011.0 | 251,776.7 | 34,352.6 | 12,013.1 |
| 2013 | 15,384,325.9 | 255,018.0 | 34,427.7 | 11,961.6 |
| 2014 | 15,894,994.9 | 263,177.9 | 34,936.3 | 12,071.8 |
| 2015 | 16,302,781.3 | 271,570.4 | 35,786.4 | 12,516.8 |
| **Estimate** | | | | |
| 2016 | 16,696,644.7 | 279,981.8 | 36,725.6 | 12,859.9 |
| **Forecast** | | | | |
| 2023 | 19,507,491.1 | 342,688.7 | 43,524.0 | 15,427.4 |
| 2028 | 21,632,355.4 | 392,918.9 | 48.742.7 | 17.486.3 |
| **Compound Annual Growth Rate** | | | | |
| 2007-15 | 1.2% | 0.1% | -0.2% | 0.5% |
| 2015-23 | 2.3% | 3.0% | 2.5% | 2.6% |
| 2023-28 | 2.1% | 2.8% | 2.3% | 2.5% |

Notes: The secondary airport service area is comprised of the following Arizona counties: Cochise County, Graham County, Greenlee County, Pinal County, and Santa Cruz County.

Source: Woods & Poole, 2016.

## 4.4 POPULATION GROWTH

From CY2007 to CY2015, the population in the Tucson MSA increased at a CAGR of 0.8 percent, while the population of the State of Arizona experienced annual growth at an average of 1.3 percent. Over the next 12 years, the population in the Tucson MSA is forecast to increase at a CAGR of 1.2 percent, which is above the national average of 0.9 percent but below the 1.6 percent expected for the State of Arizona. **Table 6** provides the historical and forecast growth of the population of the United States, the State of Arizona, the Tucson MSA, and the Airport's secondary air service region.

**Table 6 – Historical and Forecast Population**
For Calendar Years 2007 Through 2028; In Thousands

| CALENDAR YEAR | UNITED STATES | STATE OF ARIZONA | TUCSON, AZ MSA / PIMA COUNTY, AZ | SECONDARY AIR SERVICE REGION |
|---|---|---|---|---|
| **Historical** | | | | |
| 2007 | 301,231.2 | 6,167.7 | 955.9 | 523.1 |
| 2008 | 304,094.0 | 6,280.4 | 967.8 | 555.7 |
| 2009 | 306,771.5 | 6,343.2 | 975.6 | 573.1 |
| 2010 | 309,347.1 | 6,412.0 | 981.9 | 610.5 |
| 2011 | 311,721.6 | 6,472.9 | 988.1 | 610.4 |
| 2012 | 314,112.1 | 6,556.2 | 993.1 | 613.2 |
| 2013 | 316,497.5 | 6,635.0 | 998.1 | 614.2 |
| 2014 | 318,857.0 | 6,731.5 | 1,004.5 | 623.4 |
| 2015 | 321,545.1 | 6,836.7 | 1,016.4 | 634.2 |
| **Estimate** | | | | |
| 2016 | 324,506.9 | 6,948.7 | 1,029.1 | 645.7 |
| **Forecast** | | | | |
| 2023 | 346,139.6 | 7,784.6 | 1,122.8 | 732.5 |
| 2028 | 362,304.0 | 8,433.5 | 1,193.5 | 801.2 |
| **Compound Annual Growth Rate** | | | | |
| 2007-15 | 0.8% | 1.3% | 0.8% | 2.4% |
| 2015-23 | 0.9% | 1.6% | 1.3% | 1.8% |
| 2023-28 | 0.9% | 1.6% | 1.2% | 1.8% |

Notes: The secondary airport service area is comprised of the following Arizona counties: Cochise County, Graham County, Greenlee County, Pinal County, and Santa Cruz County.

Source: Woods & Poole, 2016.

## 4.5 EMPLOYMENT TRENDS

Growth in employment is an important indicator of the overall health of the local economy. Population changes and employment changes tend to be closely correlated as people migrate in and out of areas largely depending on their ability to find work.

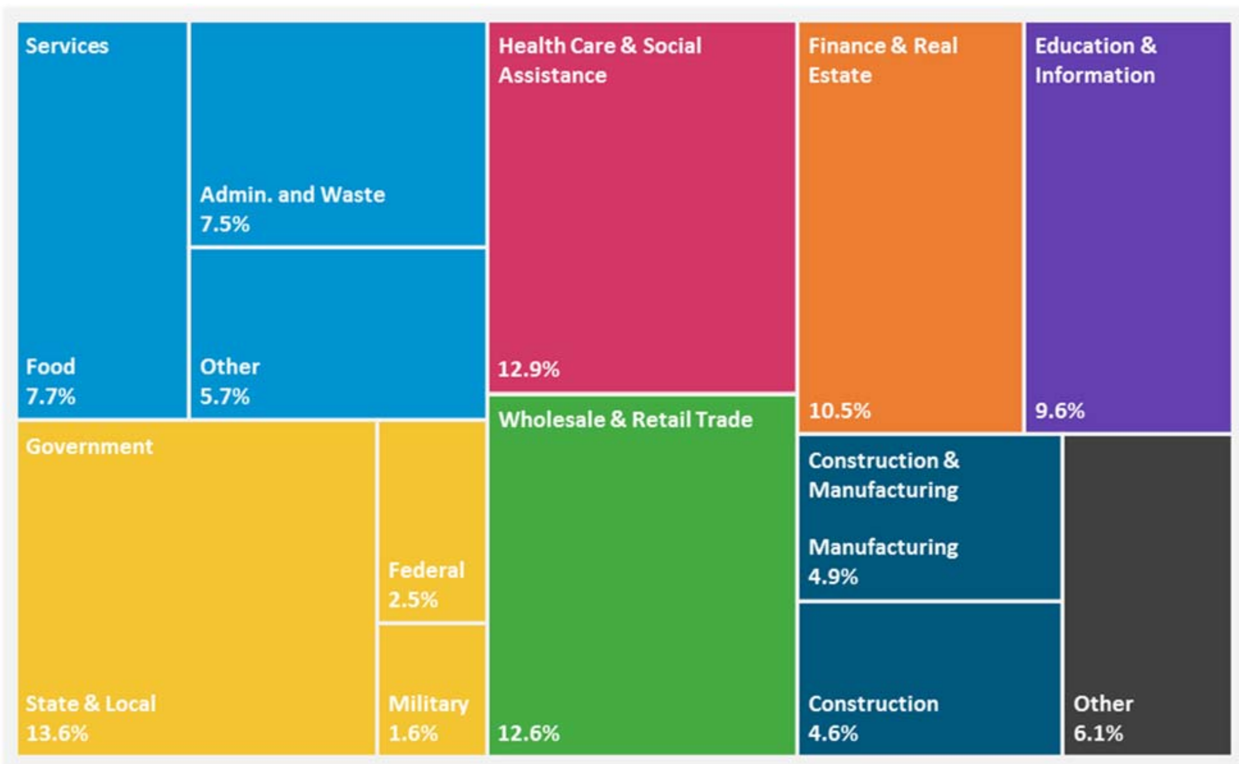
### 4.5.1 MAJOR EMPLOYERS

The Arizona Daily Star, the major newspaper that serves Tucson and the surrounding districts of southern Arizona, maintains a list of the top 200 major employers of Southern Arizona called the Star 200. According to the Star 200, the University of Arizona was the largest employer in the area with 11,251 employees in 2016. Raytheon Missile Systems, headquartered in Tucson, has historically been the largest employer in the region. However, the number of employees at Raytheon has decreased from 12,140 in 2010 to 9,600 in CY2016 making it the second largest employer in the region. Local government (Pima County and the City of Tucson) had a combined 11,655 employees in CY2016. The military also has a significant presence in the region. The United States Air Force's Davis-Monthan Air Force Base employs 8,406 people and the United States Army's Fort Huachuca employs 5,477 people. Other notable employers represent the health care, retail, mining, manufacturing, and education industries.

## 4.5.2 INDUSTRY CLUSTERS

The Tucson MSA's largest employers are in the manufacturing, government, and education industries. Combined these industries accounted for 32.3 percent of the employment in the MSA in CY2015. **Exhibit 9** provides an overview of the key industry sectors in the Tucson MSA.

**Exhibit 9 – Employment by Industry Sector**
Calendar Year 2015




Source: Woods & Poole, 2016.

### 4.5.3 EMPLOYMENT GROWTH

From CY2007 to CY2015, employment in the Tucson MSA decreased at a CAGR of 0.3 percent, while the State of Arizona experienced annual employment growth at an average of 1.8 percent. Over the next 12 years, employment in the Tucson MSA is forecast to grow at a CAGR of 1.6 percent, which is above the national average of 1.4 percent but below the 1.9 percent expected for the State of Arizona. **Table 7** provides the historical and forecast growth of the employment of the United States, the State of Arizona, the Tucson MSA, and the Airport's secondary air service region.

**Table 7 – Historical and Forecast Employment**
For Calendar Years 2007 Through 2028; In Thousands

| CALENDAR YEAR | UNITED STATES | STATE OF ARIZONA | TUCSON, AZ MSA / PIMA COUNTY, AZ | SECONDARY AIR SERVICE REGION |
|---|---|---|---|---|
| **Historical** | | | | |
| 2007 | 179,885.7 | 3,494.2 | 523.8 | 166.1 |
| 2008 | 179,639.9 | 3,434.2 | 510.8 | 169.2 |
| 2009 | 174,233.7 | 3,264.1 | 491.4 | 164.7 |
| 2010 | 173,034.7 | 3,208.3 | 484.0 | 166.4 |
| 2011 | 176,278.7 | 3,268.5 | 485.1 | 171.2 |
| 2012 | 179,081.6 | 3,322.7 | 491.5 | 173.2 |
| 2013 | 182,390.0 | 3,398.9 | 496.3 | 176.5 |
| 2014 | 185,798.8 | 3,461.6 | 500.6 | 177.2 |
| 2015 | 188,866.2 | 3,536.2 | 509.9 | 180.9 |
| **Estimate** | | | | |
| 2016 | 191,870.8 | 3,610.5 | 519.0 | 184.5 |
| **Forecast** | | | | |
| 2023 | 211,998.7 | 4,132.6 | 581.8 | 210.1 |
| 2028 | 226,065.0 | 4,518.9 | 626.7 | 229.3 |
| **Compound Annual Growth Rate** | | | | |
| 2007-15 | 0.6% | 0.1% | -0.3% | 1.1% |
| 2015-23 | 1.5% | 2.0% | 1.7% | 1.9% |
| 2023-28 | 1.3% | 1.8% | 1.5% | 1.8% |

Notes: The secondary airport service area is comprised of the following Arizona counties: Cochise County, Graham County, Greenlee County, Pinal County, and Santa Cruz County.

Source: Woods & Poole, 2016.

## 4.6 PERSONAL INCOME

From CY2007 to CY2015, the Tucson MSA's per capita personal income (PCPI) decreased at a CAGR of 0.3 percent, while the State of Arizona experienced annual PCPI decline at an average of 0.6 percent. Over the next 12 years, Tucson MSA's PCPI is forecast to grow at a CAGR of 1.5 percent, which is equal to the national average but below the 1.6 percent expected for the State of Arizona. **Table 8** provides the historical and forecast growth of the PCPI of the United States, the State of Arizona, the Tucson MSA, and the Airport's secondary air service region.

**Table 8 – Historical and Forecast Per Capita Personal Income**
For Calendar Years 2007 Through 2028; In 2009 U.S. Dollar

| CALENDAR YEAR | UNITED STATES | STATE OF ARIZONA | TUCSON, AZ MSA / PIMA COUNTY, AZ | SECONDARY AIR SERVICE REGION |
|---|---|---|---|---|
| **Historical** | | | | |
| 2007 | 41,010 | 37,001 | 35,302 | 27,781 |
| 2008 | 41,055 | 36,053 | 35,733 | 27,642 |
| 2009 | 39,376 | 34,063 | 33,570 | 26,357 |
| 2010 | 39,622 | 33,629 | 33,062 | 25,165 |
| 2011 | 40,762 | 34,254 | 33,562 | 25,753 |
| 2012 | 41,713 | 34,666 | 33,771 | 25,630 |
| 2013 | 41,310 | 34,138 | 33,331 | 25,766 |
| 2014 | 42,207 | 34,733 | 33,941 | 26,358 |
| 2015 | 42,928 | 35,375 | 34,460 | 26,763 |
| **Estimate** | | | | |
| 2016 | 43,613 | 35,985 | 34,998 | 27,186 |
| **Forecast** | | | | |
| 2023 | 48,506 | 40,445 | 38,900 | 30,303 |
| 2028 | 51,953 | 43,668 | 41,618 | 32,056 |
| **Compound Annual Growth Rate** | | | | |
| 2007-15 | 0.6% | -0.6% | -0.3% | -0.5% |
| 2015-23 | 1.5% | 1.7% | 1.5% | 1.6% |
| 2023-28 | 1.4% | 1.6% | 1.4% | 1.4% |

Notes: The secondary airport service area is comprised of the following Arizona counties: Cochise County, Graham County, Greenlee County, Pinal County, and Santa Cruz County.

Source: Woods & Poole, 2016.

## 4.7 PRICE OF AIR TRAVEL

The demand for air travel is inversely proportional to the price. As airfares increase, fewer people can afford to travel for leisure. Alternatively, as airfares decrease, more people are able to afford to travel and do so more frequently. Prior to the 2007-2009 recession, airfares did not typically have a significant impact on the air travel demand for business passengers. However, the economic climate prompted businesses to seek measures in order to save cost, part of which included shrinking travel budgets. Now many companies are substituting air travel with telecommunications, such as video calls, when the cost of travel becomes too great.

Yield is the aviation industry's measure for average ticket prices. Yield is the average fare paid by customers to fly one mile, i.e. passenger revenue divided by revenue passenger miles. In recent years, the average yield at TUS has been on the rise. When adjusted for inflation, the average yield at the Airport increased from 12.77 cents in 2006 to 13.67 cents in 2015, representing a CAGR of 0.8 percent.

The FAA estimates that U.S. mainline air carrier passenger domestic yields, when adjusted for inflation, will decrease by 3.2 percent in 2016 followed by a period of growth and until peaking in 2024. From 2024 through 2028, the FAA projects domestic yields to decrease at a CAGR of 0.5 percent.[8] The local yields at TUS are expected to follow the national trends over the forecast period. Therefore, to project the yield at TUS the year-over-year growth of the national yields were applied to the historical yields at the Airport. **Table 9** shows the historical and forecast yields at the Airport based on projections by the FAA.

[8] Federal Aviation Administration, FAA Aerospace Forecast: Fiscal Years 2016-2036.

**Table 9 – Historical and Forecast Airline Yields**
For Fiscal Years 2006 through 2028; In 2009 U.S. Cents

| FISCAL YEAR | TUS AVERAGE YIELD |
|---|---|
| **Historical** | |
| 2006 | 12.77 |
| 2007 | 12.36 |
| 2008 | 12.73 |
| 2009 | 12.24 |
| 2010 | 12.51 |
| 2011 | 13.08 |
| 2012 | 13.40 |
| 2013 | 13.58 |
| 2014 | 13.54 |
| 2015 | 13.67 |
| **Estimate** | |
| 2016 | 13.24 |
| **Forecast** | |
| 2023 | 13.80 |
| 2028 | 13.58 |
| **Compound Annual Growth Rate** | |
| 2006-15 | 0.8% |
| 2015-23 | 0.1% |
| 2023-28 | -0.3% |

Notes: The yield forecast is based on the domestic U.S. mainline air carrier forecast from the FAA Aerospace Forecast.

Sources: Federal Aviation Administration, Airline Origin and Destination Survey (DB1B); Federal Aviation Administration, FAA Aerospace Forecast: Fiscal Years 2016-2036. U.S. Bureau of Labor Statistics, Consumer Price Index - All Urban Consumers: West Urban.

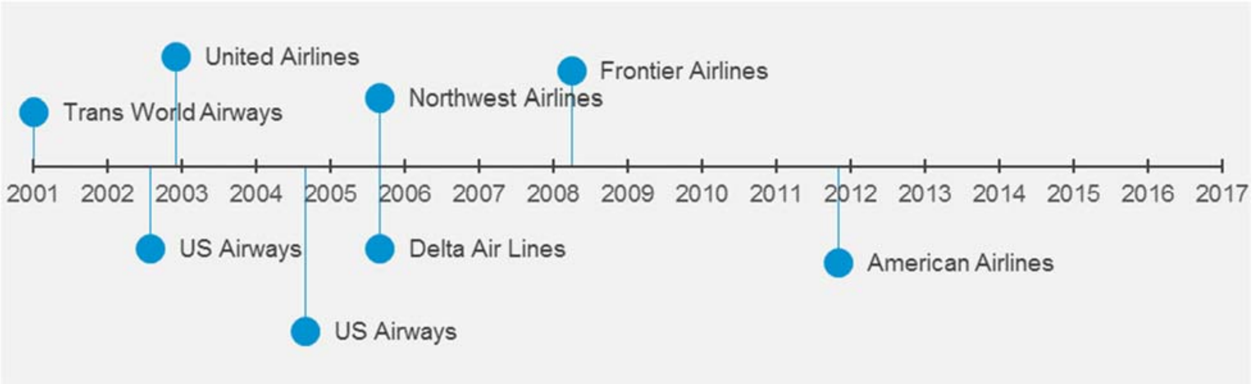
## 4.8 AIRLINE INDUSTRY STRATEGY

The financial health of the airlines will play a major role in the determination of future forecasts for TUS. This section contains a summary of the airline industry factors that were considered in developing the TUS forecast.

### 4.8.1 AIRLINE BANKRUPTCIES

There have been dramatic changes to the financial health of the airline industry in the 21st century. Numerous airlines have declared Chapter 11 bankruptcy at least once, including five of the six legacy carriers (before the latest round of mergers). There was a rash of bankruptcies between CY2001 and CY2005, and another more recent round in CY2008 as a result of the recent economic recession. The most recent airline to declare bankruptcy was American Airlines, which entered bankruptcy protection in November 2011. As shown in **Table 10**, nine airlines that operated at TUS have declared bankruptcy this century. Southwest, the second largest carrier at TUS, has never declared bankruptcy.

**Table 10 – Airline Bankruptcy Status**
Since January 2001




| AIRLINE | STATUS |
|---|---|
| Trans World Airways | Filed Chapter 11 in January 2001 as part of acquisition by American. |
| US Airways | Filed Chapter 11 in August 2002 and again in September 2004; emerged in September 2005 in conjunction with acquisition by America West. Acquired by American Airlines in 2013. |
| United Airlines | Filed Chapter 11 in December 2002; emerged in February 2006. |
| Northwest Airlines | Filed Chapter 11 in September 2005; emerged in May 2007. Acquired by Delta in 2008. |
| Delta Air Lines | Filed Chapter 11 in September 2005; emerged in April 2007. Wholly owned subsidiary Comair Airlines taken in bankruptcy with Delta Airlines |
| Frontier Airlines | Filed Chapter 11 in April 2008; emerged in October 2009. |
| American Airlines | Filed Chapter 11 in November 2011. Wholly owned subsidiary American Eagle Airlines taken into bankruptcy with American Airlines. Emerged in December 2013. |

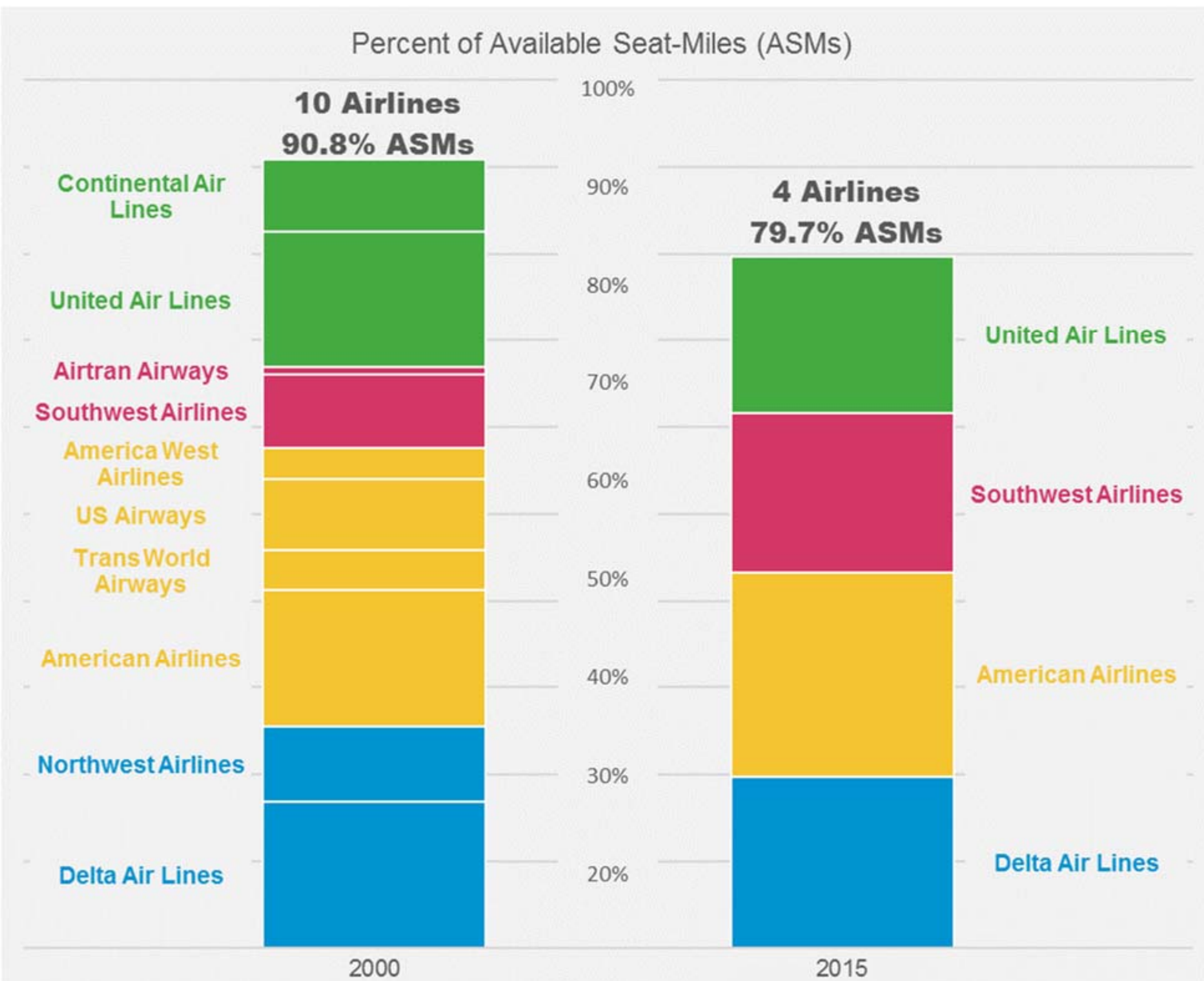
Source: Airlines for America, U.S. Bankruptcies and Service Cessations.

## 4.8.2 AIRLINE MERGERS

Many airlines have merged or been acquired since the turn of the 21st century, including American/TWA in CY2001, US Airways/America West in CY2005, Delta/Northwest Airlines in CY2008, Southwest/AirTran in CY2010, United/Continental Airlines in CY2010-2012, and most recently American/US Airways in CY2013.

These mergers have resulted in significant consolidation and economic control of passenger ridership. In CY2000, ten U.S. airlines accounted for more than 90 percent of the domestic available seat-miles (ASMs) in the United States. In CY2015, the combined airlines resulting from these mergers control 79.7 percent of the domestic ASMs. **Exhibit 10** graphically depicts how the mergers have affected the control of ASMs in the United States.

**Exhibit 10 – Percent of Available Seat-Miles by Airline**
For Calendar Years 2000 and 2015




Source: U.S. Department of Transportation, Air Carrier Statistics database (T100).

### 4.8.3 DOMESTIC CAPACITY

After five years of negative earnings, the U.S. airline industry collectively returned to profitability in 2006 after savings from labor cuts, salary concessions, and removal of many flight perquisites were realized. The success of restructuring has produced an industry that is already relatively streamlined with very little fat left to trim. The surge in oil prices in 2008 and the ensuing economic crisis pushed airlines to start raising fares and cutting capacity. To survive and be profitable, the airlines have had to reduce domestic capacity (the number of scheduled seats that are offered) to avoid losing money on unprofitable routes and excessive frequencies that are not supported with sufficient demand. As evidence of this, capacity reductions at TUS occurred from 2007 through 2015 (with the exceptions of 2010 and 2014) averaging a reduction of 6.3 percent per year in terms of domestic scheduled seats. However, there was a significant increase in capacity of 6.6 percent in 2016.

### 4.8.4 NEW SCHEDULED SERVICE

A majority of growth at the Airport will be the result of natural or organic growth to the existing service at the Airport. However, there are markets that historically have not been available at the Airport that have been announced which may result in a stimulation of passenger traffic.

In October 2016, American Airlines began new nonstop service from TUS to JFK utilizing the 160-seat Boeing 737-800 aircraft. Previously, this service was available at TUS by JetBlue Airways but since the airline discontinued service at TUS, the route has been unavailable. The new flights provide passengers direct access to New York and one-stop connections to international destinations and the northeast United States.

Aeromar, which is a codeshare partner with United Airlines and Aeroméxico, began international service at TUS in October 2016. The new service, operated with the 46-seat ATR-42 aircraft, provides the first commercial international flights at the Airport since 2008. The flights operate four days a week and depart from TUS and arrive at the General Ignacio Pesqueira García International Airport (HMO) before continuing to three other destinations in Mexico.

# 4.9 TOURISM

Tourism is a major industry in the Tucson region. In CY2015, there were 6.5 million domestic overnight visitors to the Tucson and the Southern Arizona Region directly spending $3.4 billion.[9] Tucson has a variety of attractions including the Sonoran Desert. The Desert includes the Tucson Botanical Gardens, the Arizona-Sonora Desert Museum, the Sabino Canyon, Saguaro National Parks, and a number of caves and caverns. Additionally, Tucson offers two observatories and a number of museums and galleries including the Mission San Xavier del Bac and the Pima Air & Space Museum.

Arizona has historically been a top travel destination for people who travel from the colder climates of the northern United States to warmer locales during the winter months. Tucson is no exception as the city provides the warmer climates people desire while providing quick access to many outdoor recreation areas. The tourist season usually lasts from October to May.

# 4.10 PRICE OF FUEL

The price of oil and the associated cost of jet fuel is the largest single cost affecting the airline industry. The price of West Texas Intermediate (WTI) crude oil increased dramatically, posting a 290 percent increase in June 2008 compared to January 2004. After averaging between 20 U.S. Dollar (USD) to 30 USD per barrel between CY2000 and CY2003, spot crude oil prices surged to about 140 USD per barrel in June/July 2008. Several factors drove the increase such as strong global demand, particularly in China and India, a weak U.S. dollar, commodity speculation, political unrest, and a reluctance to materially increase supply.

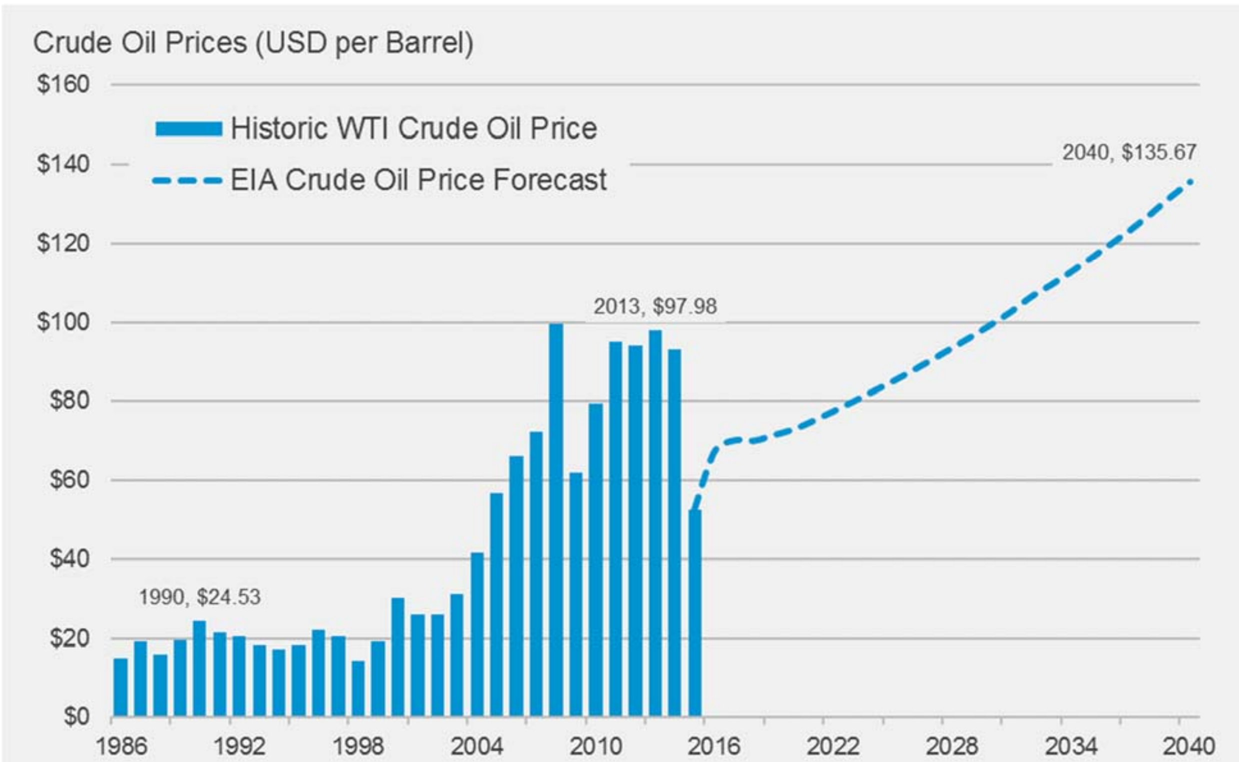
The price of oil subsequently declined sharply to 61 USD per barrel in CY2009 due to reduced demand resulting from the global financial crisis and resulting economic recession. However, oil prices increased in the subsequent three years as the economic climate improved and unrest in the Middle East contributed to rising oil prices. In CY2012, oil prices averaged 94 USD per barrel. The increase in the price of jet fuel put upward pressure on airlines' operating costs. As a result, airlines were faced with cutting capacity or increasing fares, and sometimes both. An additional impact of higher fuel prices has been a sharp increase in load factors as airlines look to make better use of their aircraft assets by constraining capacity.

The average price of oil dropped significantly in CY2015 to 49 USD per barrel, the lowest since CY2004. The drop alleviated the pressure on airlines' operating costs however, the airlines are slow to make changes as fuel prices are expected to increase in the future.

9 Arizona Office of Tourism, Tucson & Southern Region 2015 Year-End Data Review.

The U.S. Energy Information Administration (EIA) provides forecasts of the price of crude oil in a report entitled the Annual Energy Outlook (EIO). In the 2016 EIO, the EIA projects the price of oil to increase at 4.0 percent per annum through CY2040, reaching 136 USD per barrel in CY2040. **Exhibit 11** provides the historical and EIA's forecast of crude oil prices.

**Exhibit 11 – Crude Oil Prices**
For Calendar Years 1986 Through 2040; U.S. Dollar Per Barrel




Note: WTI stands for West Texas Intermediate.
Source: U.S. Energy Information Administration, Annual Energy Outlook 2016.

## 4.11 AIRCRAFT TRENDS

Variable fuel costs, aircraft type, and aircraft age have an impact on which aircraft the airlines choose to fly. The next-generation Boeing 737s and Airbus 320/321s have among the best fuel economy in the industry. The airlines have designated certain aircraft for retirement that have poor fuel economy compared to newer models. Many of the MD-80/90, DC-9, and B737-300,400,500s have all been marked for reduction of use or retirement by many domestic airlines. The MD-80 and MD-90 series and DC-9 aircraft are expected to be retired by 2017 while the older variants of the B737 are expected to be retired by 2020. These aircraft are expected to be replaced with the B737-700, B737-800 and B737 MAX aircraft with similar or higher seat capacities. Small regional jets like the EMB-135/140 and the CRJ-100/200 are also under much scrutiny and going through reductions. This trend is evident at TUS and the change in fleet structures could increase the number of seats offered in the market as the airlines will maintain frequency pre and post fleet change.

## 4.12 GENERAL AVIATION INDUSTRY

### 4.12.1 HISTORICAL NATIONAL GA ACTIVITY

The civil aviation industry in the U.S. has experienced major changes over the past several decades. GA activity levels were at its highest in the late 1970s through CY1981. GA activity levels and new aircraft production reached all-time lows in the early 1990s due to a number of factors including increasing fuel prices, increased product liability stemming from litigation concerns, and the resulting higher cost of new aircraft. The passage of the 1994 General Aviation Revitalization Act (GARA)[10] combined with reduced new aircraft prices, lower fuel prices, resumed production of single-engine aircraft, continued strength in the production and sale of business jets, and a recovering economy led to growth in the GA industry in the latter half of the 1990s.[11]

The rebound in the U.S. GA industry that began with GARA started to subside by CY2000. GA traffic at airports with air traffic control service slowed considerably in CY2001 due largely to a U.S. economic recession and to some extent the terrorist attacks of September 11, 2001. GA traffic at airports with air traffic control service continued to decline through CY2006 as spikes in fuel costs occurred and the economy grew at a relatively even pace. For the first time since CY1999, GA traffic at airports with air traffic control service increased in CY2007, but just slightly (0.2 percent over 2006). However, GA operations declined by 4.7 percent at airports with air traffic control service the following year. The decline in GA traffic continued due to the recent economic downturn and increases in fuel prices. GA operations decreased 11.3 percent in CY2009, 5.1 percent in CY2010, and 2.3 percent in CY2011. In CY2012, GA operations increased 0.6 percent but decreased 0.8 percent in CY2013 and an estimated 1.1 percent in the following years. **Exhibit 12**, shows the number of GA operations at U.S. airports since CY1990.

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10 GARA imposes an 18-year statute of repose on product liability lawsuits for GA aircraft.
11 Based on information from the General Aviation Manufacturers Association (GAMA).

**Exhibit 12 – General Aviation Operations at U.S. Airports**
For Calendar Years 1990 Through 2015


Source: FAA Air Traffic Activity Data System (ATADS).

## 4.12.2 BUSINESS AVIATION

Companies and individuals use aircraft as a tool to improve their business's efficiency and productivity. The terms business and corporate aircraft are often used interchangeably, as they both refer to aircraft used to support a business enterprise. The FAA defines corporate transportation as "any use of an aircraft by a corporation, company or other organization (not for compensation or hire) for the purposes of transporting its employees and/or property, and employing professional pilots for the operation of the aircraft." Regardless of the terminology used, the business/corporate component of GA is an important one.

After growing rapidly for most of the past decade, the demand for business jet aircraft has decelerated over the past few years. While new products, including very light jets, and increasing foreign demand helped to spur this growth in the early 2000s, the past few years have seen the dramatic impact of the recession on the business jet market. Issues such as reduced corporate profits, bankruptcies, mergers, and an intense scrutiny on GA as a result of corporate collapses have resulted in reductions in corporate GA activity, especially in the business jet sector.

Increased personnel productivity has been stated as one of the most important benefits of using business aircraft. Companies flying GA aircraft for business have more control of their travel. Itineraries can be changed as needed, and the aircraft can fly into destinations not served by scheduled airlines. Business aircraft usage provides:

- Employee time savings
- Increased en route productivity
- Minimized time away from home
- Enhanced industrial security
- Enhanced personal safety
- Management control over scheduling

Business use of GA aircraft ranges from small, single-engine aircraft rentals to multiple aircraft corporate fleets supported by dedicated flight crews and mechanics. GA aircraft use allows employers to transport personnel and air cargo efficiently. Businesses often use GA aircraft to link multiple office locations and reach existing and potential customers. Business aircraft use by smaller companies has escalated as various chartering, leasing, time-sharing, interchange agreements, partnerships, and management contracts have emerged. Businesses and corporations have increasingly employed business aircraft in their operations.

# 4.13 INDUSTRY FORECASTS

## 4.13.1 FAA AEROSPACE FORECAST

The FAA develops a set of assumptions and forecasts based on the current tends of the U.S. aviation industry. These forecasts, entitled the FAA Aerospace Forecast, are published annually and are considered to be one the most complete forecasts available for aviation activity in the U.S. The FAA Aerospace Forecast provides forecasts for passenger, cargo, and general aviation activity on a national level.

As part of the forecasting efforts, the FAA provides forecast for revenue passenger enplanements for mainline and regional carriers.[12] The FAA forecasts[13] project that domestic mainline revenue passenger enplanements will increase by 1.9 percent per annum from 2015 through 2028 while domestic regional revenue passenger enplanements will increase at 1.8 percent per annum during the same period. **Table 11** provides the national annual revenue passenger enplanement forecast by carrier type through 2028.

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[12] Mainline carriers are defined as those providing service primarily via aircraft with 90 or more seats. Regionals are defined as those providing service primarily via aircraft with 89 or less seats and whose routes serve mainly as feeders to mainline carriers.

[13] Federal Aviation Administration, FAA Aerospace Forecast, Fiscal Years 2016-2036.

**Table 11 – FAA Aerospace Forecast: Revenue Passenger Enplanements**
For Fiscal Years 2008 Through 2028; In Millions

| FISCAL YEAR | U.S. MAINLINE CARRIERS | U.S. REGIONAL CARRIERS | TOTAL ENPLANEMENTS |
|---|---|---|---|
| **Historical** | | | |
| 2008 | 521.6 | 159.1 | 680.7 |
| 2009 | 476.8 | 154.0 | 630.8 |
| 2010 | 473.1 | 161.7 | 634.8 |
| 2011 | 488.4 | 161.7 | 650.1 |
| 2012 | 494.8 | 159.0 | 653.8 |
| 2013 | 498.0 | 155.5 | 653.5 |
| 2014 | 514.8 | 154.1 | 669.0 |
| 2015 | 543.4 | 153.0 | 696.4 |
| **Estimate** | | | |
| 2016 | 571.7 | 154.2 | 725.8 |
| **Forecast** | | | |
| 2023 | 649.1 | 174.7 | 823.8 |
| 2028 | 705.6 | 189.6 | 895.2 |
| **Compound Annual Growth Rate** | | | |
| 2008-15 | 0.6% | -0.6% | 0.3% |
| 2015-23 | 2.2% | 1.7% | 2.3% |
| 2023-28 | 1.7% | 1.7% | 1.9% |

Notes: Mainline carriers are defined as those providing service primarily via aircraft with 90 or more seats. Regionals are defined as those providing service primarily via aircraft with 89 or less seats and whose routes serve mainly as feeders to mainline carriers.

Source: Federal Aviation Administration, FAA Aerospace Forecast, Fiscal Years 2016-2036.

The FAA Aerospace forecast provides projections for U.S. cargo activity in terms of revenue ton miles (RTMs). The forecast is segmented by shipping method, all-cargo carriers or passenger carriers. The FAA Aerospace forecast estimates that RTMs will decline by 6.5 percent in 2016. Afterwards, all-cargo tonnage is expected to increase at a CAGR of 0.8 percent. Passenger cargo is expected to increase over the next five years but then decline over the subsequent seven years. Overall, this results in a 0.2 percent average annual increase in the national RTM through 2028.

The FAA forecasts[14] project the following trends in the U.S. GA industry from 2015 to 2036:

- The number of active GA aircraft is forecast to increase by 0.2 percent annually.
- Growth of 1.2 percent per annum is expected in the number of GA hours flown.
- The number of student pilots is expected to decline by 0.3 percent per annum through 2036.
- GA operations at airports with air traffic control service are forecast to increase by 0.3 percent annually through 2036.
- Business use of GA aircraft has experienced historically high growth rates and will continue to grow more rapidly than recreational use.

[14] Federal Aviation Administration, FAA Aerospace Forecast, Fiscal Years 2016-2036.

### 4.13.2 AIRBUS GLOBAL MARKET FORECAST

In an effort to forecast the demand of their aircraft, thus determining the number of aircraft they must manufacture, Airbus creates their Global Market Forecast (GMF). The GMF uses a number of factors including the economy, oil prices, population, personal income, and employment to determine passenger and cargo demand. The forecasts are provided on a world region basis.

Global passenger traffic, in terms of revenue passenger kilometres (RPK), is expected to increase at a CAGR of 4.5 percent over the next 20 years according to the most recent GMF. A majority of this growth will occur in developing markets rather than the mature U.S. market. Domestic U.S. passenger traffic is forecast to increase by 2.1 percent per annum through 2035.[15]

According to the most recent GMF, global air cargo, in terms of freight tonne kilometres (FTK), is expected to increase at a CAGR of 4.0 percent over the next 20 years. However, a majority of this growth will occur in African and Asian markets. Domestic U.S. air cargo is forecast to increase by 1.6 percent per annum through 2035.[16]

### 4.13.3 BOEING CURRENT MARKET OUTLOOK & WORLD AIR CARGO FORECAST

Boeing develops the Current Market Outlook (CMO) which focus mainly on passenger traffic and the World Air Cargo Forecast (WACF) which focuses entirely on cargo traffic in order to forecast the demand of their aircraft. Both the CMO and the WACF use a number of factors including the economy, oil prices, population, personal income, and employment to determine passenger and cargo demand. The forecasts are provided on a world region basis.

Global passenger traffic, in terms of RPK, is expected to increase at a CAGR of 4.8 percent over the next 20 years according to the most recent CMO. Passenger traffic within North American is forecast to increase by 2.6 percent per annum through 2035.[17]

According to the most recent WACF, global air cargo, in terms of revenue tonne kilometres (RTK), is expected to increase at a CAGR of 4.2 percent over the next 20 years. Domestic U.S. air cargo is forecast to increase by 2.2 percent per annum through 2035.[18]

15 Airbus, Global Market Forecast: Mapping Demand 2016/2036.
16 Airbus, Global Market Forecast: Mapping Demand 2016/2036.
17 Boeing, Current Market Outlook 2016-2035.
18 Boeing, World Air Cargo Forecast 2016-2035.

# 5.0 PASSENGER ACTIVITY FORECASTS

This section presents the forecast of enplaned passenger volumes for TUS through 2028 as well as a discussion of the methodology used to develop this forecast. The enplaned passengers forecast provides the critical path for the commercial passenger operations forecast which was derived based on assumptions related to average aircraft size and load factor.

## 5.1 METHODOLOGY

In an effort to develop the enplaned passenger forecast at TUS, a number of standard industry forecasting techniques were considered such as econometric regression modeling, trend analysis, market share, and time series. Econometric regression modeling quantifies the relationship between enplaned passengers and socio-economic variables. The first step in developing the enplaned passengers model was to test the independent, or explanatory, variables against the dependent variable. In order for an econometric model to be selected, the following has to be true:

- Adequate test statistics (i.e. high coefficient of determination ($R^2$) values and low p-values statistics), which indicate that the independent variables are good predictors of TUS traffic.
- Doesn't result in theoretical contradictions (e.g., the model indicates that GDP growth is negatively correlated with traffic growth).
- The results are not overly aggressive or conservative that are incompatible with historical averages.

A number of models were tested with a variety of the socio-economic indicators presented in this documents. Only one model provided reasonable test statistics with a $R^2$ equal to 83.77 and p-values less than 0.05 while not presenting theoretical contradictions. This model used Pima County's PCPI and the Airport's yield to estimate enplaned passengers. However, this model resulted in a CAGR of 3.1 percent from 2016 through 2028. Considering the Airport has not experienced growth of more than 1.8 percent in a single year since 2007, this model was determined to be overly aggressive.

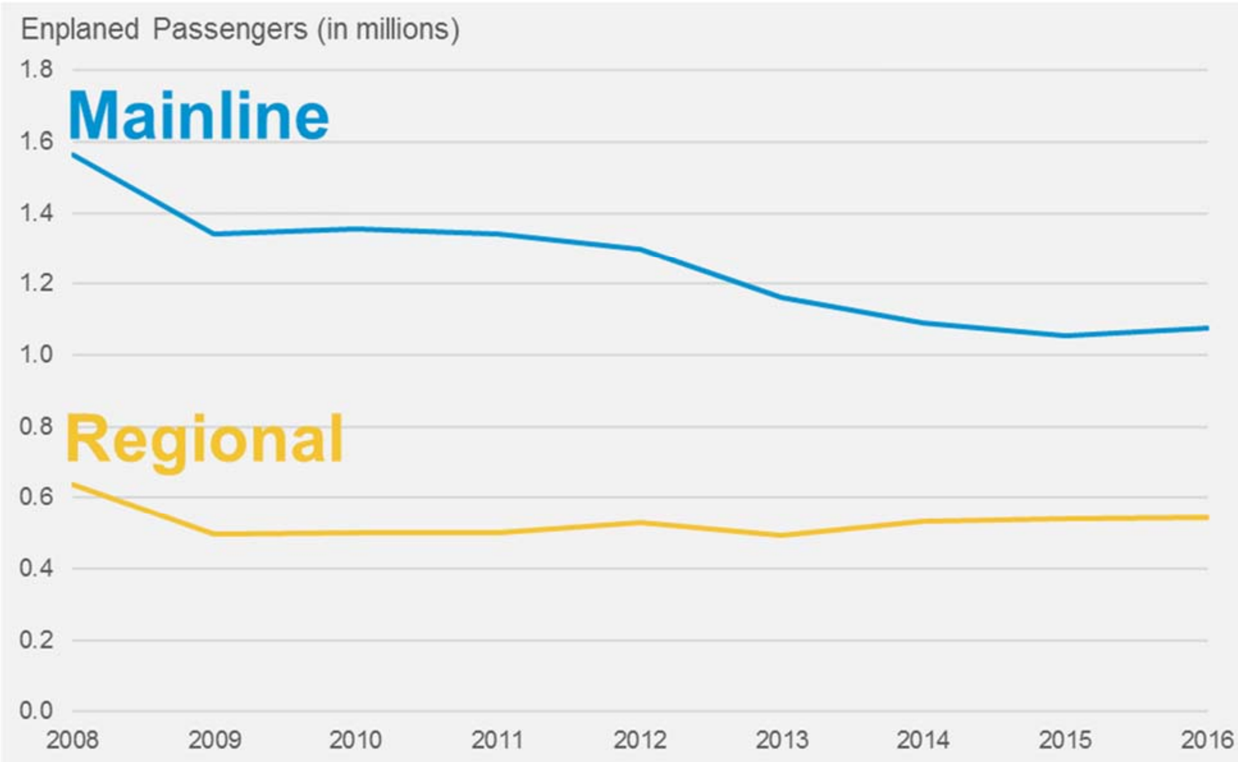
Other general methods to forecasting airport activity such as market share forecasting and time series modeling were examined. Market share forecasting is a simple top-down approach to forecasting where a regional forecast is produced and an assumption of the Airport's share of the activity is projected. However, it was determined that the nearest airports, PHX and IWA, were not close enough in proximity to validate utilizing this methodology. Additionally, time series modeling, which involves extrapolation of historical activity, resulted in a forecast that showed a decline in enplaned passengers. Given the projected growth in the economy and other key socio-economic factors in the region, this was considered unlikely.

Therefore, to determine the long-term forecast for enplaned passengers at TUS, the year-over-year growth rates for domestic RPM presented in the FAA Aerospace Forecast were applied to the historical enplaned passengers.

First, an estimate for the enplaned passengers for 2017 was developed. According to OAG, there are 0.4 percent more flights scheduled for 2017 than 2016. This increase in the number of flights combined with an increase in the average number of seats per operation for current service equates to a 3.5 percent increase in total seats from 2016 to 2017. It was assumed that the number of passengers for 2017 would increase at the same rate as the scheduled seats. Therefore, it is estimated that the Airport will handle 1.67 million passengers in 2017.

In order to apply the growth rates from the FAA Aerospace Forecast, the historical enplaned passengers were segmented into mainline carrier enplaned passengers (air carrier) and regional carrier enplaned passengers. Enplaned passengers departing on U.S. commercial air carriers and foreign flag carriers are considered mainline. Regional enplaned passengers are those passenger departing on airlines whose primary function is provide passenger feed to mainline carriers, regardless of aircraft size. Data from the U.S. Department of Transportation (DOT) Air Carrier Statistics database (T100) was used to estimate the split of mainline to regional carrier enplaned passengers from the Airport's historical enplaned passenger data. **Exhibit 13** depicts the historical trends in passenger traffic by airline classification (mainline and regional). It is clear that the recent decline in passenger traffic has occurred mainly with mainline airlines rather than their regional affiliates. This is partly attributed to the fact that Southwest Airlines, which does not have regional affiliates, has declined the most in this time.

**Exhibit 13 – Enplaned Passengers by Airline Classification**
For Fiscal Years 2006 Through 2016; In Millions




Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014.Tucson Airport Authority, 10 Year Passenger Statistics; Tucson Airport Authority, Monthly Activity Overview; U.S. Department of Transportation, Air Carrier Statistics database (T100).

## 5.2 SUMMARY OF THE ENPLANED PASSENGER FORECAST

Enplaned passengers at TUS are forecast to increase from 1.62 million in 2016 to 2.02 million in 2028, representing a CAGR of 1.86 percent. Enplaned passengers onboard air carriers are projected to increase at a slightly faster CAGR, 1.87 percent, than their regional affiliates, 1.85 percent, during this period. The results of the enplaned passenger forecast are presented in are **Table 12**.

**Table 12 – Enplaned Passenger Forecast**
For Fiscal Years 2008 Through 2028

| FISCAL YEAR | AIR CARRIER | REGIONAL | TOTAL ENPLANEMENTS |
|---|---|---|---|
| **Historical** | | | |
| 2008 | 1,565,945 | 636,428 | 2,202,373 |
| 2009 | 1,341,842 | 495,333 | 1,837,175 |
| 2010 | 1,354,562 | 501,053 | 1,855,615 |
| 2011 | 1,341,975 | 499,859 | 1,841,834 |
| 2012 | 1,297,599 | 528,447 | 1,826,046 |
| 2013 | 1,163,542 | 492,075 | 1,655,617 |
| 2014 | 1,089,738 | 531,493 | 1,621,231 |
| 2015 | 1,052,129 | 538,192 | 1,590,321 |
| 2016 | 1,073,875 | 544,429 | 1,618,304 |
| **Forecast** | | | |
| 2023 | 1,234,500 | 624,600 | 1,859,100 |
| 2028 | 1,341,900 | 678,000 | 2,019,900 |
| **Compound Annual Growth Rate** | | | |
| 2008-16 | -4.75% | -1.64% | -3.78% |
| 2016-23 | 2.01% | 1.98% | 2.00% |
| 2023-28 | 1.68% | 1.65% | 1.67% |

Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014.Tucson Airport Authority, 10 Year Passenger Statistics; Tucson Airport Authority, Monthly Activity Overview; U.S. Department of Transportation, Air Carrier Statistics database (T100). Federal Aviation Administration, FAA Aerospace Forecast, Fiscal Years 2016-2036.

# 6.0 AIR CARGO FORECAST

This section presents the forecast of air cargo tonnage. In a similar fashion to the enplaned passengers forecast, the air cargo forecast provides the critical path for the all-cargo operations forecast. Therefore, this section also provides estimates for the mode of transportation of the air cargo tonnage.

## 6.1 METHODOLOGY

A variety of methods were explored to forecast air cargo tonnage at TUS including econometric modeling and time series modeling. However, neither of these methods produced reasonable test results or realistic forecasts. Therefore, to determine the long-term forecast for air cargo tonnage at TUS, the year-over-year growth rates for RTMs presented in the FAA Aerospace Forecast were adopted. These rates were provided by mode of transportation.

## 6.2 SUMMARY OF THE AIR CARGO TONNAGE FORECAST

Cargo tonnage at TUS is forecast to increase from 30,962 metric tons in 2016 to 33,670 metric tons in 2028, representing a CAGR of 0.70 percent. Cargo tonnage onboard dedicated freighter aircraft is projected to increase at a CAGR of 0.72 percent while air cargo onboard passenger aircraft is projected to decline at a CAGR of 0.09 percent during this period. The results of the cargo tonnage forecast are presented in **Table 13**.

**Table 13 – Cargo Tonnage Forecast**
For Fiscal Years 2008 Through 2028 – Metric Tons

| FISCAL YEAR | ALL-CARGO | PASSENGER | TOTAL CARGO TONNAGE |
|---|---|---|---|
| **Historical** | | | |
| 2008 | 36,712 | 1,763 | 38,475 |
| 2009 | 29,898 | 1,518 | 31,416 |
| 2010 | 33,143 | 1,547 | 34,690 |
| 2011 | 29,485 | 1,326 | 30,811 |
| 2012 | 34,461 | 1,261 | 35,722 |
| 2013 | 33,157 | 1,030 | 34,187 |
| 2014 | 31,597 | 809 | 32,406 |
| 2015 | 32,116 | 990 | 33,107 |
| 2016 | 30,022 | 940 | 30,962 |
| **Forecast** | | | |
| 2023 | 32,470 | 960 | 33,430 |
| 2028 | 32,740 | 930 | 33,670 |
| **Compound Annual Growth Rate** | | | |
| 2008-16 | -2.48% | -7.56% | -2.68% |
| 2016-23 | 1.13% | 0.30% | 1.10% |
| 2023-28 | 0.17% | -0.63% | 0.14% |

Sources: Tucson Airport Authority, Comprehensive Annual Financial Report Years Ended September 30, 2015 and 2014. Tucson Airport Authority, Monthly Activity Overview; Federal Aviation Administration, FAA Aerospace Forecast, Fiscal Years 2016-2036.

# 7.0 AIRCRAFT OPERATIONS FORECAST

The section describes the methodology and the results of the aircraft operations forecast at TUS. Aircraft operations, defined as aircraft arrivals plus departures, were forecast separately for the five major categories: (1) commercial passenger, (2) all-cargo, (3) on-demand/limited service air taxi, (4) general aviation, and (5) military. These components are then aggregated to derive a total aircraft operations forecast for TUS.

## 7.1 PASSENGER AIRCRAFT OPERATIONS FORECAST

The number of passenger aircraft operations at an airport depends on three factors: (1) total passengers, (2) average aircraft size, and (3) average load factor (percent of seats occupied). The relationship is shown in the equation below.

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

This relationship permits literally infinite combinations of load factors, average aircraft size, and operations to accommodate a given number of passengers. In order to develop reasonable load factor and average number of seats per aircraft (average aircraft size) assumptions, commercial passenger operations were disaggregated into categories of activity (i.e., mainline and regional activity).

The fundamental approach to deriving the passenger operations forecast is essentially the same at all airports. However, the underlying assumptions at each airport are inherently different due to differences in how airlines choose to serve the demand for air travel to, from, and over each airport. These differences may result, for example, from a strategic focus on unit revenue versus unit costs, or an emphasis on a hub and spoke system versus a point-to-point operation.

A number of sources were used to develop the historical passenger operations, load factor, and average number of seats per aircraft data. The Official Airline Guide; FAA, Air Traffic Activity Data System (ATADS); and U.S. Department of Transportation (U.S. DOT), Schedule T 100 data were used to develop total departures and seats for each segment. Average seats per departure (ASPD) for each of the major groups of passenger activity was calculated from total departures and total departing seats. Aircraft load factors were calculated for each group of passenger operations by dividing total enplaned passengers by total departing seats. To calculate total operations, the total number of departures was multiplied by a factor of two.

### 7.1.1 PASSENGERS PER OPERATION

The average number of seats per aircraft for each category of activity is directly related to the type of aircraft being utilized at the Airport. There are five mainline carriers at TUS and in order to estimate the future average number of seats per aircraft, the fleet plans for these carriers were examined. The following is a description of the current fleet plans for each of the mainline carriers with a focus on potential changes at TUS:

- **American Airlines:** Currently, American Airlines is primarily utilizing the Boeing MD-80 and MD-83 aircraft at TUS. These aircraft are expected to be retired by the end of 2018. These aircraft will initially be replaced with American Airlines' existing Boeing 737-800 and Airbus A319 aircraft. American Airlines has 100 orders for the Boeing 737 Max8 aircraft with deliveries set to begin in 2017. The aircraft will likely be utilized interchangeably with the Boeing 737-800 aircraft.
- **Alaska Airlines:** The Boeing 737-900 aircraft is currently the most used aircraft by Alaska Airlines at TUS but the airline also uses the Boeing 737-800 aircraft. Currently, Alaska Airlines has orders for the Boeing 737 Max7 and Boeing 737 Max8 aircraft. When delivered, these aircraft will be used in addition to their current fleet.
- **Delta Air Lines:** Delta Air Lines uses the Boeing MD-90 as their primary aircraft at TUS. The Boeing MD-90 is expected to remain in the fleet in some capacity over the forecast period. However, Delta Air Lines does utilize some Boeing 757 aircraft for operations at TUS. The older Boeing 757 aircraft are expected to be retired and the Airbus A321-200 will act as its replacement. The airline will also begin utilizing the Bombardier CS100 where applicable.
- **United Airlines:** The Airbus A319-200 aircraft handles most of the operations of United Airlines at TUS. Although United Airlines has orders for the Boeing 737 Max9 aircraft, it is not expected that United Airlines will materially adjust their fleet at TUS.
- **Southwest Airlines:** The Southwest Airlines' Boeing 737-700 aircraft is the most used aircraft at TUS. The aircraft accounted for more than a third of the total scheduled passenger operations in 2016. The Boeing 737-300 in Southwest Airlines' fleet are to be retired by the end of 2017. It is expected that the airline will fill the demand with their current fleet of Boeing 737-800 and Boeing 737-700 aircraft. Currently, Southwest Airlines has a number of Boeing 737 Max8 and Boeing 737 Max7 aircraft on order. It is expected these aircraft will handle some of the service at TUS as soon as deliveries are made which are expected to begin in 2017 for the Boeing 737 Max8 and 2019 for the Boeing 737 Max7.

A majority of operations at TUS are conducted by the mainline airlines' regional affiliates. Small regional jets are being retired at an accelerated rate as the airlines believe these aircraft are too expensive to fly. As such, it is expected that the small regional aircraft will be nearly extinct at TUS within the next five years . In 2016, the Canadair Regional Jet CRJ200 aircraft was the most popular regional aircraft at TUS. It is expected that this aircraft will be replaced by the larger Canadair Regional Jet CRJ700 and the Embraer 175 aircraft. According to OAG, the Canadair Regional Jet CRJ200 aircraft will account for 17.7 percent of the scheduled regional aircraft in 2017, down from 35.3 percent in 2016. Both SkyWest Airlines and Trans States Airlines have orders for the Mitsubishi MRJ90 aircraft and are expected to begin entering service in 2018. This aircraft will be used interchangeably with the Canadair Regional Jet CRJ700 and the Embraer 175 aircraft. The international service provided by Aeromar started with the 46-seat ATR-42 aircraft. However, current schedules show that this is expected to be replaced with the airline's 68-seat ATR-72 aircraft by year-end 2017.

The aircraft changes over the next several years are going to result in an increase in the average number of seats per aircraft at the airport. The expected growth in the average number of seats per aircraft is likely to have a negative impact on load factors until the passenger demand growth exceeds the increase in seat capacity, particularly for regional aircraft as the small regional aircraft are removed from the fleet. **Table 14** provides the assumptions of aircraft average number of seats per aircraft and load factors by airline category.

**Table 14 – Passengers Per Operation Assumptions**
For Fiscal Years 2016 Through 2028

| FISCAL YEAR | AVERAGE NUMBER OF SEATS PER AIRCRAFT | | | LOAD FACTOR | |
|---|---|---|---|---|---|
| | MAINLINE | REGIONAL | | MAINLINE | REGIONAL |
| **Historical** | | | | | |
| 2016 | 146.8 | 65.1 | | 80.1% | 81.9% |
| **Forecast** | | | | | |
| 2023 | 151.5 | 72.3 | | 80.0% | 80.0% |
| 2028 | 151.6 | 72.8 | | 80.0% | 81.0% |

Sources: Tucson Airport Authority, Monthly Activity Overview; OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum & Brown analysis.

### 7.1.2 PASSENGER AIRCRAFT OPERATIONS FORECAST

The aircraft size and load factor assumptions were applied to the enplaned passenger forecast to derive a forecast of passenger aircraft departures which was multiplied by two to determine total operations. Based on these assumptions, passenger aircraft operations are forecast to increase from an 38,674 in 2016 to 45,120 in 2028, representing a CAGR of 1.29 percent per year. **Table 14** displays the results of the passenger operations forecast by airline category.

**Table 15 – Passenger Aircraft Operations Forecast**
For Fiscal Years 2016 Through 2028

| FISCAL YEAR | MAINLINE AND LARGE REGIONAL | SMALL REGIONAL | TOTAL |
|---|---|---|---|
| **Historical** | | | |
| 2016 | 30,984 | 7,690 | 38,674 |
| **Forecast** | | | |
| 2023 | 41,880 | 0 | 41,880 |
| 2028 | 45,120 | 0 | 45,120 |
| **Compound Annual Growth Rate** | | | |
| 2016-23 | 4.40% | -100.0% | 1.14% |
| 2023-28 | 1.50% | n.a. | 1.50% |

Sources: Tucson Airport Authority, Monthly Activity Overview; OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum & Brown analysis.

### 7.1.3 PASSENGER AIRLINE FLEET MIX FORECAST

The fleet mix forecasts were developed to match the average number of seats per aircraft assumptions for each airline category. The fleet mix forecasts also allowed for the calibration of the average number of seats per aircraft and load factor assumptions and, where appropriate, modifications were made prior to finalizing the average number of seats per aircraft and load factor assumptions. The allocation of commercial passenger airline operations by aircraft type is shown in **Table 16**.

**Table 16 – Passenger Aircraft Fleet Mix Forecast**
For Fiscal Years 2016 Through 2028

| AIRCRAFT | AVERAGE NUMBER OF SEATS PER AIRCRAFT | HISTORICAL | FORECAST | |
|---|---|---|---|---|
| | | 2016 | 2023 | 2028 |
| **Mainline** | | **18,254** | **20,360** | **22,120** |
| ***Narrow-Body*** | | ***18,254*** | ***20,360*** | ***22,120*** |
| Airbus A321-200 | 192 | 0 | 122 | 178 |
| Boeing 737 Max9 | 189 | 0 | 48 | 52 |
| Boeing 757-200, -300 | 183 | 130 | 42 | 0 |
| Boeing 737 Max8 | 182 | 0 | 530 | 752 |
| Boeing 737-900 | 181 | 664 | 710 | 772 |
| Boeing 737-800 | 171 | 1,606 | 6,548 | 6,934 |
| Boeing MD-90 | 160 | 1,536 | 1,620 | 1,716 |
| Airbus A320 | 157 | 80 | 100 | 108 |
| Boeing 737 Max7 | 155 | 0 | 244 | 442 |
| Boeing 737-700 | 143 | 6,702 | 8,386 | 8,940 |
| Boeing 737-300 | 142 | 1,632 | 0 | 0 |
| Boeing MD-80, -83, -88 | 140 | 5,554 | 0 | 0 |
| Airbus A319 | 128 | 350 | 1,888 | 2,048 |
| Bombardier CS100 | 108 | 0 | 122 | 178 |
| **Regional** | | **20,420** | **21,520** | **23,000** |
| ***Large Regional*** | | ***12,730*** | ***21,520*** | ***23,000*** |
| Canadair Regional Jet 900 | 77 | 5,748 | 4,992 | 5,336 |
| Embraer 175 | 76 | 2,958 | 3,616 | 3,866 |
| Mitsubishi MRJ90 | 76 | 0 | 552 | 592 |
| Canadair Regional Jet 700 | 70 | 4,024 | 11,940 | 12,786 |
| ATR 72 | 68 | 0 | 420 | 420 |
| ***Small Regional*** | | ***7,690*** | ***0*** | ***0*** |
| Canadair Regional Jet 200 | 50 | 7,200 | 0 | 0 |
| Embraer RJ145 | 50 | 490 | 0 | 0 |
| **Grand Total** | | **38,674** | **41,880** | **45,120** |

Sources: Tucson Airport Authority, Monthly Activity Overview; OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum & Brown analysis.

## 7.2 ALL-CARGO AIRCRAFT OPERATIONS FORECAST

The all-cargo aircraft operations forecast was derived from the air cargo tonnage forecast in a similar fashion as passenger aircraft operations are derived from the passenger forecast. The all-cargo aircraft operations are a product of the all-cargo volume from the air cargo forecast and assumed average air cargo tons per operation.

### 7.2.1 TONS PER OPERATION

A majority of the all-cargo operations, 54.1 percent, are handled by Ameriflight. The most common aircraft used by Ameriflight is the Beechcraft 1900 followed by the Beechcraft Model 99. The Beechcraft 1900 can carry up to 2.9 tons while the Beechcraft Model 99 can only handle up to 1.8 tons. The size of the aircraft limits the airline's capacity. Ameriflight is not expected to change their fleet over the forecast period.

FedEx handles the remaining scheduled air cargo service. FedEx uses a fleet of air carrier aircraft at TUS, primarily the Boeing 767-300 aircraft. The other aircraft, such as the Airbus A300-600, currently in use by FedEx at TUS are expected to be retired over the next few years. They will be replaced with new Boeing 767-300 aircraft currently on order.

In 2016, air cargo operators at TUS averaged approximately 14.1 tons of air cargo per flight. As detailed above, the air cargo airlines at TUS are not expected to materially change fleet through the forecast period. Therefore, the overall capacity at the airport is not expected to materially change in the future. However, it appears that there is plenty of room for growth based on aircraft payloads. As such, it was assumed that the average tons per operation would increase to 14.7 tons per operation in 2028.

### 7.2.2 ALL-CARGO AIRCRAFT OPERATIONS FORECAST

All-cargo aircraft operations are forecast to increase from 2,126 in 2016 to 2,230 operations in 2028, averaging growth of 0.4 percent per year.

### 7.2.3 ALL-CARGO FLEET MIX FORECAST

It is not expected that the overall mix of all-cargo aircraft will change materially over the forecast period. Ameriflight is expected to continue to deploy a mix of commuter aircraft while FedEx is expected to rely solely on the Boeing 767-300 aircraft. The allocation of all-cargo operations by aircraft type is shown in **Table 17**.

**Table 17 – All-Cargo Aircraft Fleet Mix Forecast**
For Fiscal Years 2016 Through 2028

| AIRCRAFT | PAYLOAD | HISTORICAL | FORECAST | |
|---|---|---|---|---|
| | | 2016 | 2023 | 2028 |
| **Mainline** | | **976** | **1,020** | **1,024** |
| Boeing 767-300 | 58.1 | 922 | 1,020 | 1,024 |
| Boeing 757-200 | 36.1 | 2 | 0 | 0 |
| Boeing MD-11 | 92.4 | 2 | 0 | 0 |
| Airbus A300-600 | 60.1 | 50 | 0 | 0 |
| **Regional** | | **1,150** | **1,200** | **1,206** |
| Beechcraft 1900 | 2.9 | 62 | 64 | 66 |
| Piper PA-31 | 0.9 | 500 | 522 | 524 |
| Embraer 120 | 4.0 | 550 | 574 | 576 |
| Swearingen 227 | 2.5 | 38 | 40 | 40 |
| **Grand Total** | | **2,126** | **2,220** | **2,230** |

Sources: Tucson Airport Authority, Monthly Activity Overview; Landrum & Brown analysis.

# 7.3 OTHER AIRCRAFT OPERATIONS FORECAST

## 7.3.1 ON-DEMAND/LIMITED SERVICE AIR TAXI OPERATIONS

The on-demand/limited service air taxi category represents chartered aircraft operated by companies that operate under Part 91[19] (i.e., not certificated as a scheduled air carrier by the FAA and not covered under Part 121[20]). At TUS there are two basic varieties of on-demand/limited service air taxi service, one variant which provides additional service for existing commercial operations and the other variant provides ad-hoc business charters.

Sierra Pacific Airlines, based at TUS, provides passenger charters for other airlines as well as for the U.S. military and U.S. Marshals Service. Additionally, there are airlines that provide on-demand cargo charter services such as Kalitta Air. These airlines utilize larger air carrier aircraft such as variants of the Boeing 737 aircraft.

Business charters at TUS, such as NetJets and Bombardier Business Jet Solutions, provide ad-hoc service utilizing mostly business jet aircraft. These airlines account for a majority of the on-demand/limited service air taxi service at TUS.

Since a majority of the on-demand/limited service air taxi service at TUS are operated using jet aircraft, the year-over-year growth rates for air taxi hours flown for turbo jet aircraft from the FAA Aerospace Forecast were applied to the historical number of aircraft operations. The result is that on-demand/limited service air taxi operations would increase from 9,629 in 2016 to 14,090 in 2028, representing a CAGR of 3.2 percent. **Table 18** provides the on-demand/limited service air taxi forecast by aircraft type.

**Table 18 – On-Demand/Limited Service Air Taxi Aircraft Fleet Mix Forecast**
For Fiscal Years 2016 Through 2028

| AIRCRAFT TYPE | EXAMPLE AIRCRAFT | HISTORICAL | FORECAST | |
|---|---|---|---|---|
| | | 2016 | 2023 | 2028 |
| **Air Carrier** | **Boeing 737-200** | **928** | **1,150** | **1,340** |
| **Air Taxi/Commuter** | | **8,701** | **11,000** | **12,750** |
| Business Jets | Bombardier Challenger 600 | 5,898 | 8,150 | 9,860 |
| Turboprops | Pilatus PC-12 | 1,571 | 1,670 | 1,750 |
| Pistons | Cessna 172 | 1,232 | 1,180 | 1,140 |
| **Grand Total** | | **9,629** | **12,150** | **14,090** |

Sources: FAA Aerospace Forecast; Radar Data; Tucson Airport Authority, Monthly Activity Overview; Landrum & Brown analysis.

[19] 14 Code of Federal Regulations Part 91
[20] 14 Code of Federal Regulations Part 121

### 7.3.2 GENERAL AVIATION OPERATIONS

There are a number of approaches to developing GA operations forecasts ranging from econometric, trend or time series, and market share forecasts. During the forecast development, no reasonable fit of the GA operations to time or socio-economic variables was found. Nationally, the FAA's Aerospace Forecasts projects the following growth rates by aircraft type:

- **Jets:** Increase 2.3 percent per annum from 2016 through 2028
- **Turboprops:** Increase 0.5 percent per annum from 2016 through 2028
- **Pistons:** Decrease 0.7 percent per annum from 2016 through 2028
- **Other/Helicopters:** Increase 1.4 percent per annum from 2016 through 2028[21]

FAA radar flight track data for aircraft operations at TUS was evaluated for 2016. The radar data provided insight to the type of aircraft used for itinerant operations at the Airport. Itinerant operations were segmented into aircraft categories based on the radar data. However, the radar data fails to account for a majority of the local traffic at the Airport. There are a number of flight schools at the Airport which constitutes a large portion of the local traffic at the Airport. These flight schools typically use single-engine piston aircraft for pilot training which is the predominate aircraft based at the Airport. Therefore, it was assumed the local operations in 2016 were conducted by a mix of aircraft similar to that of the based aircraft at the Airport.

These national trends were accounted for in the context of the aircraft fleet that operates at TUS. As such, the piston segment is expected to decline over the forecast period, while the jet segment is expected to experience the fastest rate of growth. **Table 19** displays the GA operations forecast by aircraft category.

**Table 19 – General Aviation Aircraft Fleet Mix Forecast**
For Fiscal Years 2016 Through 2028

| AIRCRAFT TYPE | EXAMPLE AIRCRAFT | HISTORICAL | FORECAST | |
|---|---|---|---|---|
| | | 2016 | 2023 | 2028 |
| Jets | Cessna 525 CitationJet | 12,105 | 14,150 | 15,820 |
| Turboprops | Beech 200 Super King Air | 10,743 | 11,150 | 11,450 |
| Pistons | Cessna 172 | 36,403 | 34,600 | 33,360 |
| Other/Helicopters | Bell 206 | 2,901 | 3,200 | 3,440 |
| **Grand Total** | | **62,152** | **63,100** | **64,070** |

Sources: FAA Aerospace Forecast; Radar Data; Tucson Airport Authority, Monthly Activity Overview; Landrum & Brown analysis.

[21] Includes helicopters, experimental, sport, and other aircraft.

### 7.3.3 MILITARY OPERATIONS

Military operations are aircraft operations by military and other governmental units. TUS supports the 162nd Wing of the Air National Guard, which conducts the largest training operation for the F-16 aircraft. As such, military operations at TUS constitute a significant portion of the traffic at the Airport. In calendar year 2016, there were 27,690 military aircraft operations. Military operations are expected to reach 32,000 in 2019 as a result of an increase in the Taiwanese F-16 training operations and remain at this level for the remainder of the forecast period. It is expected that the F-16 aircraft will remain the predominate military aircraft at TUS through the forecast period.

## 7.4 TOTAL AIRCRAFT OPERATIONS FORECAST

The total aircraft operations forecast is the aggregation of the passenger, all-cargo, on-demand/limited service air taxi, general aviation, and military aircraft operations. Total aircraft operations are forecast to increase from 140,271 operations in 2016 to 157,510 operations in 2028, representing a CAGR of 0.97 percent. **Table 20** provides the aircraft operations by segment through the forecast period.

**Table 20 – Total Aircraft Operations Forecast**
For Fiscal Years 2016 Through 2028

| FISCAL YEAR | PASSENGER | ALL-CARGO | AIR TAXI | GENERAL AVIATION | MILITARY | TOTAL |
|---|---|---|---|---|---|---|
| **Historical** | | | | | | |
| 2016 | 38,674 | 2,126 | 9,629 | 62,152 | 27,690 | 140,271 |
| **Forecast** | | | | | | |
| 2023 | 41,880 | 2,220 | 12,150 | 63,100 | 32,000 | 151,350 |
| 2028 | 45,120 | 2,230 | 14,090 | 64,070 | 32,000 | 157,510 |
| **Compound Annual Growth Rate** | | | | | | |
| 2016-23 | 1.14% | 0.62% | 3.38% | 0.22% | 2.09% | 1.09% |
| 2023-28 | 1.50% | 0.09% | 3.01% | 0.31% | 0.00% | 0.80% |

Note: Military operations for 2016 reflect the calendar year versus fiscal year per FAA direction.

Sources: Tucson Airport Authority, Monthly Activity Overview; OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum & Brown analysis.

# 8.0 PEAK PERIOD ANALYSIS

The traffic demand patterns imposed upon an airport are subject to seasonal, monthly, daily, and hourly variations. Peaking characteristics are critical in the assessment of existing facilities and airfield components to determine their ability to accommodate forecast increases in passenger and operational activity throughout the forecast period. The objective of developing forecasts is to provide a design level that allows for sizing facilities so they are neither underutilized nor overcrowded too often.

The annual passenger and operations forecasts for TUS were converted into peak month, daily, and peak hour equivalents. The peak period aircraft operations forecasts were developed for passenger, air cargo, on-demand/limited service air taxi, general aviation, military, and total aircraft operations.

## 8.1 MONTHLY SEASONALITY

Monthly enplanement data from the Airport were used to determine the peak month for enplaned passengers. The Airport's busy period for enplaned passengers extends from February through May. Since 2007, March has consistently been the busiest month of the year, averaging 9.7 percent of the annual enplaned passengers. **Table 21** provides the monthly enplaned passengers as a percent of the annual total. March has also typically been the peak month for total aircraft operations at the Airport, averaging 9.3 percent of the annual aircraft operations since 2013. Therefore, March was used as the basis for developing peak period forecasts for enplaned passengers and aircraft operations.

During the peak month of 2016 there were 12,976 total aircraft operations. According to the Airport's records, the operations were broken down by category in the following manner:

- **Passenger:** 3,588 aircraft operations
- **All-Cargo:** 194 aircraft operations
- **On-Demand/Limited Service Air Taxi:** 974 aircraft operations
- **Military:** 2,442 aircraft operations
- **General Aviation:** 5,778 aircraft operations

**Table 21 – Percent of Enplaned Passengers by Month**
For Fiscal Years 2007 Through 2016

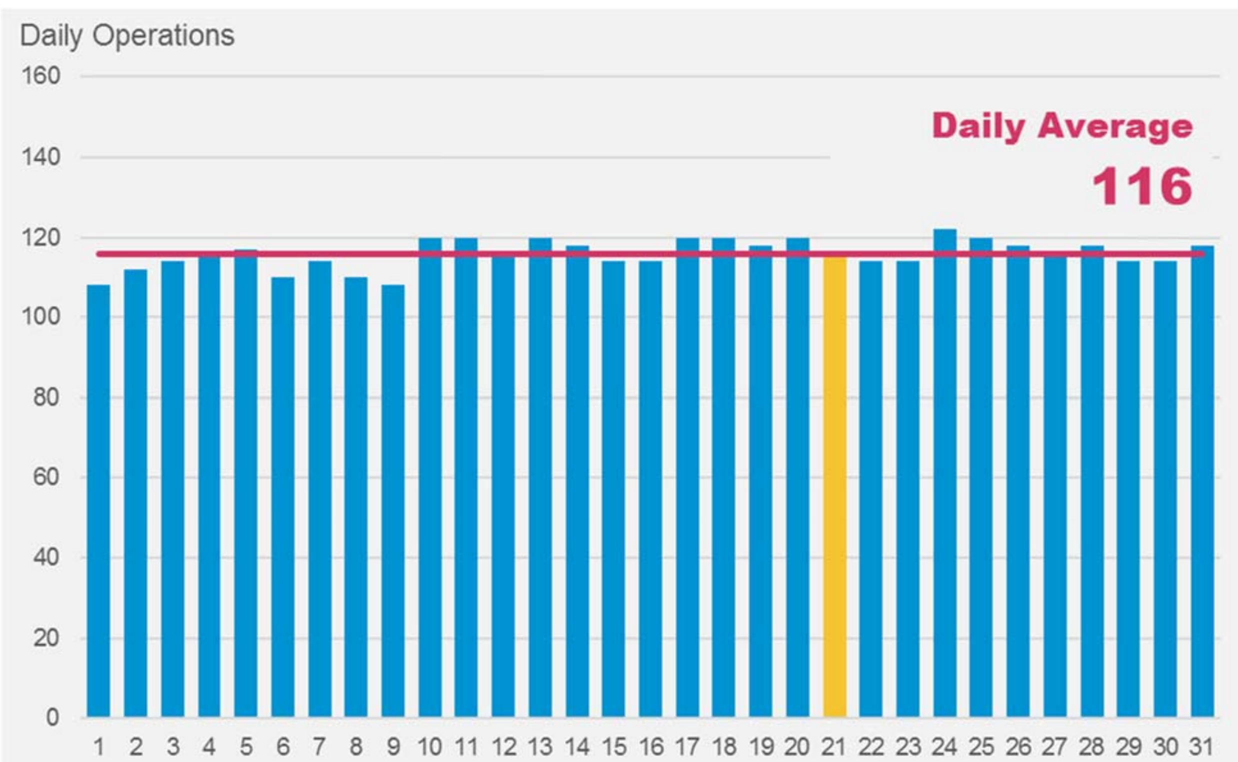
| YEAR | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | 8.0% | 8.2% | 8.2% | 7.6% | 8.2% | 9.6% | 9.3% | 9.0% | 8.4% | 8.2% | 7.9% | 7.4% |
| 2008 | 8.7% | 8.6% | 8.3% | 7.8% | 8.9% | 10.0% | 9.0% | 9.0% | 8.1% | 8.0% | 7.2% | 6.4% |
| 2009 | 9.0% | 8.3% | 8.7% | 7.6% | 8.2% | 9.2% | 9.0% | 9.0% | 8.1% | 8.2% | 7.4% | 7.2% |
| 2010 | 8.4% | 8.1% | 8.3% | 7.5% | 8.3% | 9.8% | 9.2% | 9.0% | 8.2% | 8.1% | 7.5% | 7.5% |
| 2011 | 8.9% | 8.5% | 8.5% | 7.6% | 8.3% | 9.3% | 8.8% | 9.1% | 8.2% | 7.9% | 7.3% | 7.6% |
| 2012 | 8.5% | 8.6% | 8.4% | 7.6% | 8.6% | 9.8% | 9.0% | 8.9% | 8.0% | 7.7% | 7.6% | 7.3% |
| 2013 | 9.0% | 9.0% | 8.9% | 7.7% | 8.4% | 9.6% | 8.9% | 9.2% | 7.8% | 7.4% | 7.2% | 6.9% |
| 2014 | 8.4% | 8.2% | 8.6% | 7.5% | 8.1% | 9.8% | 9.3% | 9.4% | 8.1% | 7.9% | 7.4% | 7.2% |
| 2015 | 8.8% | 8.5% | 8.7% | 7.7% | 8.4% | 9.9% | 9.4% | 9.1% | 7.8% | 7.5% | 7.0% | 7.2% |
| 2016 | 8.4% | 8.4% | 8.6% | 7.9% | 8.6% | 9.8% | 8.9% | 9.2% | 8.0% | 7.6% | 7.0% | 7.6% |

Sources: Tucson Airport Authority, Monthly Activity Overview; Landrum & Brown analysis.

## 8.2 DAILY VARIATION

The FAA recommends the use of the average day of the peak month, typically referred to as the peak month average day (PMAD), for purposes of physical planning. The PMAD is the day that most closely represents the average day in the peak month. As demonstrated above, the peak month for enplaned passenger and total aircraft operations for TUS is March. Seating data from OAG was used as a proxy to determine the PMAD as passenger data was not available at the daily level. On a daily basis, there is very little variation in both the number of passenger aircraft operations and the number of seats. The average number of daily passenger aircraft operations for March 2016 was 116 while the average number of daily seats was 12,119. Monday, March 21, 2016 was determined to be the PMAD for TUS as the number of passenger aircraft operations matched the daily average for the month and seats were just 105 fewer than the daily average for the month. **Exhibit 14** provides the daily passenger aircraft operations for the month of March 2016.

**Exhibit 14 – Daily Passenger Aircraft Operations**
For March 2016




Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum & Brown analysis.

## 8.3 DESIGN DAY FLIGHT SCHEDULES (DDFS)

DDFS for 2016 and 2017 were developed to determine the hourly profile of the traffic at the Airport. In order to develop DDFSs that are representative of the traffic at the Airport, a combination of OAG schedules and historical radar data was used.

OAG schedules for the design day provided the passenger aircraft operations. The passenger flight schedule for March 21, 2016 was used for the 2016 DDFS while the passenger flight schedule for March 20, 2017 was used for the 2017 DDFS. The 2017 DDFS was created to identify any changes in service that are scheduled to occur at the Airport. The passenger aircraft operations from OAG were supplemented with information from radar data for the cargo, GA, and military aircraft operations.

All-cargo aircraft operations typically occur during the weekdays. According to radar data, there were an average of seven all-cargo aircraft operations during weekdays in March 2016. On March 21, 2016 there were seven recorded all-cargo aircraft operations (three arrivals and four departures). However, the all-cargo aircraft operations were nearly all Ameriflight. In order to better reflect the overall demand on the Airport, eight all-cargo aircraft operations from another day which represented an even mix of Ameriflight and FedEx aircraft operations were included in the DDFS for 2016.

The radar data recorded 835 of the 974 on-demand/limited service air taxi aircraft operations. In order to scale the number of aircraft operations in the design day, the percent of aircraft operations for the month that occur during the design day according to the radar data (3.7 percent) was multiplied by the true number of aircraft operations for the month. This results in 36 on-demand/limited service air taxi aircraft operations during the design day.

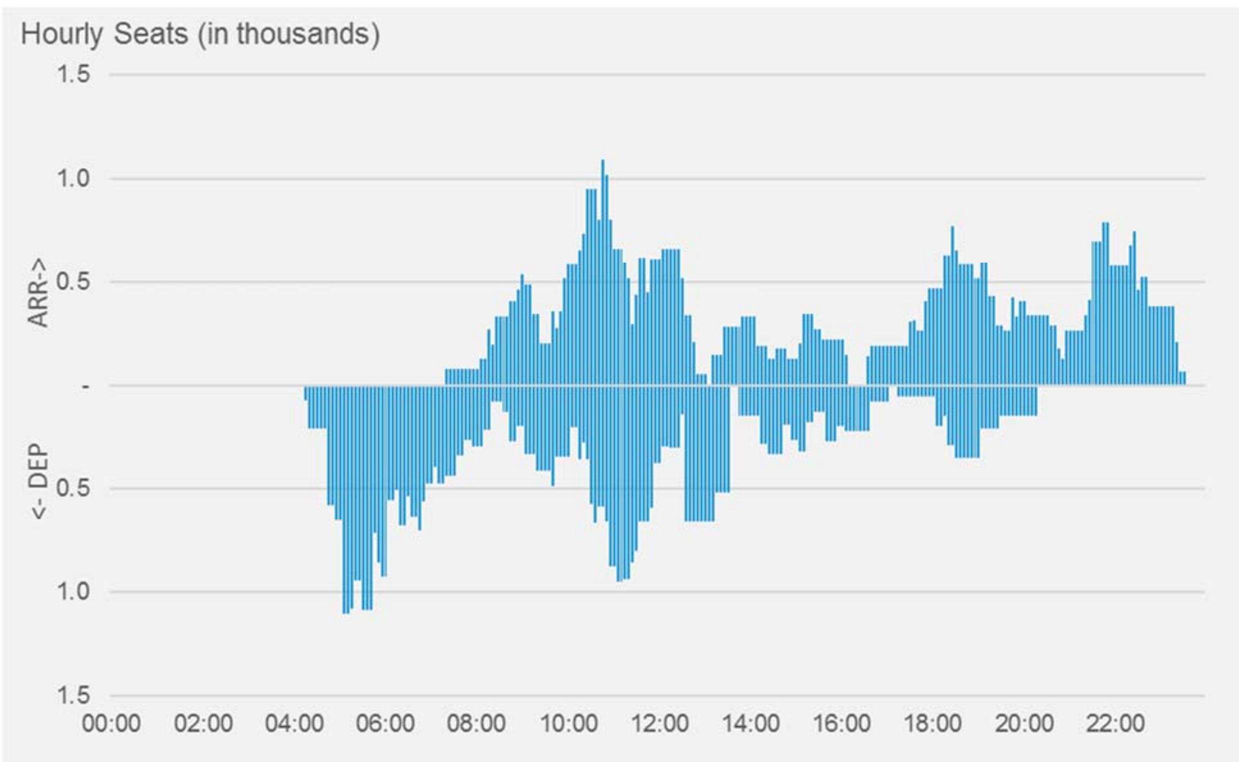
The radar data is missing a significant portion of military and GA aircraft operations, as the training departures utilizing the F-16 Fighting Falcon aircraft were not available in the data. In order to rectify this, a similar methodology was applied to the military aircraft arrivals as the on-demand/limited service air taxi operations. The typical F-16 Fighting Falcon training flight of these aircraft includes the aircraft departing from the Airport, pilots performing their training, and then the aircraft arriving at the Airport. It was assumed that the training would average one and a half hours, so for each arrival a departure was added to the DDFS with a time one and a half hour prior to arrival. The result of this methodology resulted in 108 military aircraft operations in the DDFS for 2016.

A number of itinerant and a significant portion of local GA aircraft operations are not captured in the radar data. Using a methodology similarly to the on-demand/limited service air taxi aircraft operations, 184 GA aircraft operations should be in the DDFS for 2016.

## 8.4 HOURLY PROFILES

The DDFS were analyzed to determine the hourly profile at the Airport to identify the periods of time that traffic is most concentrated. Using a clock hour as the basis for peak periods does not allow for peak periods of traffic that occur across clock hours to be identified. Therefore, a rolling 60-minute hour approach was used to determine the design day profile. In this case, aircraft operations were categorized into one of the 288 five-minute buckets that occur during a given day. The sum of twelve sequential buckets represents a rolling 60-minute hour. **Exhibit 15** provides the commercial passenger seats for rolling 60-minute hours for the 2016 DDFS. **Exhibit 16** provides the aircraft operations for rolling 60-minute hours for the 2016 DDFS.

**Exhibit 15 – Rolling 60-Minute Seats Profile**
For March 21, 2016

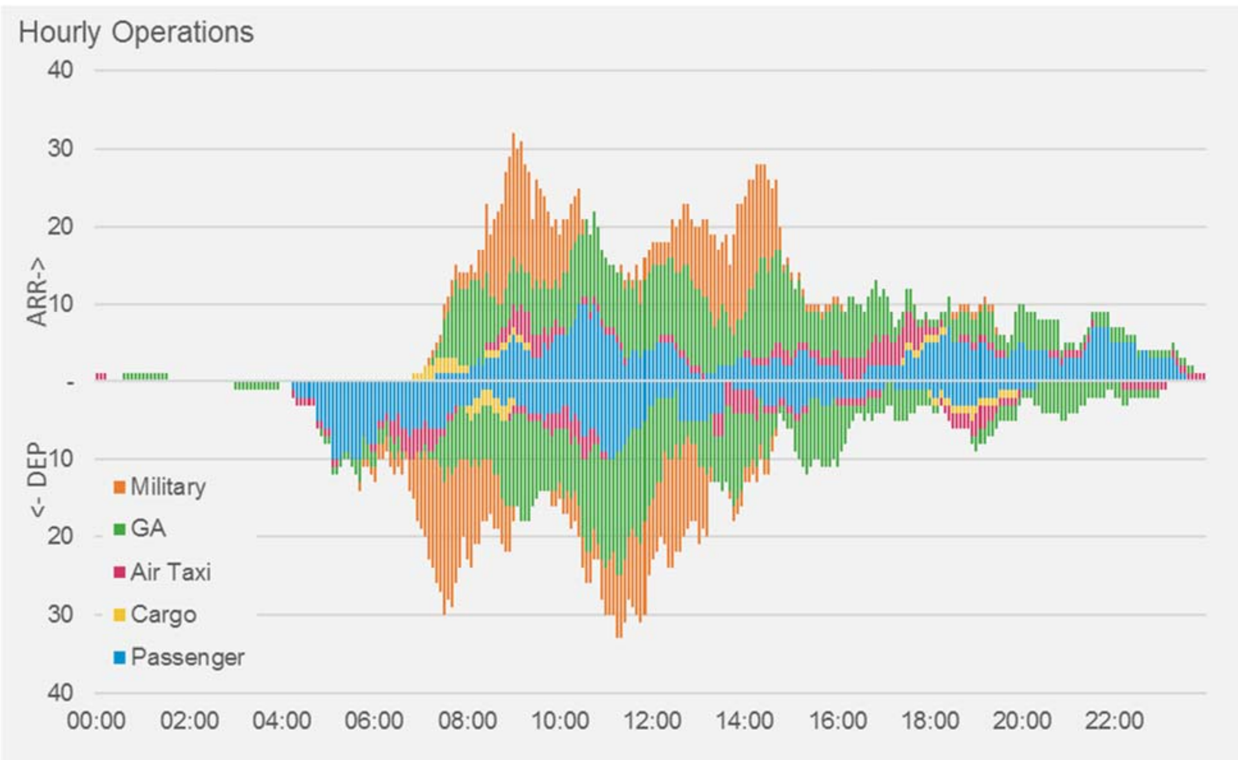



Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Radar Data; Landrum & Brown analysis.

# 8.5 DERIVATIVE FORECAST

Information regarding the peak month, average day, and peak hour were used to formulate metrics to determine the peak period forecast. These metrics include the peak month as a percent of the annual, the design day as a percent of the peak month, and the peak hour as a percent of the design day. It should be noted that peak hour metrics are specific to the Airport's design day. As airlines begin to add future flights, more flights will likely be added outside of the peaks thereby reducing the peak month, design day, and peak hour metrics.

**Exhibit 16 – Rolling 60-Minute Operations Profile**
For March 21, 2016




Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Radar Data; Landrum & Brown analysis.

### 8.5.1 PEAK PERIOD AIRCRAFT OPERATIONS FORECAST

Annual aircraft operations were divided by the peak month aircraft operations, peak month aircraft operations were divided by the design day aircraft operations, and the design day aircraft operations were divided by peak hour aircraft operations to determine these peak period factors. Peak factors were expressed for each of the segments (commercial passenger, all-cargo, on-demand/limited service air taxi, GA, and military).

It was assumed that the peak month and design day factors would remain relatively unchanged through the forecast period. However, as incumbent airlines increase frequency on existing routes, they will add flights during the off-peak periods. As such, peak hour aircraft operations will decrease as a percent of the design day through the forecast period.

The annual, monthly, daily, and hourly peak aircraft operations forecasts are presented in **Table 22**. The total of annual, monthly, and design day aircraft operations is the aggregation of the individual segments. However, each of the individual segments peak at different periods of the day. For example, during the design day passenger aircraft operations peak at 10:30 while all-cargo aircraft operations peak at 8:25. As a result, peak hour total aircraft operations are not equal to the sum of the categories. The total peak hour aircraft operations are expected to grow from 51 in 2016 to 53 in 2028.

**Table 22 – Peak Period Aircraft Operations Forecast**
For Fiscal Years 2016 Through 2028

| SEGMENT | LEVEL | HISTORICAL | FORECAST | | |
|---|---|---|---|---|---|
| | | 2016 | 2017 | 2023 | 2028 |
| **Passenger** | Annual | 38,674 | 38,830 | 41,880 | 45,120 |
| | Peak Month Factor | 9.28% | 9.28% | 9.28% | 9.28% |
| | Peak Month | 3,588 | 3,602 | 3,885 | 4,186 |
| | Design Day Factor | 3.23% | 3.25% | 3.23% | 3.23% |
| | Design Day | 116 | 117 | 125 | 135 |
| | Peak Hour Factor | 14.66% | 11.97% | 11.20% | 12.03% |
| | Peak Hour | 17 | 14 | 15 | 16 |
| **All-Cargo** | Annual | 2,126 | 2,160 | 2,220 | 2,230 |
| | Peak Month Factor | 9.13% | 9.12% | 9.10% | 9.10% |
| | Peak Month | 194 | 197 | 202 | 203 |
| | Design Day Factor | 4.12% | 4.06% | 4.46% | 4.46% |
| | Design Day | 8 | 8 | 9 | 9 |
| | Peak Hour Factor | 37.50% | 37.50% | 33.33% | 33.33% |
| | Peak Hour | 3 | 3 | 3 | 3 |
| **Air Taxi** | Annual | 9,629 | 9,980 | 12,150 | 14,090 |
| | Peak Month Factor | 10.12% | 10.12% | 10.12% | 10.12% |
| | Peak Month | 974 | 1,010 | 1,230 | 1,426 |
| | Design Day Factor | 3.73% | 3.76% | 3.77% | 3.76% |
| | Design Day | 36 | 37 | 45 | 52 |
| | Peak Hour Factor | 13.89% | 13.16% | 11.11% | 9.62% |
| | Peak Hour | 5 | 5 | 5 | 5 |
| **GA** | Annual | 62,152 | 62,290 | 63,100 | 64,070 |
| | Peak Month Factor | 9.30% | 9.30% | 9.30% | 9.30% |
| | Peak Month | 5,778 | 5,791 | 5,866 | 5,956 |
| | Design Day Factor | 3.18% | 3.18% | 3.18% | 3.18% |
| | Design Day | 184 | 184 | 186 | 189 |
| | Peak Hour Factor | 13.59% | 13.59% | 13.44% | 13.23% |
| | Peak Hour | 25 | 25 | 25 | 25 |
| **Military** | Annual | 27,690 | 32,000 | 32,000 | 32,000 |
| | Peak Month Factor | 8.82% | 8.82% | 8.82% | 8.82% |
| | Peak Month | 2,442 | 2,822 | 2,822 | 2,822 |
| | Design Day Factor | 4.42% | 4.43% | 4.43% | 4.43% |
| | Design Day | 108 | 125 | 125 | 125 |
| | Peak Hour Factor | 19.44% | 16.80% | 16.80% | 16.80% |
| | Peak Hour | 21 | 21 | 21 | 21 |
| **Total** | Annual | 140,271 | 145,260 | 151,350 | 157,510 |
| | Peak Month Factor | 9.25% | 9.24% | 9.25% | 9.26% |
| | Peak Month | 12,976 | 13,422 | 14,005 | 14,593 |
| | Design Day Factor | 3.48% | 3.51% | 3.50% | 3.49% |
| | Design Day | 452 | 471 | 490 | 510 |
| | Peak Hour Factor | 11.28% | 11.04% | 10.82% | 10.39% |
| | Peak Hour | 51 | 52 | 53 | 53 |

Note: Military operations for 2016 reflect the calendar year versus fiscal year per FAA direction.

Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Radar Data; Landrum & Brown analysis.

### 8.5.2 PEAK PERIOD ENPLANED PASSENGERS FORECAST

Peak hour enplanements were calculated using a similar methodology as peak hour operations. The annual and monthly enplanements were determined from Airport records. The design day enplanements are the peak month divided by 31. Peak hour enplanements were determined from peak hour passenger departures and the average enplanements per departure in the peak month. Peak hour enplanements as a percentage of the design day are projected to decline over time. **Table 23** presents the peak enplanement forecasts for TUS.

**Table 23 – Peak Period Enplanements Forecast**
For Fiscal Years 2016 Through 2028

| LEVEL | HISTORICAL | FORECAST | | |
|---|---|---|---|---|
| | 2016 | 2017 | 2023 | 2028 |
| Annual | 1,618,304 | 1,674,780 | 1,859,100 | 2,019,900 |
| Peak Month Factor | 9.78% | 9.77% | 9.77% | 9.77% |
| Peak Month | 158,192 | 163,691 | 181,710 | 197,447 |
| Design Day Factor | 3.23% | 3.23% | 3.23% | 3.23% |
| Design Day | 5,103 | 5,295 | 5,822 | 6,341 |
| Peak Hour Factor | 18.26% | 14.90% | 14.32% | 13.93% |
| Peak Hour | 932 | 789 | 834 | 883 |

Sources: OAG Aviation Worldwide Ltd, OAG Schedules Analyser; Landrum; Radar Data; Landrum & Brown analysis.

# 9.0 COMPARISON OF EIS FORECAST TO TERMINAL AREA FORECAST

The FAA publishes its own forecast annually for each U.S. airport, including TUS. The TAF is "prepared to assist the FAA in meeting its planning, budgeting, and staffing requirements. In addition, state aviation authorities and other aviation planners use the TAF as a basis for planning airport improvements."[22] The most recent release is the 2016 TAF which was issued in January 2017.

If the forecast prepares specifically for the EIS is used for FAA decision-making, such as key environmental issues, noise capability planning, airport layout plan, and initial financial decisions, the FAA requires that forecast be compared to the most recent TAF to determine if they are consistent. For all classes of airports, forecasts for total enplanements, based aircraft, and total aircraft operations are considered consistent with the TAF if they meet the following criterion:[23]

- Forecasts differ by less than 10 percent in the 5-year forecast period.
- Forecasts differ by less than 15 percent in the 10-year forecast period.

If the forecasts are determined not to be consistent with the TAF, differences must be resolved before proceeding.

The 2016 TAF includes historical information on aircraft operations from 1990 through 2015 and forecasts for 2016[24] to 2045. At airports with FAA towers like TUS, historical aircraft operations data is provided by FAA air traffic controllers, which count landings and takeoffs. These aircraft operations are recorded as either air carrier, commuter & air taxi, GA, or military. Air carrier is defined as an aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation. Commuter & air taxi aircraft are designed to have a maximum seating capacity of 60 seats or a maximum payload capacity of 18,000 pounds carrying passengers or cargo for hire or compensation.

According to the 2016 TAF, aircraft operations at TUS have declined from 257,527 in 2007 to 139,555 in 2016, representing a CAGR of decline of 6.6 percent. The 2016 TAF projects that aircraft operations at TUS will increase from 139,555 in 2016 to 149,711 in 2028, representing a CAGR of 0.6 percent.

The enplanement information in the 2016 TAF includes historical values from 1976 through 2015, estimated enplanement figures for 2016, and forecasts from 2017 to 2040. Historical enplanement data is obtained through the U.S. Department of Transportation T-100 Reports.

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22 Federal Aviation Administration, Terminal Area Forecast Summary: Fiscal Years 2015-2045, January 2016.
23 Federal Aviation Administration, Review and Approval of Aviation Forecasts, June 2008.
24 Operations data for FAA towers and Federal contract towers for 2016 are actual.

According to the 2016 TAF, enplanements at TUS have declined from a high of 2.16 million in 2007 to an estimated 1.57 million in 2016, representing a CAGR of decline of 3.5 percent. During this span, enplanements provided in the 2016 TAF have on average been within 2.6 percent of the Airport's records. A difference is common when comparing the TAF to airport records because the enplanements provided in the TAF exclude non-revenue passengers and military charter passengers. In 2016, the Airport reported 1.62 million enplanements, which is 3.1 percent higher than the 1.57 million estimated for 2016 in the 2016 TAF. The 2016 TAF projects that enplanements will increase from an estimated 1.57 million in 2016 to 2.01 million in 2028, representing a CAGR of 2.1 percent.

In order to compare the forecast presented herein to the 2016 TAF, Appendix B and C templates from the FAA Office of Aviation Policy and Plans (APO) document, Forecasting Aviation Activity by Airport, have been completed and are provided in the **Table 24** and **Table 25**, respectively.

## Table 24 – FAA TAF Forecast Comparison
For Fiscal Years 2016 Through 2026

A. Forecast Levels and Growth Rates

| | Base Year 2016 | Base Year + 1 year 2017 | Base Year + 5 years 2021 | Base Year + 10 years 2026 | Base Year + 15 years 2031 | Base Year to + 1 year 2016-2017 | Base Year to + 5 years 2016-2021 | Base Year to + 10 years 2016-2026 | Base Year to + 15 years 2016-2031 |
|---|---|---|---|---|---|---|---|---|---|
| **Passenger Enplanements** | | | | | | | | | |
| Air carrier | 1,073,875 | 1,111,400 | 1,203,200 | 1,293,000 | | 3.5% | 2.3% | 1.9% | |
| Commuter | 544,429 | 563,380 | 609,200 | 653,700 | | 3.5% | 2.3% | 1.8% | |
| TOTAL ENPLANEMENTS | 1,618,304 | 1,674,780 | 1,812,400 | 1,946,700 | | 3.5% | 2.3% | 1.9% | |
| **Operations** | | | | | | | | | |
| Itinerant | | | | | | | | | |
| Air carrier | 32,888 | 35,956 | 42,560 | 45,880 | | 9.3% | 5.3% | 3.4% | |
| Commuter/air taxi | 17,541 | 15,014 | 12,220 | 13,220 | | -14.4% | -7.0% | -2.8% | |
| Total Commercial Operations | 50,429 | 50,970 | 54,780 | 59,100 | | 1.1% | 1.7% | 1.6% | |
| General aviation | 62,152 | 62,290 | 62,840 | 63,670 | | 0.2% | 0.2% | 0.2% | |
| Military | 27,690 | 32,000 | 32,000 | 32,000 | | 15.6% | 2.9% | 1.5% | |
| Local | | | | | | | | | |
| General aviation | 0 | 0 | 0 | 0 | | 0.0% | 0.0% | 0.0% | |
| Military | 0 | 0 | 0 | 0 | | 0.0% | 0.0% | 0.0% | |
| TOTAL OPERATIONS | 140,271 | 145,260 | 149,620 | 154,770 | | 3.6% | 1.3% | 1.0% | |
| **Instrument Operations** | | | | | | | | | |
| **Peak Hour Operations** | 51 | 52 | 53 | 53 | | 2.0% | 0.8% | 0.4% | |
| **Cargo/Mail** | | | | | | | | | |
| **(Enplaned + Deplaned Tons)** | 30,962 | 31,640 | 33,210 | 33,570 | | 2.2% | 1.4% | 0.8% | |
| **Based Aircraft** | | | | | | | | | |
| Single Engine (Nonjet) | 169 | | | | | | | | |
| Multi Engine (Nonjet) | 26 | | | | | | | | |
| Jet Engine | 18 | | | | | | | | |
| Helicopter | 10 | | | | | | | | |
| Other | - | | | | | | | | |
| TOTAL BASED AIRCRAFT | 223 | | | | | | | | |

B. Operational Factors

| | Base Year 2016 | Base Year + 1 year 2017 | Base Year + 5 years 2021 | Base Year + 10 years 2026 | Base Year + 15 years 2031 |
|---|---|---|---|---|---|
| **Average aircraft size (seats)** | | | | | |
| Air carrier | 143.0 | 146.8 | 151.7 | 151.6 | |
| Commuter | 60.6 | 65.1 | 69.7 | 72.6 | |
| **Average enplaning load factor** | | | | | |
| Air carrier | 79.4% | 80.1% | 80.3% | 80.0% | |
| Commuter | 83.3% | 81.9% | 80.9% | 80.6% | |
| **GA operations per based aircraft** | 279 | | | | |

Note: Military operations for 2016 reflect the calendar year versus fiscal year per FAA direction. This is Appendix B of the FAA Office of Policy and Planning document.

Sources: Federal Aviation Administration, Terminal Area Forecast; Landrum & Brown analysis.

**Table 25 – FAA TAF Forecast Comparison**
For Fiscal Years 2016 Through 2026

| | FORECAST YEAR | EIS FORECAST | 2016 FAA TAF | % VARIANCE EIS FORECAST VS 2016 TAF |
|---|---|---|---|---|
| **Passenger Enplanements** | | | | |
| Base year | 2016 | 1,618,304 | 1,569,720 | 3.1% |
| Base year + 5 years | 2021 | 1,812,400 | 1,774,670 | 2.1% |
| Base year + 10 years | 2026 | 1,946,700 | 1,937,796 | 0.5% |
| Base year + 15 years | 2031 | - | 2,117,871 | n.a. |
| **Commercial Operations*** | | | | |
| Base year | 2016 | 50,429 | 50,429 | 0.0% |
| Base year + 5 years | 2021 | 54,780 | 56,315 | -2.7% |
| Base year + 10 years | 2026 | 59,100 | 61,302 | -3.6% |
| Base year + 15 years | 2031 | - | 66,523 | n.a. |
| **Total Operations** | | | | |
| Base year | 2016 | 140,271 | 139,555 | 0.5% |
| Base year + 5 years | 2021 | 149,620 | 141,137 | 6.0% |
| Base year + 10 years | 2026 | 154,770 | 147,227 | 5.1% |
| Base year + 15 years | 2031 | - | 153,591 | n.a. |

Notes: Military operations for 2016 reflect the calendar year versus fiscal year per FAA direction Commercial operations includes operations by passenger airlines, all-cargo airlines, and air taxi operators. This is Appendix C of the FAA Office of Policy and Planning document.

Sources: Federal Aviation Administration, Terminal Area Forecast; Landrum & Brown analysis.

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