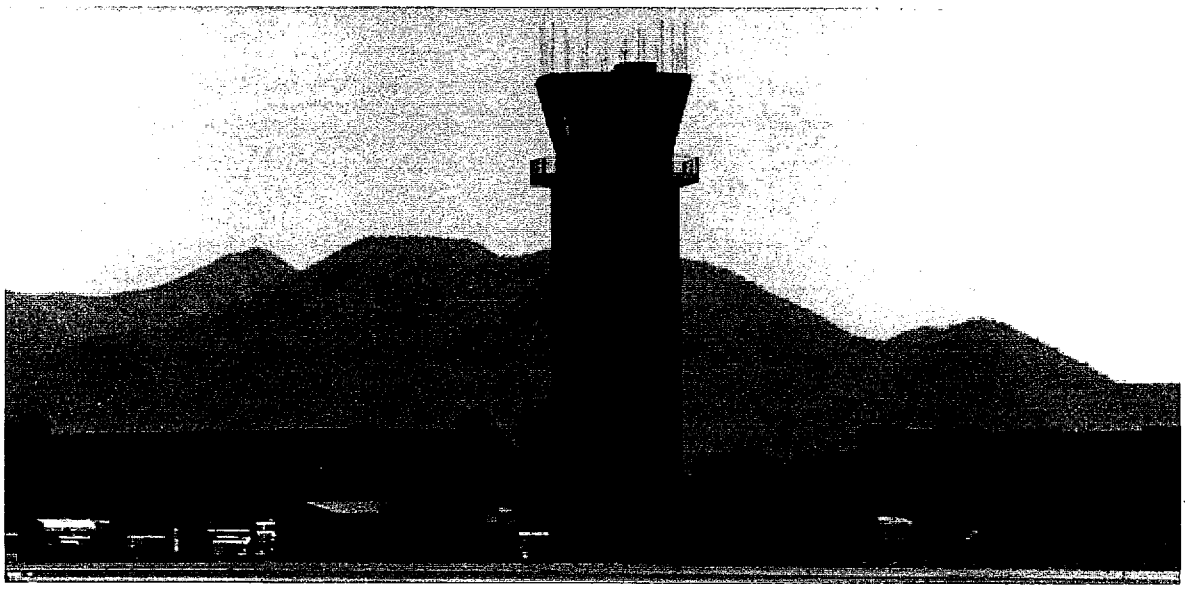
Chapter 3

DEMAND / CAPACITY

DEMAND/CAPACITY

Airport Master Plan

Chapter 3



In the previous chapter, forecasts of unconstrained aviation demand were presented for Scottsdale Airport through the year 2015. These forecasts include airport operations, annual enplanements, based aircraft, peaking characteristics, and aircraft fleet mix. With this information, the capability of the airfield can be evaluated to determine if it is adequate to accommodate the forecast aviation demands without significant delay or deterioration of service levels.

The demand/capacity analysis provides a basis to assess the capability of the existing airport facilities to accommodate current and future levels of activity. Analysis of this relationship results in the identification of deficiencies that may be alleviated through planning and development activities.

AIRFIELD CAPACITY METHODOLOGY

An airfield capacity analysis for Scottsdale Airport was conducted to determine the existing capacity of the airfield and to identify any present or potential deficiencies in the airfield system. Capacity and delay will be examined in this master plan using *FAA Advisory Circular (AC) 150/5060-5, Airport Capacity and Delay*. The methodology presented in this advisory circular and utilized here produces statement of airfield capacity in these major terms.

- **Hourly Capacity of Runways:** The maximum number of aircraft operations that can take place on the runway system in one hour.

- **Annual Service Volume:** The annual capacity or maximum level of annual aircraft operations that may be used as reference in planning the runway system.

- **Annual Aircraft Delay:** The total delay incurred by all aircraft on the airfield in one year.

As indicated on **Exhibit 3A, Demand/ Capacity Methodology Factors**, the capacity of an airport is determined by several factors, including airport layout, meteorological conditions, aircraft mix, runway use, percent arrivals, percent touch-and-go's, and exit taxiway locations. Each of these elements and their impact on airfield capacity are discussed in the following paragraphs.

AIRPORT LAYOUT

The airport layout refers to the location and orientation of runways, taxiways and the terminal area. The layout of Scottsdale Airport, as illustrated on **Exhibit 1B**, consists of a single runway oriented northeast-southwest. Runway 3-21 has a full length parallel taxiway on the west side of the runway with 13 connecting taxiways. The runway also has a partial-parallel taxiway on the east side, with five connecting taxiways. All terminal area landside facilities are located on the west side of the runway/ taxiway system.

METEOROLOGY

Weather conditions can affect runway utilization due to changes in cloud ceilings and visibility. When weather conditions deteriorate below Visual Flight Rule (VFR) conditions, the instrument capacity of the airport becomes a factor in determining airport capacity.

During Instrument Flight Rule (IFR) conditions, separations between landing and departing aircraft increase in length and the capabilities of the airfield system to accept operations is reduced.

The *Airfield Capacity and Delay Advisory Circular (AC 150/5060-5)* recognizes three categories of ceiling and visibility minimums. VFR conditions occur whenever the cloud ceiling is at least 1,000 feet above ground level and the visibility is at least three statute miles. IFR conditions occur whenever the reported cloud ceiling is at least 500 feet but less than 1,000 feet and/or visibility is at least one statute mile but less than three statute miles. Poor Visibility and Ceiling (PVC) conditions exist whenever the cloud ceiling is less than 500 feet and/or visibility is less than one statute mile.

At Scottsdale Airport, VFR conditions occur approximately 98 percent of the time and IFR conditions occur the re-

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AIRFIELD CAPACITY

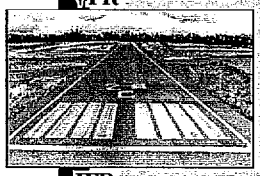
1 INPUT

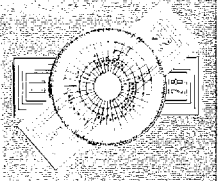
Airport Layout Meteorology Aircraft Mix Percent Arrivals Touch & Go's Exit Taxiways

2 PROCESS

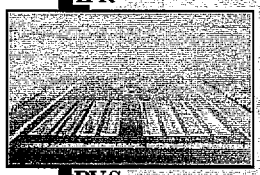
Wind & Weather

VFR

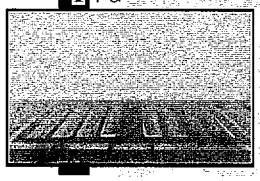




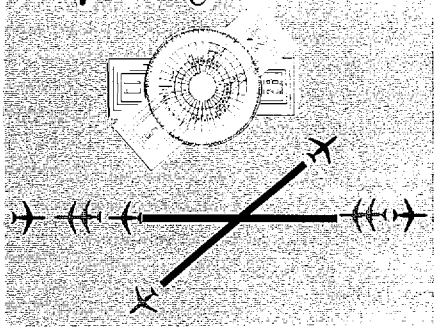
IFR



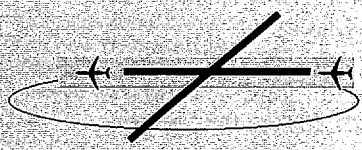
PVC



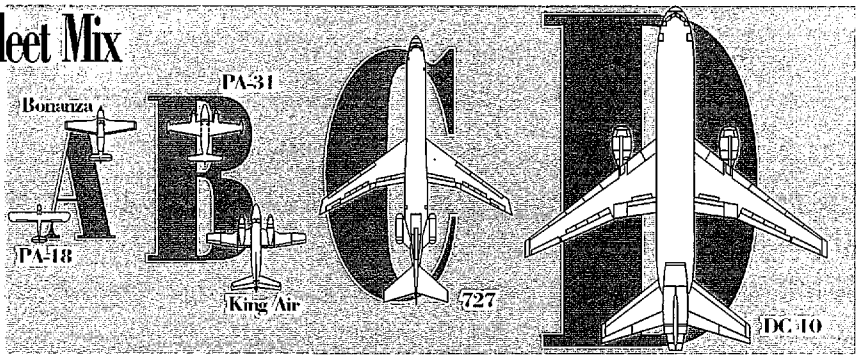
Runway Configuration



Touch & Go Factor

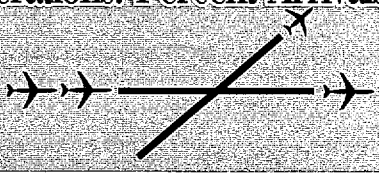


Fleet Mix



Exit Factor

Operations: Percent Arrivals



3 OUTPUT

Runway Hourly Capacity
Annual Aircraft Delay

ANNUAL SERVICE VOLUME

SCOTTSDALE AIRPORT

Exhibit 3A
DEMAND/CAPACITY
METHODOLOGY FACTORS

maining two percent. PVC conditions generally do not occur at Scottsdale Airport. These annual percentages of VFR, IFR, and PVC conditions for Scottsdale Airport were estimated from historical weather data for the area.

AIRCRAFT MIX

The airside capacity methodology identifies four classes into which aircraft are categorized. Classes A and B include small propeller aircraft and jets weighing 12,500 pounds or less. Class C consists of business jets and commuter aircraft while Class D consists of turbo jet and propeller aircraft generally associated with airline and military use. The aircraft operational mix used in calculating the capacity of Scottsdale Airport, based upon the forecasts of aviation demand, is presented in **Table 3A, Aircraft Operational Mix Forecast.**

TABLE 3A
Aircraft Operational Mix Forecast
Scottsdale Airport

	Existing	Forecast			
	1994	2000	2005	2010	2015
Aircraft Classification					
Class A	69%	67%	65%	63%	61%
Class B	19%	19%	19%	19%	19%
Class C	12%	14%	16%	18%	20%
Class D	0%	0%	0%	0%	0%

Definitions	
Class A:	Small single-engine, gross weight 12,500 pounds or less. Examples include: Cessna 172/182, Mooney 201, Beech Bonanza, and Piper Cherokee/Warrior.
Class B:	Small, twin-engine, gross weight 12,500 pounds or less. Examples include: Beach 1300, Cessna 402, Lear 25, Mitsubishi MU-2, Piper Navajo, Rockwell Shrike, Beech 99, and Cessna Citation.
Class C:	Large aircraft, gross weight 12,500 pounds to 300,000 pounds. Examples include: Beech King Air 200, Gulfstream III, Citation II, DeHavilland DH-8, Lear 35/55, Swearingen Metro, and Beech 1900.
Class D:	Large aircraft, gross weight more than 300,000 pounds. Examples include Lockheed L-1011, Douglas DC-8-60/70, Boeing 747, and Airbus A-300/A-310.

PERCENT ARRIVALS

The percentage of arriving aircraft also influences the capacity of runways. In most cases the higher the percentage of arrivals during the peak period, the arrivals equal departures for capacity analysis.

TOUCH-AND-GO OPERATIONS

A touch-and-go operation refers to an aircraft which lands then makes an immediate takeoff without coming to a full stop or exiting the runway. These operations are normally associated with training and are classified as local operations. Touch-and-go's currently are estimated to comprise approximately 33 percent of general aviation operations at Scottsdale Airport. This percentage is expected to decrease during the planning period to approximately 30 percent of total general aviation operations.

EXIT TAXIWAYS

In addition to the runway configuration, the most notable characteristic considered in the airside capacity model is the number and types of taxiways available to exit the runway. The location of exit taxiways affects the occupancy time of an aircraft on the runway. The longer a plane remains on the runway, the lower the capacity of that runway. The aircraft mix index determines the distance the taxiway must be located from the runway end to qualify as an exit taxiway. At the mix indexes determined for the planning period, only those exits located 2,000 and 4,000 feet lower the service volume. At Scottsdale Airport, there was no information that indicated a disproportionate share of arrivals to departures during peak periods; therefore, it was assumed that

off the runway ends qualify as exit taxiways in the capacity analysis. Using the mix index criteria, there are three qualified exit taxiways for approaches to Runway 3 and four for approaches to Runway 21. These numbers of exit taxiways resulted in the maximum multiplier to be utilized for capacity analysis.

AIRFIELD CAPACITY ANALYSIS

The preceding information was used in conjunction with the airside capacity methodology developed by the FAA to determine airfield capacity for Scottsdale Airport. From these results, it is possible to determine the adequacy of the current airfield to accommodate potential demand scenarios and to determine the range of aircraft delay associated with each demand level.

HOURLY RUNWAY CAPACITY

The first step in capacity analysis involves the computation of an hourly runway capacity during VFR and IFR conditions. Because of increased separations required between aircraft under IFR conditions, VFR hourly capacity is normally much higher. From these calculations, a weighted hourly capacity can be calculated.

The airfield capacity is also influenced by the runway configuration. Parallel runway systems provide greater airport capacity than a single runway or two intersecting runways. The weighted hourly capacity for the existing runway system is 99.9 operations, as depicted in **Table 3B, Airfield Demand/Capacity and Delay Summary**. Due to the combination of the previously defined capacity factors, the hourly capacity at Scottsdale Airport is expected to decrease by the end of the planning period to 89.5 operations, if no further airfield improvements are provided.

ANNUAL SERVICE VOLUME

Once the hourly capacity is known, the annual service volume (ASV) can be determined. The ASV was calculated using the following equation.

ASV = C x D x H

C = weighted hourly capacity

D = ratio of annual demand to average daily demand during the peak month

H = ratio of average daily demand to average peak hour demand during the peak month

The existing weighted hourly capacity (C) for Scottsdale Airport is 99.9 operations. The daily demand ratio (D) is determined by dividing the annual operations by average daily operations during the peak month. The hourly ratio (H) is determined as the inverse of the percent of daily operations occurring during the peak hour. The data used for these ratios were based on the peaking characteristics developed in the previous chapter.

The ASV for Scottsdale Airport's existing configuration was determined to be 199,000 operations. This ASV indicates that the airport is currently operating at approximately 84 percent of the ASV and would be expected to reach an ASV of 180,000 operations or 139 percent by the year 2015.

ANNUAL DELAY

Even before an airport reaches the ASV, it begins to experience certain amounts of delay to aircraft operations. Delays occur to arriving traffic that must wait in the VFR traffic pattern or in the IFR holding pattern, waiting their turn to land. Departing traffic must hold on the taxiway or the holding apron while waiting for the runway and final approach to be clear.

As an airport's level of operations increases, delay increases exponentially. According to the FAA model, with 166,738 annual operations for 1994 at Scottsdale Airport, aircraft experience an average delay per aircraft operation of about one minute. At peak periods, however, delays at Scottsdale Airport can average between 30 minutes and one hour. At present operational levels, total annual delay to aircraft at Scottsdale Airport is 2,779 hours. When the airport reaches 250,700 operations, as forecast for the year 2015, delays will average nearly 12.5 minutes per air-

craft operations and will total 52,229 hours annually.

In general, the FAA recommends consideration of development improvements to increase capacity when annual aircraft operations reach 60 percent of ASV or delays exceed three minutes per aircraft operation. Operations at Scottsdale Airport currently exceed 60 percent of ASV, however, delays are not expected to exceed three minutes until the year 2000.

Table 3B provides a summary of the operational capacity and delay analysis for Scottsdale Airport. Airfield capacity at Scottsdale Airport is inadequate throughout the planning period; therefore, airport capacity improvements should be examined in the short-term. As discussed in the previous chapter, there are management policies and other issues that will need to be considered. The feasibility of providing capacity enhancements at Scottsdale Airport will be examined in **Chapter Five, Development Alternatives.**

TABLE 3B
Airfield Demand Capacity and Delay Summary
Scottsdale Airport

	Existing	Forecast			
	1994	2000	2005	2010	2015
Annual Operations	166,738	193,100	211,000	232,400	250,700
Weighted Hourly Capacity	99.9	98.7	97.5	90.6	89.5
Annual Service Volume (ASV)	201,000	198,600	196,000	183,100	180,000
Percentage of ASV	83%	97%	108%	127%	139%
Average Delay per Operation (Minutes)	1.0	3.3	4.6	8.6	12.5
Total Annual Delay (Hours)	2,779	10,621	16,177	33,311	52,229

AIRCRAFT GATE CAPACITY ANALYSIS

The required number of aircraft gate positions can greatly influence the terminal concept as well as building design. The size and type of aircraft serviced, the aircraft parking arrangement and procedures also affect the size and layout of the terminal building. Several methodologies exist for analyzing gate positions at an airport. The following gate analysis examines the aircraft gate requirements at Scottsdale Airport utilizing the FAA guidelines outlined in **Advisory Circular 150/5360-9,** *Planning and Design of Airport Terminal*

Building Facilities at Nonhub Locations.

There are currently two gate positions at Scottsdale Airport. These two position are generally used by the charter operator located within the terminal building. At the present, there are no scheduled airlines operating at Scottsdale Airport, however, as discussed in the previous chapter it is anticipated that commuter activity could occur during the planning period.

Utilizing the number of peak hour passengers (the total peak number of enplanements and deplanements per hour) determined in the previous chapter, the estimated number of aircraft gate positions were determined for the planning period. According to AC 150/5360-9, the two existing aircraft gate positions would be sufficient through the year 2005. Due to the addition of commuter activity between the years 2000 and 2005, another aircraft gate position may be warranted. As this activity is realized, aircraft gate position utilization should be examined to determine if it is necessary to provide additional aircraft gate positions. The configuration of the existing aircraft gate positions would appear to be adequately sized to accommodate the anticipated aircraft types throughout the planning period.

SUMMARY

This chapter provided an analysis of the airfield and aircraft gate position capacity. As shown in this chapter, Scottsdale Airport airfield capacity is inadequate throughout the planning period. Methods of providing additional airfield capacity will be further examined in the Alternatives Chapter. The aircraft gate position analysis has indicated that the existing number of gate positions would appear to be adequate until scheduled commuter service begins at the Airport. When commuter service is realized, the aircraft gate positions may need to be increased to three. Chapter Five, Airport Alternatives, will examine the locations of these aircraft gate positions. The following chapter will examine the facility requirements of Scottsdale Airport to meet the projected aircraft activity throughout the planning period.