4.0 DEMAND CAPACITY AND FACILITY REQUIREMENTS

This chapter of the Master Plan Study examines the capabilities and conditions of the existing facilities and proposals for improved or new facilities for the Airport. The capacities of the Airport's airfield, passenger terminal, ground access, parking, cargo and support systems are examined. Information appearing in Chapter 3.0 *Activity Projections* is translated into the types and quantities of facilities necessary to accommodate increasing levels of activity demand.

The assessment of facilities requirements was performed for the following functional areas:

- Airfield
- Ground Access
- Employee Parking and Rental Car Facilities
- Cargo
- Airport and Airline Support Facilities

Passenger terminal requirements (terminal building, curbside, public parking) are presented in Chapter 6. The requirements for additional or improved facilities are based upon the following analysis years: existing conditions (1999-2000); future projections (2005, 2010, 2020). The year 1999 represents the most recent, full year of Airport activity for the purposes of this analysis. Where available, additional information from 2000 was compiled and analyzed as well. The existing conditions reflect improvements made to the Airport over the past several years.

Analyses for existing conditions, 2005, 2010, and 2020 represent a "no build" situation, that is, no additional facilities are assumed to be available, with the exception of projects already in progress.

This Airport Master Plan was initiated in 2000. The project progressed through establishing a vision for the Airport, compiling existing facility information, projecting activity expected in the future, determining the facilities that will be required to accommodate that activity, and formulation of preliminary alternatives for development of the Airport. It was at this point that the events of September 11, 2001 led the SCAS to temporarily suspend work on the Master Plan Study and await anticipated changes on the Airport and the airline industry.

The Master Plan Study was restarted in January 2003. A review of previous efforts was performed to determine if the earlier analysis and conclusions remain valid given the changes in overall economic conditions and aviation activity.

Recent Airport activity was reviewed and the activity forecasts prepared in 2000 were examined to determine their appropriateness for continued use in the Master Plan Study. In summary, aviation activity growth between 2000 and 2002 was slower than forecast in the 2000 Master Plan projections due to the events of September 11 and a significant and prolonged downturn in the US economy. These two factors have contributed to unprecedented financial difficulties for the airline industry. Sacramento is fortunate that Southwest Airlines remains one of the most financially secure airlines in the industry. Post September 11, 2001 activity has shown traffic growth has reemerged. It is believed that rate of growth projected in the forecasts remains appropriate, although the achievement of projected activity levels may be delayed by a few years based on the past two years' growth patterns. However, with several exceptions as noted below, should the Sacramento region experience a period of more robust economic growth, the activity levels could rapidly reach those projected in the 2000 forecasts. Therefore, the Master Plan Study will continue to use the previous forecasts to determine the scope and schedule of facilities that will be needed in the future. The timing for implementation of these facilities may be adjusted as necessary as the Airport monitors activity growth.

- Passenger traffic has grown steadily and at rates well above the national average, but is estimated to be 6.5 percent below the level previously forecast. The levels may lag the original forecast by a minimum of one or two years or up to a maximum of four or five years, but the forecasts are still valid for planning purposes.
- Airline service has grown slightly ahead of forecast – the Airport currently has 145 daily departures compared with a previously projected 138 daily departures. The Airport has seen an increase in service using regional jets, similar to that experienced at many other airports. The patterns of service and carriers serving the Airport are still in keeping with the assumptions embodied in the 2000 forecast.
- Freight volumes are estimated to be 19.6 percent below the level forecast in 2000 although the Airport has experienced a strong rebound of approximately 27 percent

growth in 2002. Mail volumes have declined substantially and are estimated to be 41.3 percent below the 2000 projections. It is probable that the United States Postal Service is now contracting with airline freight carriers for mail shipments, instead of on passenger airlines.

- The decline in general aviation aircraft operations that the Airport experienced in the 1990s continued in the period since the 2000 forecasts were prepared. The decline is attributable to the availability of facilities at reliever airports in the region and the trend is consistent with the overall decline in general aviation activity nationwide.
- Military aircraft operations were previously forecasted to remain at 5,000 annually throughout the forecast period, and this projection remains valid.

The requirements for passenger terminal facilities (terminal building, curbside vehicle parking) were reevaluated in 2003 and the requirements presented in Chapter 6 reflect this analysis. In general, the space requirement has increased since the events of September 11, 2001 led to greater space needs for security equipment and operations as well as more area for passenger and checked baggage processing functions.

The facility requirements identified represent a level of detail common to a Master Plan Study effort, not a level of detail equivalent to an architectural or engineering level of design. Rather, the demand/capacity analysis focuses on the determination of the capacity of existing facilities and identifies facilities requirements that will be necessary if future demand levels are to be accommodated. The next step in the Master Plan Study process, the alternatives analyses, will examine options for providing the additional or improved facilities.

4.1 Airfield Requirements

The ability of an airfield to accommodate projected air traffic is an important element of every master plan study. Airfield facilities require a significant amount of land. The layout of the airfield must adhere to federal requirements, minimize the opportunity for incursions, and facilitate air traffic management as best possible. Also, the configuration of an airfield is a major determinant of an airport's impact on surrounding communities.

An extensive analysis was undertaken to evaluate the capacity and capabilities of the airfield at the Airport. The capacity of the airfield to accommodate projected levels of activity was evaluated by first assessing the theoretical capacity of the airfield, i.e., the number of operations that the current runway and taxiway configuration could be expected to accommodate. Computer simulations were then performed to provide a more realistic assessment of congestion points and levels of aircraft delay. The capability of the airfield to accommodate traffic was ascertained through an examination of design standards and requirements for runway width, runway length, airfield safety areas, taxiways, and navigational aids.

4.1.1 Theoretical Capacity Analysis

Airfield capacity has been defined in two ways. One definition has been used extensively in the United States in the past: capacity is the number of aircraft operations during a specified time corresponding to a tolerable level of average delay; this is referred to as practical capacity. Another definition of capacity is: the number of aircraft operations that an airfield can accommodate during a specified time while there is a continuous demand for service. Continuous demand for service means that there are always aircraft ready to takeoff or land. This definition has been referred to in several ways, namely as ultimate capacity, saturation capacity, or maximum throughput rate. An important difference in these two measures of capacity is that one is defined in terms of delay and the other is not.

Capacity is most often expressed in hourly or annual measures. For long-range planning efforts, such as this Master Plan Study, the annual operating capacity or annual service volume (ASV) is used to measure an airport's ability to process existing and future demand levels. Hourly capacity is analyzed, as well, in order to identify any peak-period issues that may arise.

The generally accepted methodology for calculating airfield capacity is based on the FAA's *Airport Capacity and Delay Manual*, (FAA Advisory Circular 150/5060-5). For verification purposes, the FAA's Capacity and Delay computer model was also used. The methodology incorporated in the FAA's Advisory Circular and computer model relies upon two general concepts for determining airport capacity. These concepts are:

Hourly Capacity of Runway – the maximum number of aircraft operations that can take place on a runway system in a one-hour period.
Annual Service Volume – a reasonable estimate of the annual number of aircraft operations that an airport can accommodate.

Many factors influence the capacity of an airport, and some are more significant than others. In general, capacity depends on the configuration of the airfield, the environment in which aircraft operate, availability and sophistication of aids to navigation, and air traffic control facilities and procedures.

The airfield capacity analysis conducted for this Master Plan Study considers the following elements:

- Airfield layout
- Meteorology
- Aircraft operational fleet mix
- Percentage of arrivals
- Touch-and-Go operations
- Peak hour airfield capacity
- Annual service volume

Factors such as runway configuration, weather, and fleet mix were reviewed to determine their influence on operational capacity. Calculated capacity was compared to projected demand to assess the potential need for airfield improvements.

4.1.1.1 Airfield Layout

The runway/taxiway configuration is determined by the physical layout of the airfield system, including the number of runways, their orientation, and their locations relative to each other and to other landside facilities. Each runway/taxiway configuration has a different capacity due to operational locations relative to each other and to other landside facilities. Each runway/taxiway configuration has a different capacity due to operational limitations and restrictions. Capacity differs with each additional runway, depending on its wind coverage and location relative to other existing runways. With a separation of at least 4,300 feet, operations on parallel runways can be conducted independently during all weather conditions.

Exhibit 4.1-1 shows the runway layout and the predominant runway operating configuration used at the Airport. The Airport has two parallel runways:

- Runway 16L/34R is 8,600 feet long by 150 feet wide
- Runway 16R/34L is 8,600 feet long by 150 feet wide

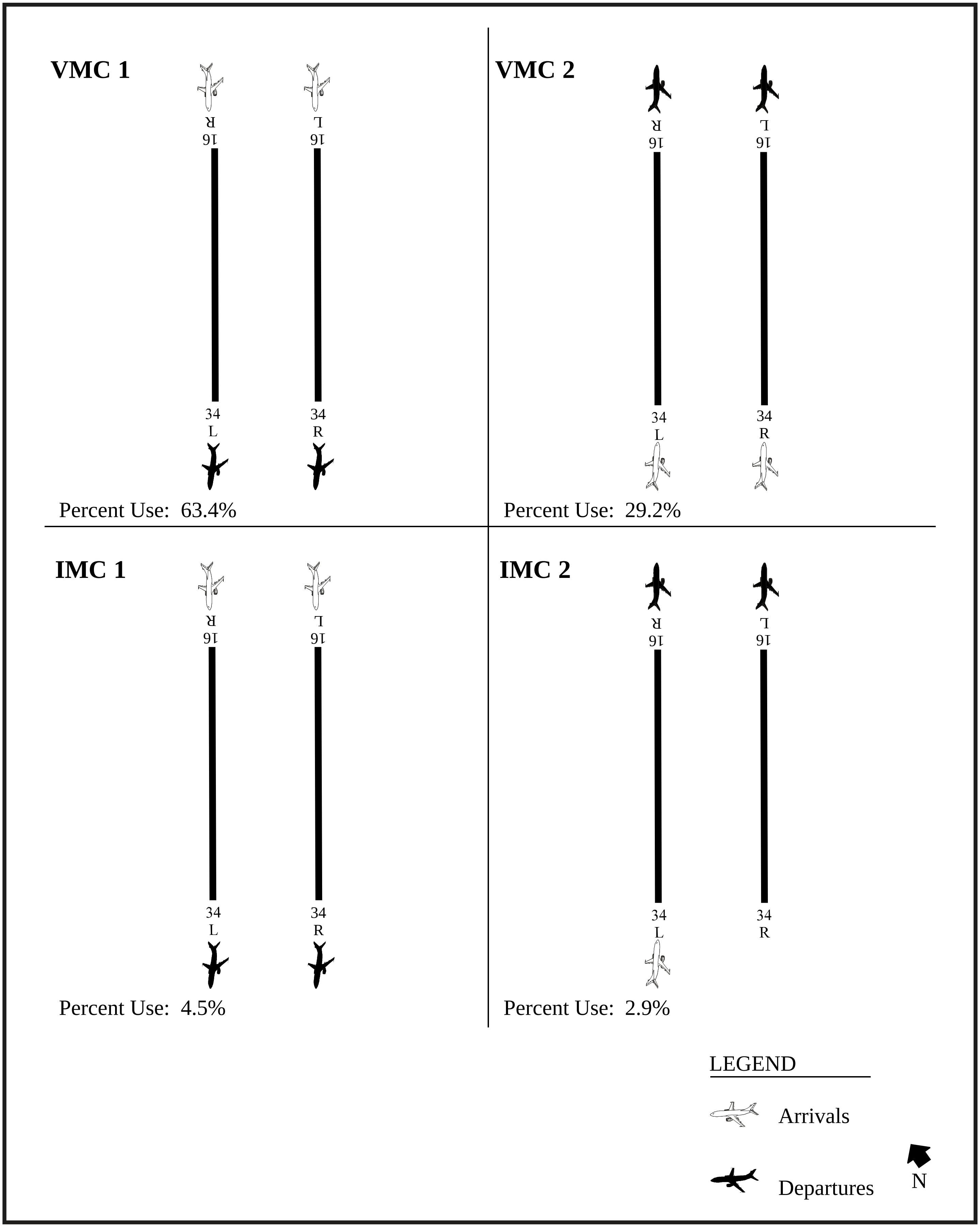
Both runways are served by full-length parallel taxiways. The parallel runways are separated by 6,000 feet, which allows for dual simultaneous precision instrument approaches. However, the lack of a precision instrument approach on Runway 34R limits simultaneous approaches during Instrument Meteorological Conditions (IMC) when the airfield is operating in a north flow.

Another runway characteristic considered in the airfield capacity analysis is the number and location of taxiway exits from each runway threshold. Existing taxiway exits at the Airport include:

- Runway 16R/34L has six exits: beginning with the 16R end, the exits are located at the threshold, 2,150, 3,700, 4,300, 6,050, and 8,500 feet

- Runway 16L/34R has five exits: beginning with the 16L end, the exits are located at the threshold, 2,850, 3,700, 5,200, and 8,500 feet

- The optimal taxiway exit distance depends on the type of aircraft that use the runway (i.e., the fleet mix). The aircraft mix is the relative percentage of operations conducted by each of the four classes of aircraft (A, B, C, and D) listed in **Table 4.1-1**. Strategically located exits for reduce runway occupancy time and, therefore, improve capacity. The Airport's mix index is obtained by calculating the percent of Class C aircraft plus three times the percent of Class D aircraft, % (C+3D).



Sacramento County Airport System

Sacramento International Airport Master Plan Study

RUNWAY USE CONFIGURATIONS

EXHIBIT 4.1-1

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PB AVIATION, INC.

TABLE 4.1-1 ***Sacramento International Airport*** ***AIRCRAFT CLASSIFICATIONS***			
Aircraft Class	Maximum Certified Takeoff Weight (lbs)	Number of Engines	Estimated Approach Speed (knots)
A	12,500 or less	Single	95
B	12,500 or less	Multi	120
C	12,500 – 300,000	Multi	130
D	Over 300,000	Multi	140

Source: FAA Advisory Circular 150/5060-5

4.1.1.2 Meteorology

The runway operating configurations illustrated in Exhibit 4.1-1 are grouped into visual flight rule (VFR) and instrument flight rule (IFR) categories. VFR procedures apply when weather conditions are such that aircraft can maintain safe operations by visual means, i.e., visual meteorological conditions (VMC). Instrument meteorological conditions (IMC) prevails when the visibility or cloud ceiling falls below those minimums prescribed for VMC operations (1,000-foot ceiling, three-mile visibility). VMC1 (south flow) configuration is used 68.4 percent of the time, VMC2 (north flow) is 31.6 percent, IMC1 (south flow) is 60.8 percent, and IMC2 (north flow) is 39.2 percent.

4.1.1.3 Aircraft Operational Fleet Mix

The fleet of aircraft using an airport affects its capacity because an aircraft's speed and weight affect the length of time the aircraft occupies the runway and the spacing of aircraft scheduled to land at the airport. Airspace separation must be increased when large aircraft utilize an airport because of the wake vortices created. For the Airport, the aircraft fleet mix is shown in **Table 4.1-2.**

TABLE 4.1-2 ***Sacramento International Airport*** ***PEAK HOUR VMC AND IMC FLEET MIX***										
Aircraft	2000		2005		2010		2015		2020	
Class	VMC	IMC	VMC	IMC	VMC	IMC	VMC	IMC	VMC	IMC
A & B	39%	14%	38%	22%	43%	28%	43%	31%	43%	32%
C	61%	86%	60%	76%	55%	70%	55%	67%	54%	65%
D	0%	0%	2%	2%	2%	2%	2%	2%	3%	3%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: PB Aviation Analysis

4.1.1.4 Percent of Arrivals

The percent of all aircraft operations that are arrivals has an influence on the capacity of runways. For example, a runway used exclusively for departures will have a different capacity than one used solely for arrivals. Based on observations of the runway use and discussions with FAA ATC personnel, arrivals and departures each constitute 50 percent of total annual and peak period operations at the Airport.

4.1.1.5 Touch-and-Go Operations

Touch-and-go operations are landings after which the aircraft continues to roll down the runway and takes off again. Pilots conducting touch-and-go operations normally stay in the airport traffic pattern. This procedure is usually a training activity. Airport operational capacity can increase with the ratio of touch-and-go operations to total operations; the reason for this increase is that the aircraft in the pattern are continually available for approaches. Touch-and-go operations, however, reduce the availability of the runway for other operations. In instances where commercial operations constitute a substantive portion of the Airport's total operations, training by light aircraft can actually reduce airport capacity. Touch-and-go operations were observed at the Airport, but almost all were performed by aircraft based at other airports in the region. As traffic increases at the Airport, touch-and-go operations are assumed to be transferred to other airports, and thus are not a factor in the demand/capacity analysis.

4.1.1.6 Peak Hour Airfield Capacity

The activity projections presented in Chapter 3.0 were used as part of the demand/capacity analysis. Peak hour capacity was calculated for each of the Airport's runway operating configurations by utilizing the hourly capacity methodology presented in FAA Advisory Circular 150/5060-5. The input assumptions used for these calculations are summarized as follows:

- The number of arrival equals the number of departures during the peak hour
- VMC and IMC fleet mixes are shown in Table 4.1-2
- Dry runway conditions are assumed
- Percentage of touch-and-go operations is less than 10 percent during the peak hour

The results of the hourly capacity analysis are listed in **Table 4.1-3**. This table also compares projected peak hour VMC and IMC activity for the Airport to hourly operational capacities. As shown, the Airport has adequate hourly capacity throughout the 20-year planning period to accommodate projected peak hour VMC and IMC (south flow) demand. However, by the year 2005, peak hour demand is projected to reach 68 percent of the peak hour capacity for IMC (north flow) weather. The absence of precision instrument approach capabilities on Runway 34R severely limits the capacity of the airfield during IMC north flow activity. When the airfield is in this operating configuration, Runway 16L/34R is used only for departures. Plans to provide precision instrument approach capability for Runway 34R should be initiated by 2005 and precision approach to Runway 34R should be in place by 2010.

TABLE 4.1-3
Sacramento International Airport
AIRFIELD DEMAND/CAPACITY ANALYSIS RESULTS

Configurations (PH=Peak Hour)	Operations				
	2000	2005	2010	2015	2020
VMC 1 (south flow)					
PH Demand	31	48	58	65	69
PH Capacity	121	120	120	120	120
VMC 2 (north flow)					
PH Demand	31	48	58	65	69
PH Capacity	121	120	120	120	120
IMC 1 (south flow)					
PH Demand	22	38	46	54	58
PH Capacity	110	110	110	110	110
IMC 2 (north flow)					
PH Demand	22	38	46	54	58
PH Capacity	56	56	56	56	56

Source: PB Aviation Analysis

4.1.1.7 Annual Service Volume

Annual service volume (ASV) is an important indicator of an airport's ability to meet demands placed on its airfield. ASV combines the physical capacity of the airfield, as measured by its hourly capacity, with the characteristics of an airport's users, as measured by peak period operations.

To calculate an airfield's ASV, the percentage of occurrence of different runway operating configurations and their associated hourly capacities must be specified. These percentages, along with ASV weighting factors (derived from the capacity estimate), are used to compute a weighted hourly capacity. Two additional factors—the ratio of annual demand to average daily demand in the peak month of the year (referred to as the D factor) and the ratio of average daily demand to average peak hour demand, for the peak month of the year (referred to as the H factor)—are then used to calculate the ASV (see **Table 4.1-4**).

TABLE 4.1-4 Sacramento International Airport AIRFIELD CAPACITY					
Operation Configuration	Runway Use Percentage (P)	Hourly Capacity (C*)	Weighting Factor (W)[1]	Weighted Hourly Capacity (CPw_n)	Weighted Runway Use Percentage (Pw_n)
VMC 1	63.4%	120	1	76.08	0.634
VMC 2	29.2%	120	1	35.04	0.292
IMC 1	4.5%	110	1	4.95	0.045
IMC 2	2.9%	56	25	40.6	0.725
	100%			156.67	1.696

The ASV was calculated as follows: [1]

* Runway use percentages (P) were obtained from FAA ATC personnel.
* ASV weighting factors (w) were assigned to each runway use configuration in accordance with Table 3-1 contained in FAA Advisory Circular 150/5060-5.
* The weighted hourly capacity (C_w) is calculated by divided CPW by PW, where:

CPW = the sum total of $CPW_1 + CPW_2 + \ldots + CPW_n$, and

PW = the sum total of $PW_1 + PW_2 + \ldots + PW_n$

Thus: $CPW = 156.667$

$PW = 1.696$

$C_w = 92.39$

* Daily and Hourly demand ratios, (D) and (H) respectively, were calculated based on guidelines contained in the FAA Advisory Circular 150/5060-5.

$D = 320$

$H=12$

* The annual Service Volume (ASV) is calculated ad follows:

$ASV = (C_w)(H)(D)$

Thus: $ASV = 355,000$

[1]FAA Advisory Circular 150-5060-5

Source: PB Aviation Analysis

The following equation was used to calculate the ASV for the Airport:

$$
\begin{aligned}
\text{ASV} &= \text{Weighted Hourly Capacity x D x H} \\
&= 92.38 \times 320 \times 12 \\
&= 355{,}000 \text{ Annual Operations}
\end{aligned}
$$

It is typically not desirable for an airport's operations to exceed 60 percent of its airfield capacity. When an airport's demand reaches 60 percent of its capacity, enhancements should be planned. When airport activity reaches 80-percent of the capacity, new airfield facilities should be constructed or demand management strategies should be in place. The 60 percent planning ratio and the 80 percent action ratio were applied to the estimated ASV for the Airport to determine a specific time frame in which these milestones could be expected to be reached (see **Exhibit 4.1-2**). As shown, the Airport's baseline annual demand is projected to increase from 159,783 operations (45 percent of ASV) in 2000 to 256,762 operations (72 percent of ASV) in 2020. This level of demand, when compared to the Airport's ASV, indicates that the planning for capacity-enhancing measures should commence toward the end of planning period.

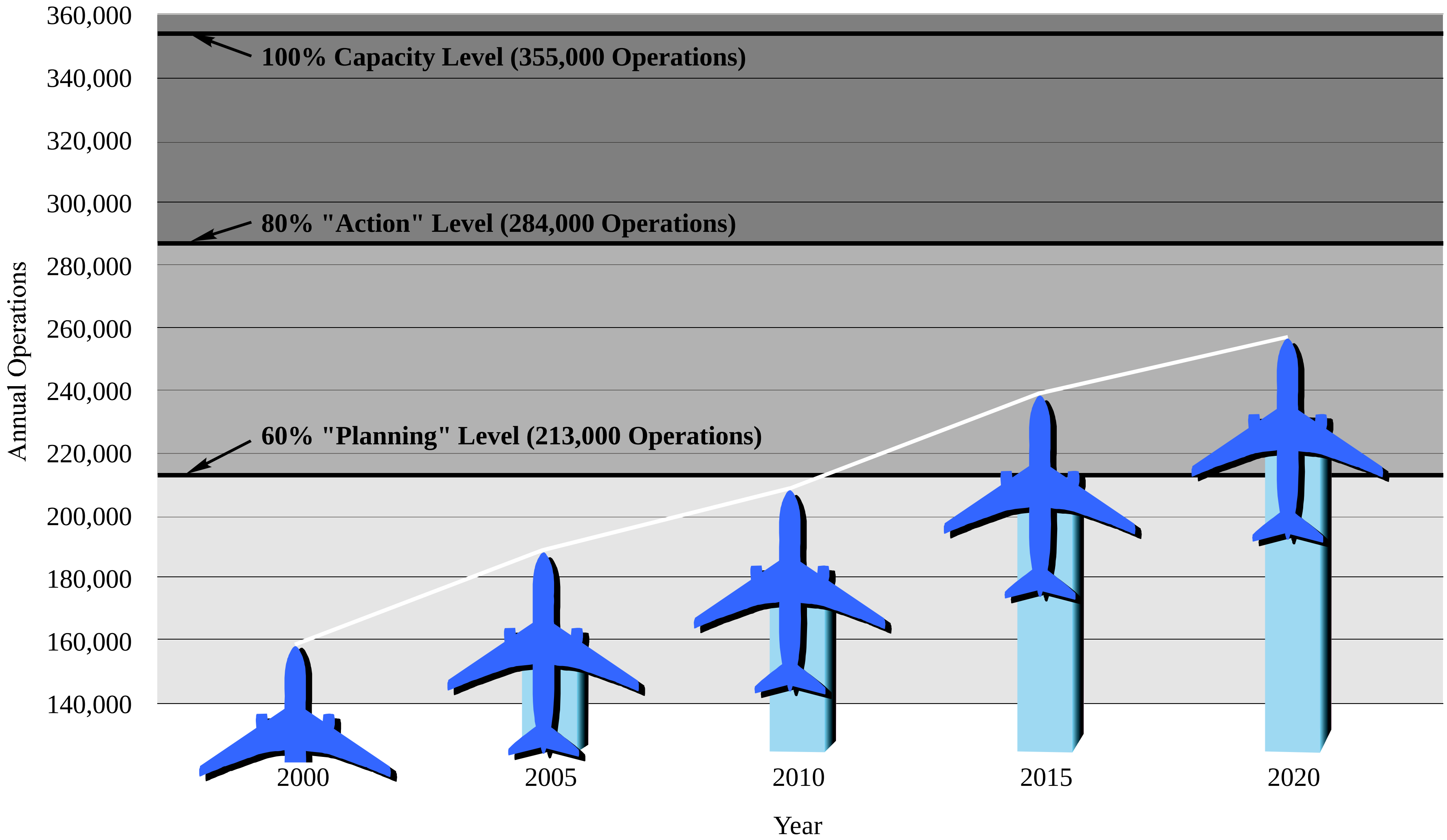
4.1.2 Airfield Simulation Analysis

Computer simulations were used to evaluate the ability of the existing airfield to accommodate projected operations for 2005, 2010, and 2020. The analysis was conducted using the FAA's Airport and Airspace Simulation Model, *SIMMOD PLUS*. *SIMMOD PLUS* is a comprehensive package of airport/airspace simulation development tools to aid in the development of airfield and airspace simulations.

Simulations were conducted for south and north flow conditions in both VMC and IMC. Each simulation considered typical 24 hour days including peak hour operations. The airfield simulations measured the amount of aircraft delay that occurs in each of these conditions with existing and forecast levels of traffic.

4.1.2.1 Simulated Activity Levels

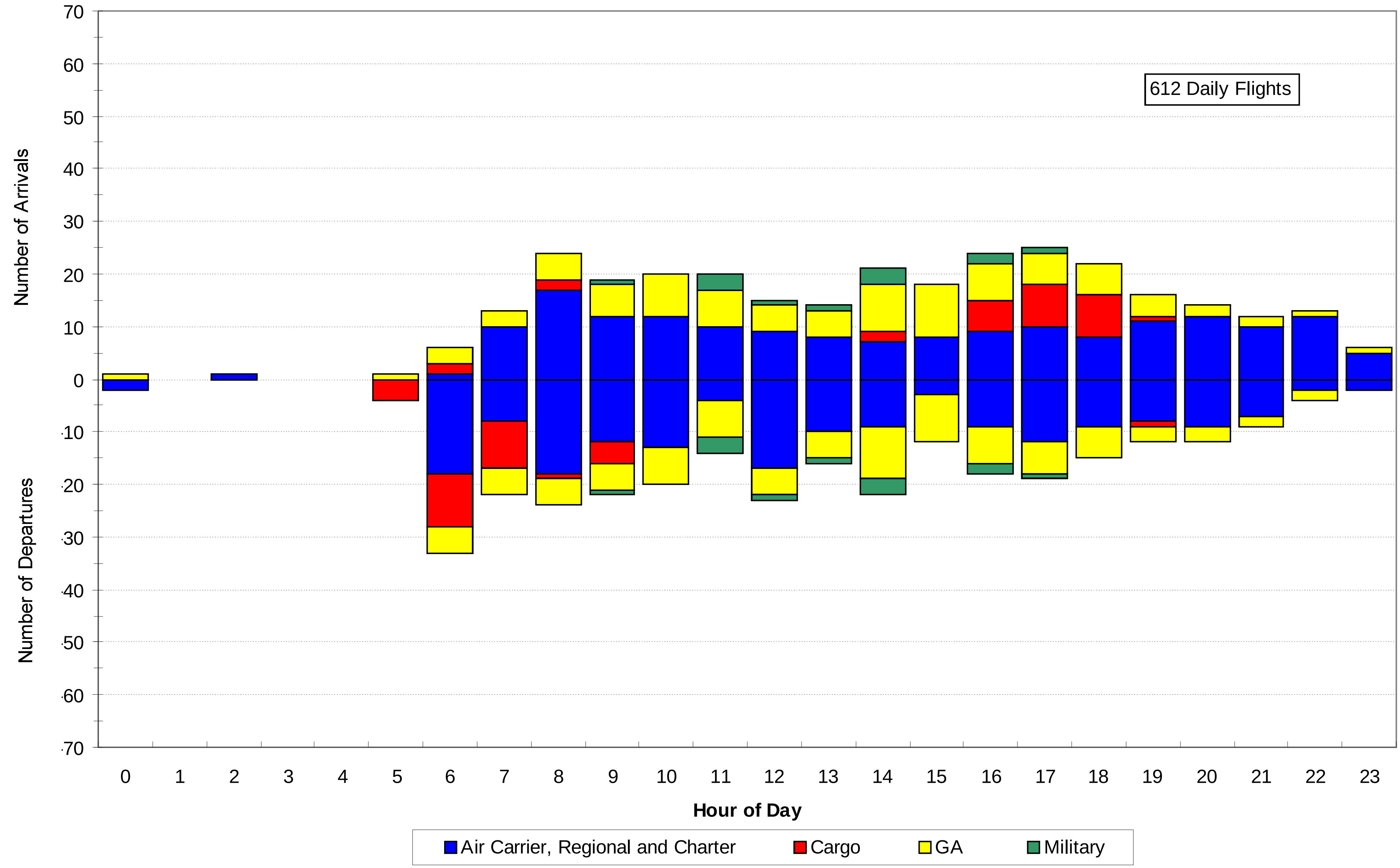
The three future 24 hour schedules that were simulated contained the number of flights depicted by hour in **Exhibits 4.1-3** through **4.1-5**. The total number of daily operations increases from 612 in year 2005 to 824 in year 2020. **Table 4.1-5** presents the maximum number of operations that are simulated during the peak hour period.



Sacramento International Airport
Master Plan Study

DEMAND VERSUS CAPACITY

EXHIBIT
4.1-2

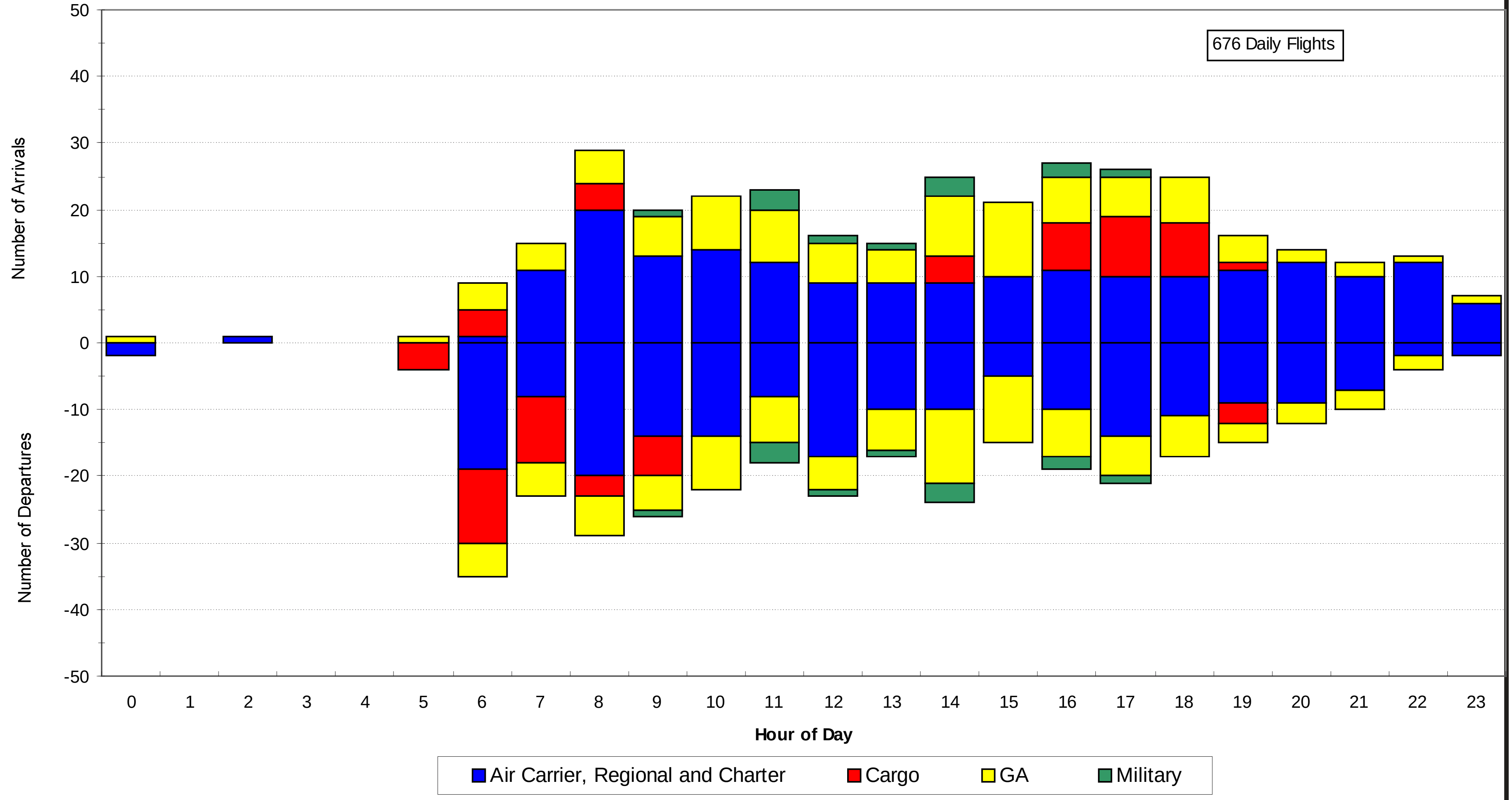


SACRAMENTO COUNTY AIRPORT SYSTEM

Sacramento International Airport Master Plan Study

DAILY DEMAND 2005

EXHIBIT 4.1-3



SACRAMENTO COUNTY AIRPORT SYSTEM

Sacramento International Airport Master Plan Study

DAILY DEMAND 2010

EXHIBIT 4.1-4

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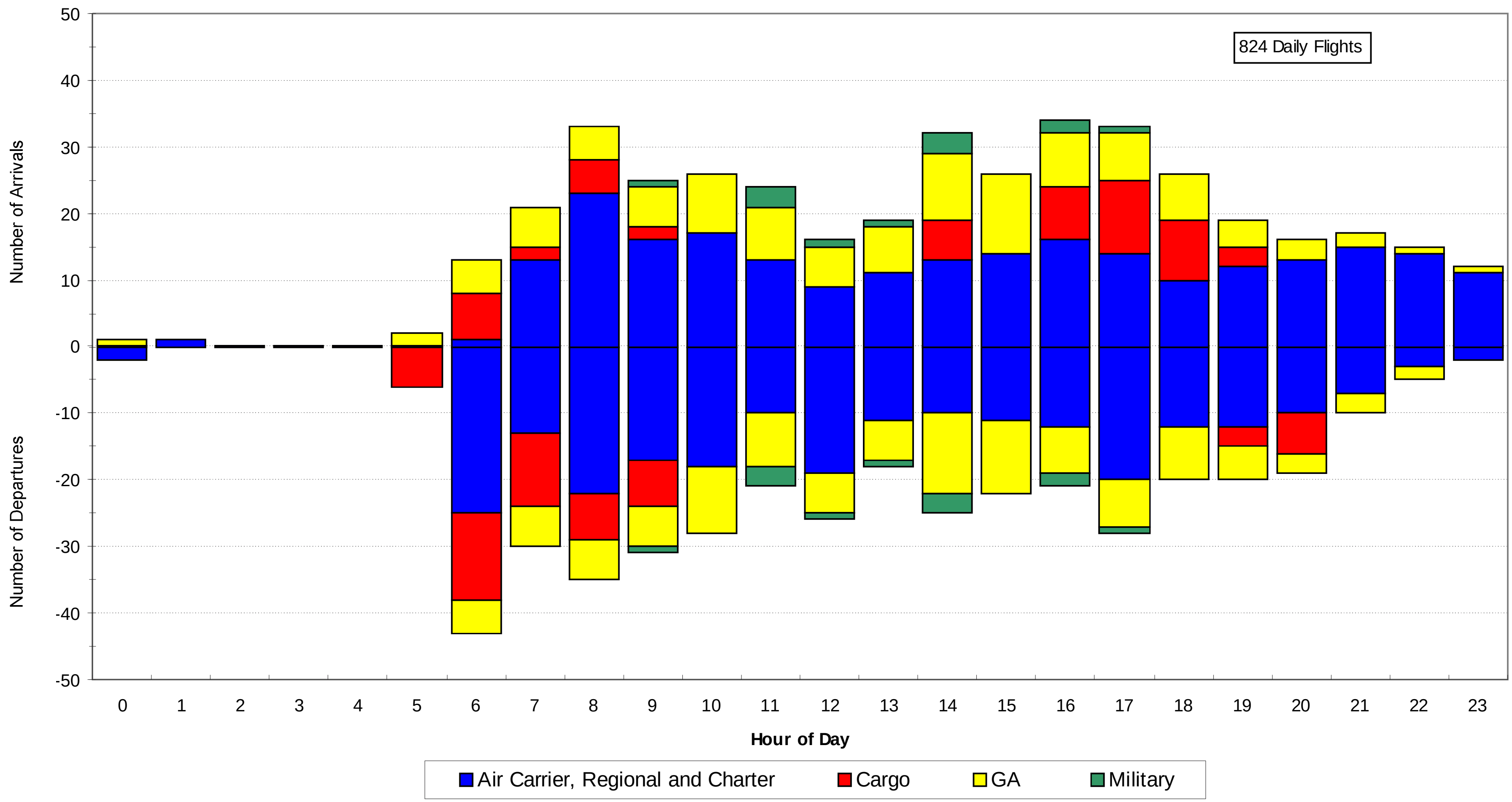

SACRAMENTO COUNTY AIRPORT SYSTEM

Sacramento International Airport
Master Plan Study

DAILY DEMAND 2020

EXHIBIT
4.1-5

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PB AVIATION, INC.

TABLE 4.15 Sacramento International Airport SIMULATED ACTIVITY LEVELS		
Year	Daily Operations	Peak Arrival and Departure Hour
2005	612	48 (08:00-8:59 AM)
2010	676	58 (08:00-8:59 AM)
2020	824	69 (08:00-8:59 AM)

Source: PB Aviation Analysis

Note: The four helicopter operations in each traffic demand projection were removed from the simulation because they do not use a runway.

SIMMOD PLUS is capable of handling a wide variety of aircraft types. However, aircraft are grouped into aircraft classes defined by the user. Within each class, aircraft generally have the same size, weight, and performance characteristics. For the simulation experiments, the following classes were used:

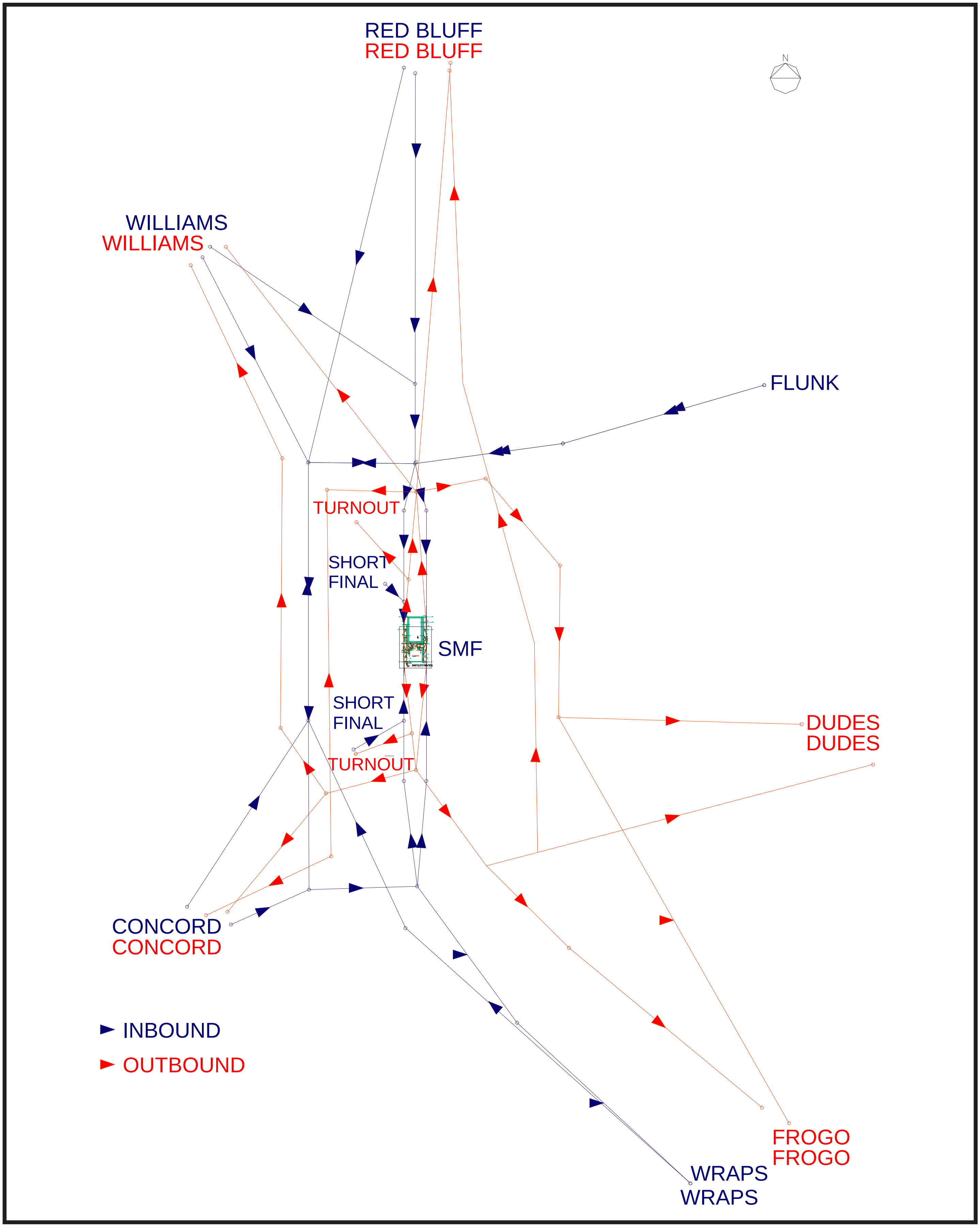
- Group 5–Heavy Jets–includes all wide-bodied aircraft, plus DC 8 and 707 freighters. Of these, only the DC 10 was observed at the Airport.
- Group 4–757 aircraft
- Group 3–Large Jets–Air carrier jets ranging in size from the F-28 to the A320. This class also includes the various 737 models seen at the Airport.
- Group 2–Small Aircraft–Primarily covers all twin turboprop aircraft, but includes a range covering regional jets, corporate jets and single-engine Cessna Caravan turboprops.
- Group 1–General Aviation–All single-engine piston aircraft

In many studies, the 757 has been classified in its own separate category due to its unique airspace separation characteristics; this simulation study utilized that approach and modeled the 757 separately.

4.1.2.2 Airspace Utilization

SIMMOD airspace is defined as an interrelated network of aircraft routes that are comprised of a series of nodes and links. As each aircraft traverses a link, it is required to maintain minimum separation from preceding and succeeding aircraft unless the link is defined to allow passing.

Exhibit 4.1-6 depicts the arrival and departure routes that were simulated for this analysis. There are five approach paths to the Airport that are used in all wind and weather situations:



Sacramento County Airport System

Sacramento International Airport
Master Plan Study

SIMULATED AIRSPACE

EXHIBIT
4.1-6

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PB AVIATION, INC.

- FLUNK3 – Northeast from Squaw Valley – Handles jet arrivals from Denver, Dallas, Phoenix, Kansas City, Las Vegas, Houston, Chicago, Washington and other destinations not in California, Oregon or Washington.

- WRAPS5 – South over the Linden VORTAC – Handles jet traffic from Southern California, including Los Angeles, San Diego, Orange County, Burbank, and Ontario. Any future traffic from Mexico would approach over this fix.

- TUDOR1 (Red Bluff) – North from Red Bluff – Handles Jet arrivals from Portland and Seattle. Would handle future traffic from Vancouver.

- TUDOR1 (Williams) – Northwest from the Williams VORTAC – Handles turboprop arrivals from Eureka/Arcata and other northern California locations.

- CONCORD1 – Southwest from the Concord VORTAC – Handles all turboprop traffic from San Francisco, Oakland and San Jose.

In South Flow VMC, an arrival route is designated for all Group 1 and Group 2 general aviation. Aircraft on this route arrive from the west to Runway 16R after a short (two nautical miles) final approach. In North Flow VMC, a similar arrival route handles Group 1 and Group 2 arrivals on Runway 34L. These routes are discontinued in IMC and the traffic on these routes is divided between the Concord1 and Tudor1 (Williams) approaches.

There are five departure routes from Sacramento:

- DUDES9 – Aircraft turn eastbound when feasible after departure and proceed to the DUDES intersection south of Squaw Valley. Jets bound for all destinations not in California, Oregon or Washington use this route.

- FROGO6 – Aircraft proceed southeast, staying north of the Linden VORTAC. Jet departures bound for destinations in Southern California use this route.

- METRO1 (Jet) – Aircraft turn east, and then proceed northbound toward Red Bluff. Jet departures bound for Seattle and Portland use this route.

- METRO1 (Prop) – Aircraft turn northwest toward Williams. Turboprops bound for Eureka/Arcata use this route.

- CONCORD1 (Prop) – Aircraft turn southwest toward Concord. Turboprops bound for San Francisco, Oakland and San Jose use this route.

In South Flow VMC, general aviation traffic in Group 1 and Group 2 makes a westbound turn two nautical miles beyond the end of Runway 16R. Group 1 aircraft follow this procedure after an intersection takeoff from Taxiway A8. Group 2 aircraft follow this procedure from the runway end (Taxiway A3). In North Flow VMC, general aviation traffic in Group 1 and Group 2 make a westbound turn two nautical miles beyond the end of Runway 34L. These routes are discontinued in IMC weather, and the traffic displaced from these departure routes is divided equally between the Metro 1 (Prop) procedure and the Concord1 (Prop) procedure.

Aircraft enter and exit each node on a first-come-first-serve basis, except at nodes where paths converge, where the faster aircraft proceeds ahead of the slower aircraft. In-trail separations are a minimum of five nautical miles through each node, except on final approach or immediately after departure (within six nautical miles of the runway end), when the minimum separation is three nautical miles. Each node has a capacity of one; aircraft are held at a node if the next node is occupied. No holding patterns are provided.

Arrivals within three nautical miles of the runway block departure procedures until the arriving aircraft is clear of the runway. Group 1 arrivals clear the runway in 45 seconds, Group 2 clear in 50 seconds, Groups 3, 4 and 5 clear in 60 seconds. Departures block subsequent arrivals for a minimum of 45 seconds, and block subsequent departures until the aircraft is 3 nautical miles beyond the departure runway end. Minimum aircraft separations during VMC are presented in **Table 4.1-6**.

TABLE 4.1-6
Sacramento International Airport
MINIMUM AIRCRAFT SEPARATIONS (NM) – VMC

	Lead Aircraft				
Trail Aircraft	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1	1.9	2.1	2.7	3.6	4.5
Group 2	1.9	2.1	2.7	3.6	4.5
Group 3	1.9	1.9	1.9	2.7	3.6
Group 4	1.9	1.9	1.9	2.7	3.6
Group 5	1.9	1.9	1.9	2.7	2.7

Source: FAA Advisory Circular 150-5060-5 and FAA EM-78-8A

During IMC, arrivals within three nautical miles of Runways 16L and 16R block departure procedures until clear of the runway. Arrivals do not occur on Runway 34R, which has no ILS system. Arrivals within five nautical miles of Runway 34L block departures until clear of the runway (because departures need the additional spacing to reach the runway end from the queue on Taxiway A and begin their takeoff roll). Group 1 and Group 2 arrivals clear the runway in 65 seconds, Groups 3, 4 and 5 clear the runway in 75 seconds. Departures block subsequent arrivals for a minimum of 45 seconds, and block subsequent departures until the aircraft is three nautical miles beyond the departure runway end. Minimum aircraft separations during IMC are presented in **Table 4.1-7**.

TABLE 4.1-7

Sacramento International Airport

MINIMUM AIRCRAFT SEPARATIONS (NM) – IMC

	Lead Aircraft				
Trail Aircraft	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1	3.0	3.0	4.0	4.0	6.0
Group 2	3.0	3.0	4.0	4.0	6.0
Group 3	3.0	3.0	3.0	3.0	5.0
Group 4	3.0	3.0	3.0	3.0	5.0
Group 5	3.0	3.0	3.0	3.0	4.0

Source: FAA Advisory Circular 150-5060-5 and FAA EM-78-8A

Average aircraft speeds for all conditions are presented in **Table 4.1-8**.

TABLE 4.1-8

Sacramento International Airport

AVERAGE AIRCRAFT SPEEDS (NM/HR) – ALL CONDITIONS

	Air Link Type						
Aircraft Class	1	2	3	4	5	6	7
Group 1	110	100	90	80	90	100	110
Group 2	230	170	120	115	120	170	200
Group 3	250	210	170	135	170	210	250
Group 4	250	210	170	135	170	210	250
Group 5	250	210	170	140	180	210	250

Source: FAA Advisory Circular 150-5060-5 and FAA EM-78-8A

4.1.2.3 Runway Utilization

To the extent practical, aircraft arriving at the Airport are assigned to a particular runway based on their terminal location, rather than their arrival or departure airspace fix. Therefore, operations by American, United, Alaska Airlines, Horizon, TWA and Northwest are assigned to Runway 16R/34L, while operations by Southwest, Continental, America West, and Delta are assigned to 16L/34R. All cargo and general aviation operations are located on the west side of the Airport and use Runway 16R/34L.

Today, FAA Air Traffic Control (ATC) personnel are able to separate aircraft landings by terminal because there is ample airfield capacity. As air traffic grows, however, this flexibility will diminish. SIMMOD has the capability to perform dynamic reassignment of aircraft to an available runway; as demand levels increase, this capability was used to model operations in the forecast years. **Exhibit 4.1-7** depicts the airfield network that was used in the simulations.

Assumptions concerning arrival runway length usage were based on field observations of runway exit utilization and were adjusted based on input from FAA ATC personnel at the Airport. **Table 4.1-9** depicts the assumptions that were used to model arrival runway length use for each aircraft class during VMC (dry pavements). Group 1 percentages are adjusted to compensate for the tendency of general aviation arrivals on Runway 16R to "land long."

TABLE 4.1-9

Sacramento International Airport

PERCENTAGE OF ARRIVALS EXITING RUNWAY 16R WITHIN STATED DISTANCE - VMC

All Runways	2,150 feet	3,700 feet	4,300 feet	5,200 feet	6,050 feet	8,500 feet
Group 1	7%	14%	79%	0%	0%	0%
Group 2	4%	6%	51%	20%	19%	0%
Group 3, 4	0%	0%	6%	52%	22%	20%
Group 5	0%	0%	0%	10%	60%	30%

Source: PB Aviation Analysis

Runway usage assumptions during IMC (wet pavements) are listed in **Table 4.1-10**. The average length of runway used by arriving aircraft increases in IMC.

TABLE 4.1-10

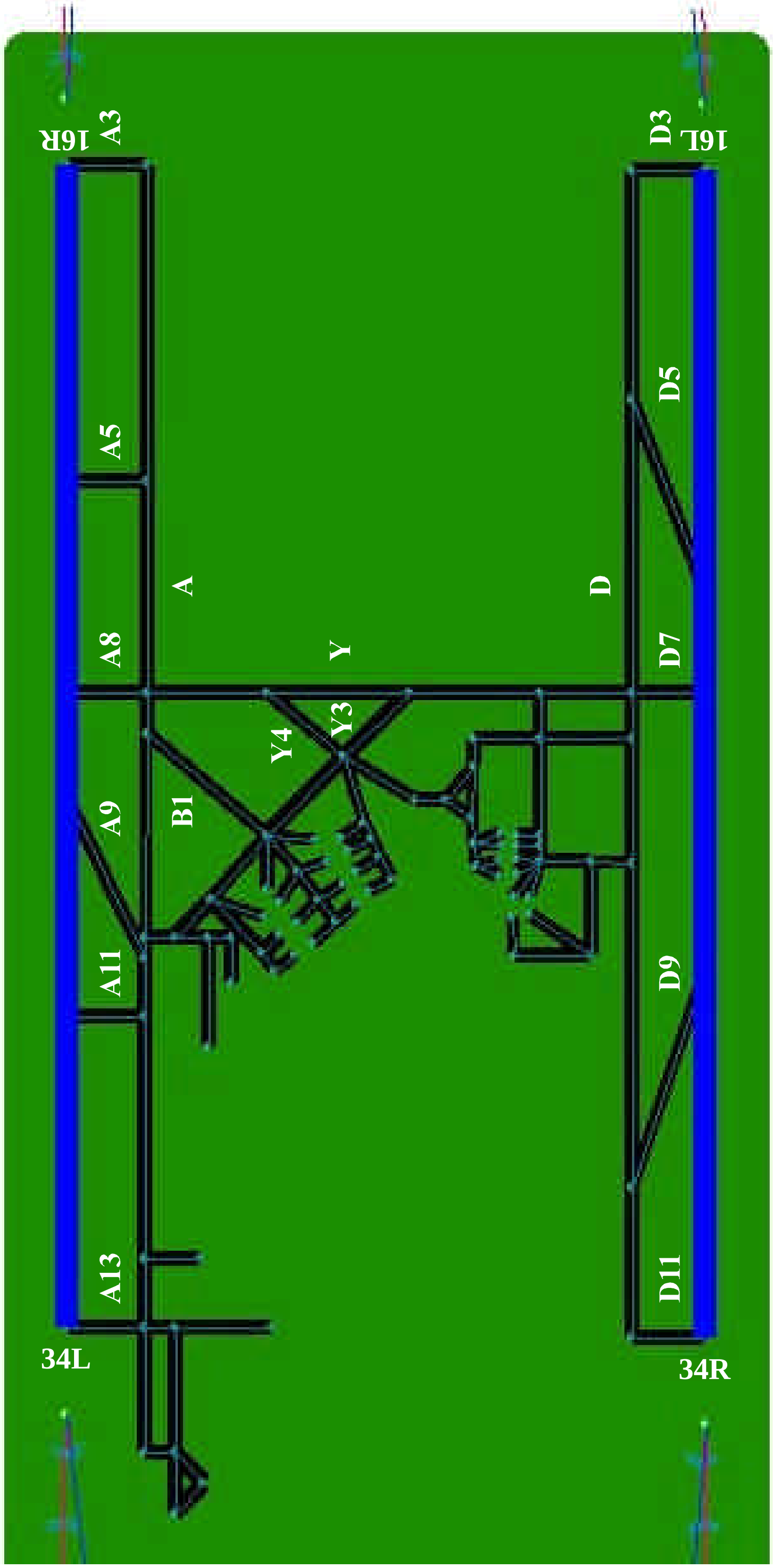
Sacramento International Airport

PERCENTAGE OF ARRIVALS EXITING RUNWAY 16R WITHIN STATED DISTANCE - IMC

All Runways	2,150 feet	3,700 feet	4,300 feet	5,200 feet	6,050 feet	8,500 feet
Group 1	0%	10%	60%	30%	0%	0%
Group 2	0%	0%	25%	25%	50%	0%
Group 3, 4	0%	0%	0%	25%	40%	35%
Group 5	0%	0%	0%	0%	50%	50%

Source: PB Aviation Analysis

Departure runway length usage was not measured and was confirmed through coordination with FAA ATC personnel. **Table 4.1-11** contains departure runway length usage assumptions for VMC and IMC. Departure runway length usage is expected to be unaffected by wet weather.



SACRAMENTO COUNTY AIRPORT SYSTEM

Sacramento International Airport
Master Plan Study

SIMULATED AIRFIELD

EXHIBIT 4.1-7

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PB AVIATION, INC.

TABLE 4.1-11 Sacramento International Airport DEPARTURE RUNWAY LENGTH USAGE DISTRIBUTION				
All Runways	2,500 feet	4,500 feet	6,500 feet	8,500 feet
Group 1	65%	35%	-	-
Group 2	25%	75%	-	-
Group 3, 4	-	25%	50%	25%
Group 5	-	-	75%	25%

Source: PB Aviation Analysis

4.1.2.4 Airfield Utilization During South Flow VMC

Both cargo and general aviation aircraft in Groups 1 and 2 were observed to depart on Runway 16R from a variety of taxiway intersections. To simplify the model inputs, intersection departures were only permitted from Taxiway A8. United Airlines departures using Group 2 aircraft do not use intersection departure procedures.

General aviation arrivals and departures were frequently observed using a short final arrival procedure, in which the aircraft merged with the final approach path to Runway 16R within two nautical miles of the runway threshold or turned off of departure heading two nautical miles beyond the runway end. For the purposes of coding both the arrival and departure flight tracks, Group 1 and Group 2 general aviation and cargo departures were assumed to execute a westbound turn two nautical miles beyond the runway end. Group 2 arrivals were assumed to approach from the west and converge with the final approach to Runway 16R two nautical miles from the runway threshold.

Because the location of the general aviation terminal is close to Taxiway A13, many aircraft in Group 1 elect to “land long” on Runway 16R and exit the runway at Taxiway A13. The landing distance probability distribution reflects the occurrence of long landings on Runway 16R.

4.1.2.5 Airfield Utilization During South Flow IMC

Intersection departures are assumed to be discontinued in inclement weather, as are “long landings” by Group 1 aircraft. All departures use the queues at the ends of Runways 16L and 16R. At the same time, short final approaches and turns from departure heading following takeoff, used principally by general aviation aircraft, are assumed to be discontinued. General aviation operations by Group 1 aircraft, which are usually not equipped for instrument operations, are assumed to be discontinued.

IMC conditions are often associated with wet pavements and reduced braking capability. The analysis assumes that wet weather increases the stopping distance of arriving aircraft by 1000 feet in all aircraft classes and on all runways.

The additional braking time increases the time separation intervals between an arrival and a following arrival or departure on the same runway by an average of 10 seconds.

Discussions with FAA ATC personnel indicated that marginal visibility conditions (e.g. fog), which occur frequently, require air traffic controllers to verify aircraft positions by radio contact. Consequently, the analysis assumes that aircraft taxi speeds outside the terminal gate areas during IMC are reduced by 10 nautical miles/hour.

4.1.2.6 North Flow VMC

Airfield operations under north wind conditions could not be observed during the study period. However, SIMMOD determines runway exit utilization based on a probability curve that defines the runway length used by an arriving aircraft.

Runway 34L has no hold apron associated with it. Departing aircraft queue on Taxiway A13 and must be processed on a first-come-first-served basis. Runway 34R has a hold apron which allows aircraft whose departure is delayed to be pulled out of sequence so that following aircraft can be cleared for departure. Therefore, the departure queue for Runway 34L is assumed to have a capacity of one aircraft, and departures may not be taken out of sequence as they become ready due to the lack of pavement that would provide a bypass.

4.1.2.7 North Flow IMC

Runway 34R has no ILS. It is assumed all arrivals use Runway 34L in IMC situations. For existing activity levels, the model distributed departures to each runway based on their terminal gate location. As activity levels increased, it was necessary to assign departing aircraft to whichever runway was available in order to make more efficient use of the runway system and reduce departure delays.

Aircraft departing on Runway 34L may not interfere with the runway glide slope. To avoid potential interference, the runway queue is established on a section of Taxiway A, midway between Taxiways A11 and A13. The queue is assumed to have a capacity of one (preventing an aircraft from taxiing around another aircraft in queue), and departures may not be taken out of sequence as they become ready.

Assumptions concerning additional breaking distance, reduced taxi distances and discontinuance of short final approaches and departure turns are identical to those assumed for South Flow IMC.

4.1.2.8 Taxiway Travel Times and Routes

Aircraft travel times on various airfield segments were measured in order to assign taxi speeds to aircraft on those segments. While some carriers had faster taxi speeds than others, it was generally observed that aircraft in all classes had similar taxi speeds on the same taxiway segments, and that taxi speeds tend to be slower in the terminal area than on the taxiways paralleling the two runways. Therefore, aircraft speeds on the taxiway system were estimated to average 25 nautical miles/hour (knots per hour), while taxi speeds in the gate areas were assumed to be 15 nautical miles/hour.

Aircraft routings on the taxiway system are assigned by the model on the basis of the shortest path (based on travel time) from exit taxiway to gate, and from gate to departure runway queue. Head-to-head conflicts were avoided by placing controls in the model. When aircraft are westbound on Taxiway Y, the model prevents eastbound aircraft from entering the taxiway until westbound traffic has cleared the taxiway, and vice versa. Taxiway A is controlled in the model in order to prevent head-to-head aircraft conflicts between Taxiways A9 and A13.

4.1.2.9 Departure Queues

In South Flow VMC, there are two departure queues for Runway 16R (at Taxiway A3 and Taxiway A8) and one for Runway 16L (at Taxiway D3). The departure queues at A3 and D3 can accommodate all aircraft groups; these queues are assumed to have a capacity of two aircraft each. Aircraft departing on all the principal departure fixes use this queue, except for the Group 1 general aviation aircraft that make an immediate westbound turn after departure. These aircraft depart from the queue at Taxiway A8. That queue has a capacity of one aircraft and is limited to Group 1 aircraft.

In South Flow IMC, there is only one departure queue at each runway end. The departure queue at Taxiway A8 is not used. Queue utilization and capacity are the same as in VMC.

In North Flow VMC and IMC, the departure queue for Runway 34R is Taxiway D11. It accommodates all aircraft groups and has a capacity of two aircraft. It is used by departures bound for all of the principal departure fixes, but not by general aviation departures. The departure queue for Runway 34L in VMC is Taxiway A13. It accommodates all aircraft groups and has a capacity of one aircraft. It is used by departures bound for all of the principal departure fixes. In IMC, the departure queue is at a point on Taxiway A, midway between Taxiways A11 and A13.

When a departure has been in queue for more than 180 seconds, the model increases the spacing between arrivals to allow the aircraft sufficient separation to depart.

4.1.2.10 Terminal Gate Utilization

To allow the simulation to model the aircraft interactions occurring in the terminal areas, the gate area for Terminals A and B was defined. Each individual gate was modeled with a capacity of one aircraft, except for the gate used by United Express (UAX), which uses Group 2 aircraft (EMB-120s). Gate area characteristics are presented in **Table 4.1-12**.

TABLE 4.1-12
Sacramento International Airport
GATE AREA CHARACTERISTICS

Gates	Number of Gates	Capacity	Largest Aircraft Class	Carrier
A-1, A-3	2	1	Group 4	Delta (DL)
A-2, A-4	2	1	Group 3	America West (HP), Continental (CO) (shared)
A-11 to A-17	8	1	Group 3	Southwest (WN)
B-31	1	3	Group 2	United Express (UE); No pushback, hardstand
B-33	1	1	Group 3	American (AA)
B-34 to B-38	5	1	Group 4	United (UA)
B-32	1	1	Group 3	TWA (TW)
B-21	1	1	Group 3	Alaska (AS)
B-22	1	1	Group 4	Northwest (NW)
B-23 to B-26	4	1	Group 3	Alaska (AS)
B-27	1	1	Group 3	Horizon (QX)
Fed Ex Feeder Apron	1	10	Group 2	Fed Ex Feeder (PC)
Fed Ex Apron	1	1	Group 5	Fed Ex (FE)
DHL	1	10	Group 4	DHL (DH)
General Aviation	1	100	Group 3	General Aviation (GA)

Source: Sacramento County Airport System

Gate assignments for each flight are made at random among the gates available to that particular airline. Arrivals and departures were paired, which allowed the impacts of delayed arrival times on the scheduled departure time of the outbound flight to be measured. All gates are pushback, and aircraft pushbacks block the taxi path adjacent to the gate.

4.1.2.11 24-Hour Average Aircraft Delay

When using a simulation model, the primary measures of airfield/airspace capacity are arrival airspace delay and departure taxi-out delay (including departure queue delay). Delay is measured as the difference in the amount of time an aircraft actually uses the runway and the time it would have used if it were able to move unimpeded throughout the airfield/airspace system. For example, if there is only one aircraft taxiing out to depart and it obtains immediate departure clearance, the aircraft would have no delay (0.0 minutes delay).

The majority of the arrival delay occurs in the airspace as aircraft maintain separations and are merged into final approach. However, the majority of the departure delay occurs on the airfield as aircraft taxi from the gate to takeoff on the runway. Generally, average arrival airspace delays less than three minutes are considered to be acceptable, while departure taxi-out delays often reach an average of six minutes before delays are considered unacceptable.

Delay statistics were evaluated for the entire 24-hour traffic demand. **Tables 4.1-13** and **4.1-14** present average delays for south flow and north flow under VMC. As indicated by the simulation results in Tables 4.1-13 and 4.1-14, the average delays during VMC are quite low at the Airport.

TABLE 4.1-13

Sacramento International Airport

AVERAGE DELAYS—SOUTH FLOW (RUNWAYS 16R/16L) – VMC

(minutes per aircraft)

	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	202	0.37	205	0.30
2005	305	1.26	305	0.71
2010	338	1.62	338	0.81
2020	412	2.63	412	2.22

Source: PB Aviation Analysis

TABLE 4.1-14

Sacramento International Airport

AVERAGE DELAYS—NORTH FLOW (RUNWAYS 34R/34L) – VMC

(minutes per aircraft)

	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	202	0.48	205	0.42
2005	305	1.39	305	0.59
2010	338	1.89	338	0.78
2020	412	3.12	412	1.75

Source: PB Aviation Analysis

Tables 4.1-15 and **4.1-16** present average delays for south flow and north flow under IMC. The delays observed during IMC North flow are considerably higher than VMC because only one runway (34L) is available for arrivals. Only a small percentage of the annual operations occur in IMC at the Airport; however, estimates of delay during IMC are very important in the airfield capacity evaluation for the Airport.

TABLE 4.1-15				
Sacramento International Airport				
AVERAGE DELAYS—SOUTH FLOW (RUNWAYS 16R/16L) – IMC				
(minutes per aircraft)				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	202	0.39	205	0.36
2005	298	1.61	298	0.82
2010	331	1.93	331	0.85
2020	405	3.68	405	2.76

Source: PB Aviation Analysis

TABLE 4.1-16				
Sacramento International Airport				
AVERAGE DELAYS—NORTH FLOW (RUNWAYS 34R/34L) – IMC				
(minutes per aircraft)				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	202	1.01	205	0.66
2005	298	1.75	298	0.91
2010	331	3.09	331	1.29
2020	405	9.93	405	3.01

Source: PB Aviation Analysis

4.1.2.12 Peak Hour Average Delay

Another measure of delay is the average delay for peak hour operations. **Tables 4.1-17** and **4.1-18** present average delays during peak hour operations for south flow and north flow in VMC. As indicated, departure delays are expected to be acceptable throughout the planning period; however, peak hour arrival delays begin to reach an unacceptable level of delay (three minutes) when activity levels for 2010 and 2020 are simulated.

TABLE 4.1-17				
Sacramento International Airport				
AVERAGE PEAK HOUR DELAYS—SOUTH FLOW (RUNWAYS 16R/16L) – VMC				
(minutes per aircraft)				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	15	0.67	16	0.25
2005	24	2.13	24	0.75
2010	29	2.52	29	0.86
2020	34	3.56	35	2.40

Source: PB Aviation Analysis

TABLE 4.1-18 *Sacramento International Airport* *AVERAGE PEAK HOUR DELAYS—NORTH FLOW (RUNWAYS 34R/34L) – VMC* *(minutes per aircraft)*				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	15	0.69	16	0.38
2005	24	2.67	24	0.79
2010	29	3.03	29	1.55
2020	34	4.43	35	1.63

Source: PB Aviation Analysis

Tables 4.1-19 and **4.1-20** present average peak hour delays for south flow and north flow during IMC. The delays observed during IMC are slightly higher than those simulated for VMC, especially during the north flow. Arrival delays become unacceptable as peak hour activity levels grow, and particularly during north flow IMC conditions.

TABLE 4.1-19 *Sacramento International Airport* *AVERAGE PEAK HOUR DELAYS—SOUTH FLOW (RUNWAYS 16R/16L)* *INSTRUMENT METEOROLOGICAL CONDITIONS* *(minutes per aircraft)*				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	15	0.67	16	0.31
2005	22	2.36	21	0.76
2010	27	2.78	25	1.16
2020	32	4.44	32	3.28

Source: PB Aviation Analysis

Table 4.1-20 *Sacramento International Airport* *AVERAGE PEAK HOUR DELAYS—NORTH FLOW (RUNWAYS 34R/34L)* *INSTRUMENT METEOROLOGICAL CONDITIONS* *(minutes per aircraft)*				
	Arrival		Departure	
Year	Number of Flights	Average Delay	Number of Flights	Average Delay
2000	15	1.60	16	0.56
2005	22	5.45	21	0.62
2010	27	6.59	25	1.44
2020	32	12.81	32	1.56

Source: PB Aviation Analysis

4.1.2.13 Summary of Simulation Results

Much like the analysis of the theoretical capacity, the simulations indicate that the airfield at the Airport generally is capable of accommodating projected demands throughout the planning period. However, the simulations indicate some very specific issues that should be addressed in planning for the Airport's future. First, the need for precision approach capability on Runway 34R is clearly evident in the simulations. Second, the simulations demonstrate a need to balance runway use in the future and the flexibility of FAA ATC personnel to assign a runway based on its origin or destination point on the Airport will diminish as traffic levels grow. Third, the simulations project rising levels of peak hour arrival delay during the latter portion of the planning period. Consequently, the Master Plan Study should consider peak hour arrival capacity enhancement measures in its assessment of long-term alternatives.

Also, it is important to note that the delays that were simulated occur as a result of the airfield configuration, airspace procedures, and air traffic demand specific to the Airport and the airspace immediately surrounding it. No attempt has been made to account for delays to aircraft generated by traffic at destination airports. While a number of aircraft departing from the Airport were delayed because of flow controls at the Los Angeles and San Francisco airports, those delays are not part of this study.

4.1.3 Airspace Capacity Issues

The airspace surrounding the Airport is under the operational jurisdiction of FAA ATC. The efficiency of the use of that airspace is determined by air traffic control procedures implemented for the safety of operations through the airspace as described in the previous sections.

ATC flow management and traffic separation standards ensure that actual operations do not exceed the airspace capacity. The trade-off for such safety assurance measures is that some aircraft are delayed. As indicated in Section 4.1.2, an increase in arrival delay is expected at the Airport as traffic levels increase, and arrival delays are likely to become problematic during peak hour operations. Arrival delay is a measurement of aircraft delays in the air and is related to the configuration of the airfield as well as airspace management and ATC procedures. Consequently, it may be necessary to look at opportunities for improving airspace procedures during the later part of the planning period. Improvements to airspace management are the responsibility of the FAA.

The FAA through its National Airspace Redesign (NAR) will restructure existing domestic and oceanic airspace to increase its efficiency, while maintaining a high level of safety. The NAR will consist of incremental changes to the national airspace structure, consistent with evolving air traffic and avionics technologies. The particular elements described have the potential to improve airspace capacity for the Airport. One key element of the NAR is the redesign of traffic routes. Aircraft generally follow airways defined by ground navigational aids. Because these are not direct routes from origin to destination, the time and distance required is increased. Modern avionics such as the global positioning system (GPS) and flight management systems (FMS) can provide more direct and user-preferred routes.

The other key element that is nearing implementation is the consolidation of terminal radar approach facilities, including several in Northern California. Rather than using separate TRACON facilities at each airport in a particular region, a consolidated facility allows airspace restructuring by improving communications among controllers handling operations over a wide geographic range and increasing their flexibility in merging, maneuvering, and sequencing aircraft to and from the area airports.

Finally, airspace capacity is also limited by special use airspace. The only special use airspace in the area is the Alert Area associated with Travis Air Force Base, which is twelve miles southwest of the Airport. Alert Area airspace is not restricted to civil air traffic. Civil air traffic in this area is advised to remain "particularly alert" during hours of military flight activities. The Alert Area is subdivided into north and south areas. The north area, nearest the Airport, extends from the surface to 6,000 feet, and the published hours of use are 8 AM to 9 PM, local time. Because of the cooperation between civilian and military air traffic control personnel, the Alert Area is not a problem today or expected to be in the future.

4.1.4 Geometric Design Requirements

The planning and design of an airport is typically based on the airport's role and the critical aircraft that are planned to use it. Guidance for the planning and design of the airfield are based on FAA Advisory Circulars that aim to maximize airport safety, economy, efficiency, and longevity.

For geometric design purposes, it is necessary to establish applicable design standards for future runway and taxiway development. Information from FAA Advisory Circular 150/5300-13, *Airport Design*, was used to determine the Airport Reference Code (ARC) for the Airport. The ARC is a coding system used to relate airport design criteria to the operational and physical characteristics of the aircraft intended to operate at an airport (see **Table 4.1-21**). The ARC has two components that reflect an airport's critical aircraft. The first component, designated by a letter, is the approach category of the aircraft as defined by aircraft approach speed. The second component, designated by a Roman numeral, is the airplane design group as determined by aircraft wingspan. Generally, aircraft approach speed applies to runways and runway-related facilities, whereas, aircraft wingspan relates primarily to separation criteria involving taxiways and taxilanes.

Standards at the Airport are based on the current and projected aircraft fleet. It should be noted that the airfield will be designed to meet a variety of needs of many different aircraft. As reflected in Table 4.1-21, all series of Boeing's 747 aircraft fall within an ARC of D-V, while the 767 and 757 are classified as ARC C-IV aircraft. The A380 superjumbo aircraft under development by Airbus would be classified as ARC D-VI.

TABLE 4.1-21 *Sacramento International Airport* *FAA AIRCRAFT CLASSIFICATIONS*		
FAA Aircraft Approach Category Classification		
Approach Category	Approach Speed (knots)	
A	Less than 91	
B	91 – 120	
C	121 – 140	
D	141 – 165	
E	166 or greater	
FAA Airplane Design Group Classification		
Airplane Design Group	Wingspan (feet)	Typical Aircraft
I	Less than 49	Learjet 24, Rockwell Sabre 75A
II	49 but less than 79	Falcon 50, Rockwell Sabre 80
III	79 but less than 118	727, 737, MD80, DC9
IV	118 but less than 171	757, 767
V	171 but less than 214	747, A330, A340
VI	214 but less than 262	Antonov AN-124, A380

Source: FAA Advisory Circular 150/5300-13

Forecasts prepared for the Airport indicate that the DC10, A300-600, and the 767-400ER will be the critical aircraft for the airfield. All these aircraft have an ARC of D-IV, so the runway and taxiway systems, as a minimum, will need to be designed to these standards. Another consideration is the Airport's role in the regional aviation system. When San Francisco International Airport, the 5th busiest airport in the United States, experiences poor weather conditions and congestion, the Airport is used as an alternate for landing. Therefore, runway width and taxiway separations need to meet design standards for Group V (e.g., 747) and Group VI (e.g., A3XX) aircraft. **Table 4.1-22** shows the applicable FAA design criteria for Group IV, V, and VI aircraft.

TABLE 4.1-22 ***Sacramento International Airport*** ***AIRFIELD DESIGN REQUIREMENTS***			
Design Criteria	Group IV (ft.)	Group V (ft.)	Group VI (ft.)
Runway Width	150	150	200
Runway Shoulder Width	25	35	40
Runway Centerline to:			
- Taxiway Centerline	400	400	600
- Aircraft Parking Area	500	500	500
Runway Object Free Area (Width)	800	800	800
- Length Beyond Runway End	1,000	1,000	1,000
Runway Obstacle Free Zone (Width)	400	400	400
- Length Beyond Runway End	200	200	200
Runway Safety Area (Width)	500	500	500
- Length Beyond Runway End	1,000	1,000	1,000
Taxiway Width	75	75	100
Taxiway Centerline to:			
- Parallel Taxiway Centerline	215	267	324
- Fixed or Movable Object	130	160	193
Taxiway Object Free Area (Width)	259	320	386
Taxiway Safety Area (Width)	171	214	262
Runway Blast Pad			
- Length	200	400	400
- Width	200	220	280

Source: FAA Advisory Circular 150/1500-13

4.1.5 Runway Length

The future fleet mix at the Airport is projected to contain a mix of aircraft types that shift over the planning period. As outlined in Chapter 3.0, Activity Projections, the passenger fleet includes larger aircraft traveling longer distances, which results in the need for longer runways. The most demanding aircraft in the projected fleet in terms of runway length is the 767-400ER (Extended Range). This would be operated on direct international routes to London, England (projected by 2015) and Frankfurt, Germany (projected by 2020). The latest generation narrow-body aircraft, such as the 737-800 and A319, can provide non-stop service from Sacramento to the east coast, particularly New York City.

Runway length requirements were determined by the performance characteristics of the 767-400ER aircraft at maximum gross take-off weight for standard day and hot day temperatures. **Table 4.1-23** depicts runway length requirements at maximum gross takeoff weight. As shown, a runway length of 11,000 feet is needed to meet this requirement.

TABLE 4.1-23 ***Sacramento International Airport*** ***CRITICAL AIRCRAFT RUNWAY LENGTH REQUIREMENTS***			
Aircraft Model	Max. TOW (pounds)	Standard Day[2] (feet)	Hot Day[3] (feet)
767-400ER[1]	450,000	10,500	11,000

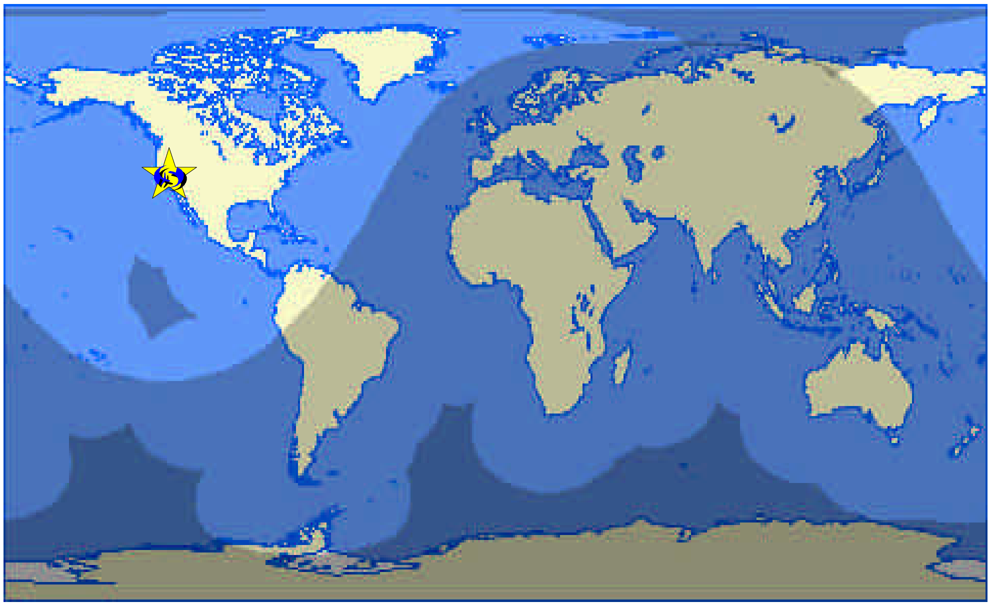
Sources: PB Aviation Analysis
Aircraft Operating Manuals

Notes: [1] GE CF6-80T9D-7Q Engines
[2] 59° F at sea level
[3] Hot day is defined as standard day + 27 degrees Celsius

To illustrate the operational limitations of the current airfield, **Exhibit 4.1-8** depicts ranges available at the existing 8,600-foot runway length and with an 11,000-foot runway length. If the runway were extended to 11,000 feet, the 767-400ER would be capable of flying non-stop to London or Frankfurt; these flights would require a fueling stop if the runway were to remain at 8,600 feet. Therefore, it is recommended that at least one runway at the Airport be extended to 11,000 feet. This runway extension may be needed earlier in the planning period if airlines choose to use different aircraft for non-stop service to the east coast.

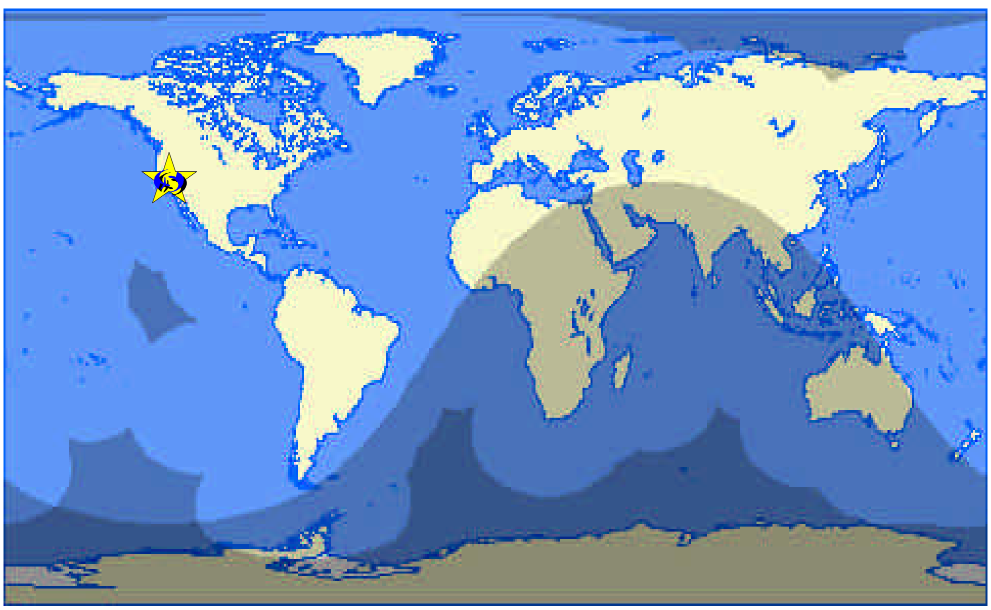
4.1.6 Runway Width

The Airport's parallel runways, Runways 16L/34R and 16R/34L are currently 150 feet wide. This runway width meets Group V design requirements. If there are



Shaded Area is Out of the Range

B-767-400ER
Aircraft Range with 8,600 FT Runway



Shaded Area is Out of the Range

B-767-400ER
Aircraft Range with 11,000 FT Runway

sufficient operations to qualify the A380 as the critical aircraft (500 per year), a runway width of 200 feet would be required. It is not anticipated that this requirement would be met at the Airport during the planning period.

4.1.7 Airfield Safety Areas

This section presents the FAA's standards as they apply to safety at the Airport. The following airfield safety standards apply and are reviewed in this section:

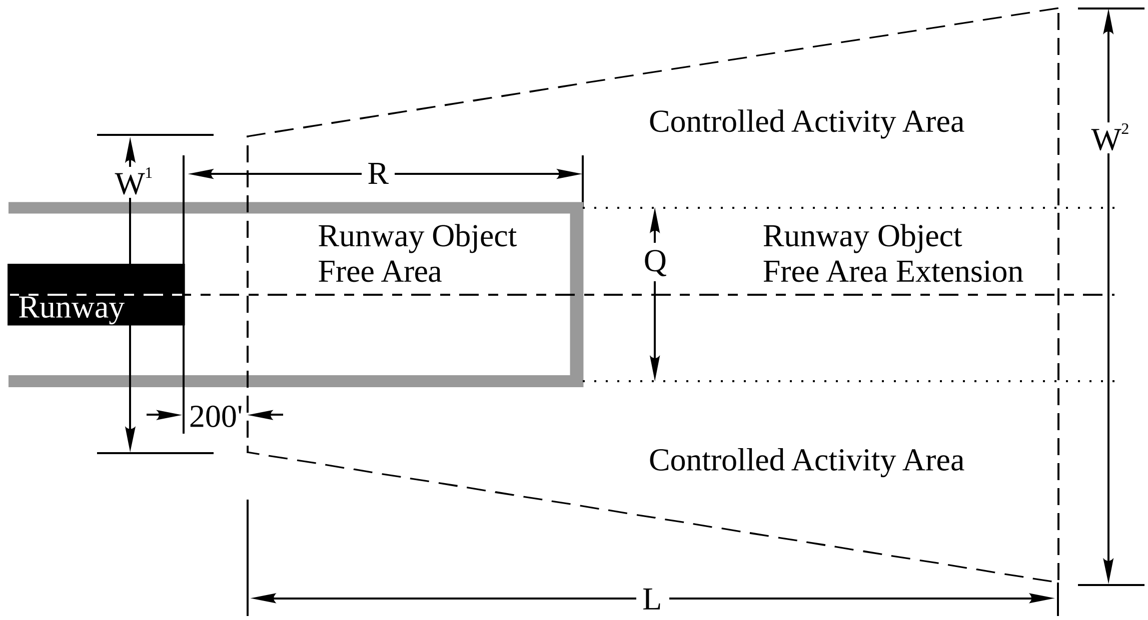
- Runway Protection Zone (RPZ)
  - Runway Object Free Area (OFA)
  - Controlled Activity Area
- Runway Safety Area (RSA)
- Obstacle Free Zone (OFZ)
  - Runway OFZ
  - Inner Approach OFZ
    - Inner-Transitional OFZ

4.1.7.1 Runway Protection Zone (RPZ)

As depicted in **Exhibit 4.1-9**, the RPZ is an area on the ground that is trapezoidal in shape and is centered on the extended runway centerline. The purpose of the area is to enhance the protection of people and property on the ground. This is achieved through airport owner control of property located in RPZs. The RPZ begins 200 feet beyond the end of the useable runway pavement/threshold. It is important to note that the threshold location does not affect the beginning point of the RPZ. The dimensions of the RPZ are contingent on the size of aircraft operating on the runway as well as the type of approach capability. Generally, as aircraft size increases and approach minimums decrease, the dimensions of the RPZ increase.

The RPZ contains two sub-areas: the runway OFA and the controlled activity area. These two sub-areas are described as follows:

- Runway OFA – The runway OFA is a two-dimensional ground area surrounding the runway. FAA standards prohibit parking aircraft and objects, except NAVAIDs and frangible objects with locations fixed by function, (e.g. RVR posts) within the OFA. The OFA lengths for both runways extend 1,000 feet beyond the respective runway end and are 800



Runway	W^1	W^2	L	R	Q
34L	1,000 FT	1,750 FT	2,500 FT	1,000 FT	800 FT
16R	1,000 FT	1,750 FT	2,500 FT	1,000 FT	800 FT
34R	1,000 FT	1,750 FT	2,500 FT	1,000 FT	800 FT
16L	1,000 FT	1,750 FT	2,500 FT	1,000 FT	800 FT

W^1 = Runway Protection Zone - Inner Width
W^2 = Runway Protection Zone - Outer Width
L = Runway Protection Zone - Length
R = Object Free Area - Length
Q = Object Free Area - Width

Source: Advisory Circular 150/5300-13, *Airport Design*, Change 6.

Note: Dimensions shown are for approach visibility minimums of lower than 3/4 mile. Runway 34R does not currently have the instrument landing system required for this visibility minimum. However, the Airport has reserved the illustrated RPZ dimensions and will continue to do so in anticipation of equipping this runway with an instrument landing system.

SACRAMENTO COUNTY AIRPORT SYSTEM

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RUNWAY PROTECTION ZONE AND OBSTACLE FREE AREA STANDARDS

EXHIBIT 4.1-9

- feet wide. The runway system was reviewed and no prohibited objects in the runway OFAs were noted.

- Controlled Activity Area – The controlled activity area is the portion of the RPZ that lies outside the runway OFA. It is recommended that the Airport have positive control of this area. It should be free of land uses that create glare, smoke and activities that attract large amounts of people. While it is desirable to clear all objects from this area, some uses are permitted if they are below the approach surface and do not interfere with NAVAIDs. Golf courses (but not clubhouses) and certain agricultural operations, in particular, are permitted within the controlled activity area. The controlled activity areas for all runway ends are located on Airport property and are free of objects.

4.1.7.2 Runway Safety Area (RSA)

The RSA is a critical two-dimensional safety area surrounding the runway. Based on FAA design criteria, the RSAs for the runways at the Airport are 500 feet in width and extend 1,000 feet beyond each runway end. The RSA must be:

- Cleared, graded, and free of potentially hazardous surface variations
- Properly drained
- Capable of supporting ARFF equipment or an aircraft without causing damage to the aircraft
- Free of objects, except for objects mounted on low-impact resistant supports whose location is fixed by function

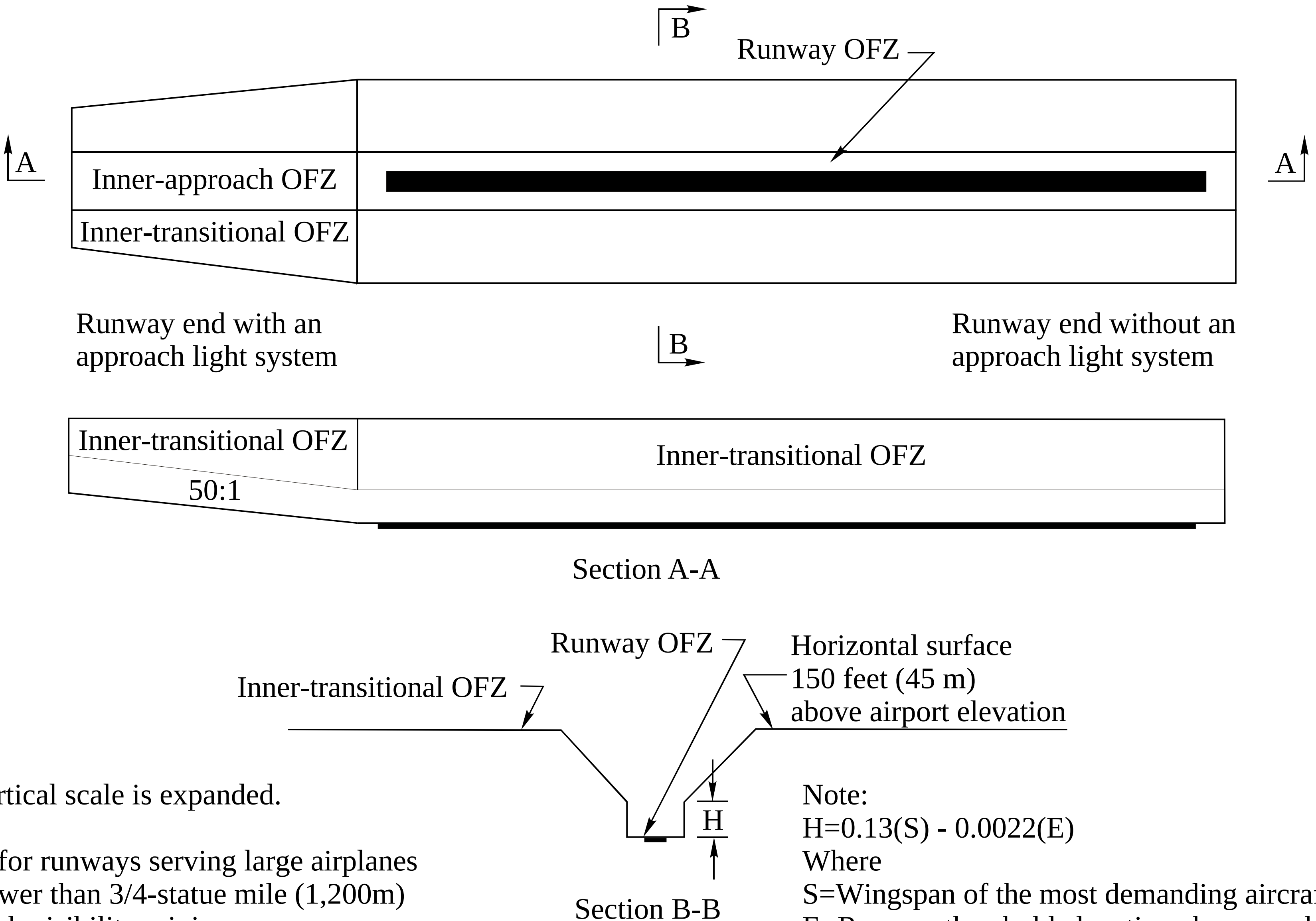
The RSA is the most stringently regulated surface associated with a runway. Currently, there are no violations to the RSAs for either existing runway.

4.1.7.3 Obstacle Free Zone (OFZ)

The OFZ, depicted in **Exhibit 4.1-10**, is a three-dimensional volume of airspace (as opposed to the RPZ, OFA, and RSA, which are two-dimensional and at ground level) that supports the transition of ground to airborne operations (or vice versa). The standards prohibit taxiing and parked aircraft and other objects, except frangible NAVAIDs or fixed-function objects, from penetrating the OFZ.

The runway OFZ extends 200 feet beyond each end of the runway and measures 400 feet in width.

Inner-Approach OFZ – The inner-approach OFZ is a defined volume of airspace centered on the approach area that applies only to runways



The vertical scale is expanded.

(OFZ) for runways serving large airplanes with lower than 3/4-statue mile (1,200m) approach visibility minimums.

Source: FAA AC 150/5300-13

Note:
H=0.13(S) - 0.0022(E)
Where
S=Wingspan of the most demanding aircraft
E=Runway threshold elevation above sea level

COUNTY AIRPORT SYSTEM

Sacramento International Airport Master Plan Study

OBSTACLE FREE ZONE

EXHIBIT 4.1-10

with approach lighting. The inner-approach OFZ begins 200 feet from the runway threshold and extends 200 feet beyond the last unit in the approach lighting system. It is the same width as the runway OFZ and rises at a slope of 50:1 away from the runway.

The Inner-Transitional OFZ – The inner-transitional OFZ is a defined volume of airspace along the sides of the runway OFZ and inner-approach OFZ. It applies to runways with lower than the ¾-statute mile approach visibility minimums.

Currently, no objects violate the runway OFZ, the inner-approach OFZ or the inner-transitional OFZ for the runways at the Airport.

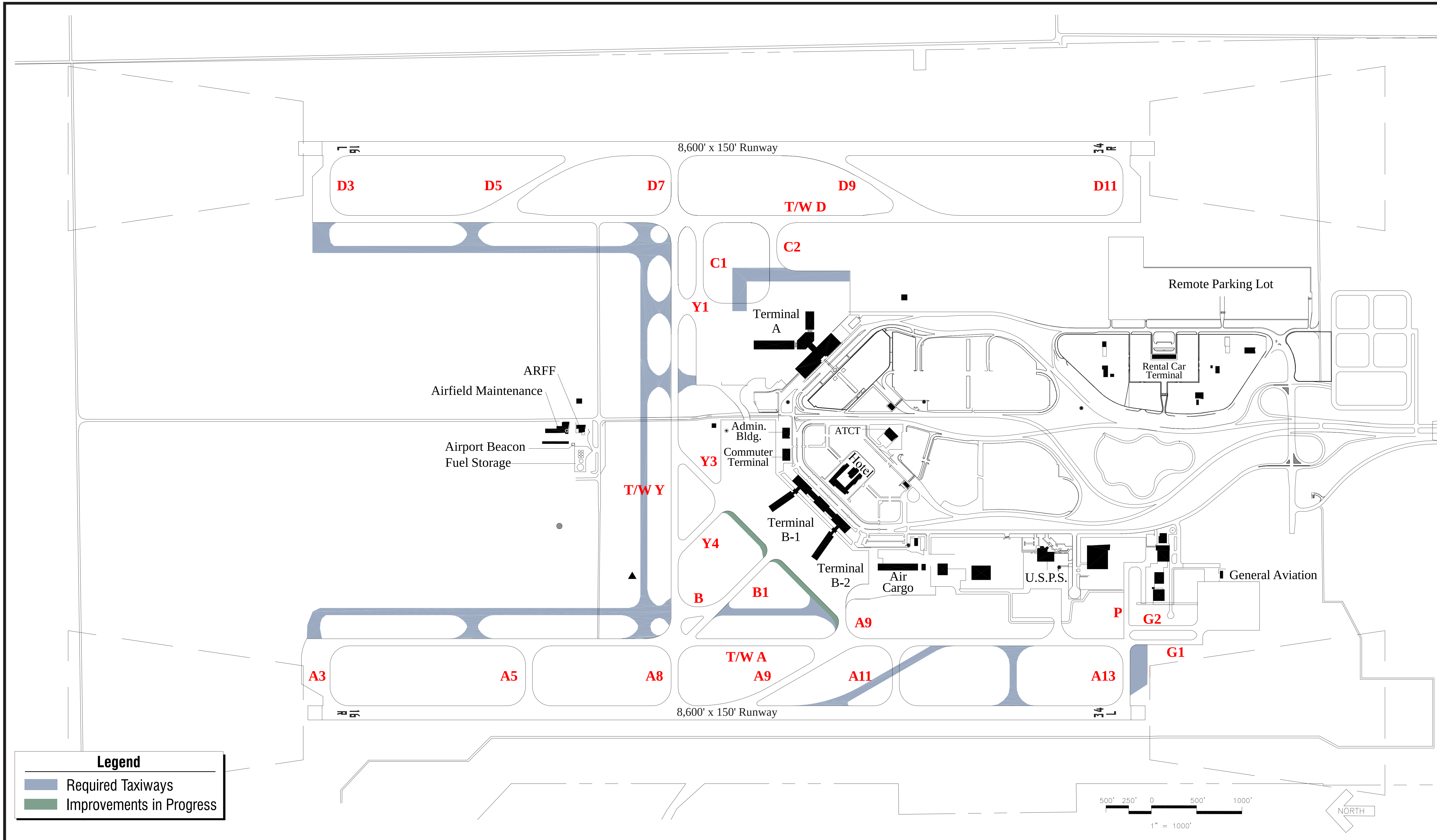
4.1.8 Taxiway Requirements

Taxiway requirements are based on the projected fleet that will be using the Airport over the 20-year planning period. With the exception of Taxiway G1 and G2 that provide access to the general aviation area, all existing taxiways meet or exceed Group V aircraft design standards. The separation distance between Taxiway A and Runway 16R/34L is 750 feet while the separation distance between Taxiway D and Runway 16L/34R is 748 feet.

It was ascertained through interviews with FAA ATC personnel and airfield users that several additional taxiways are desirable to make the airfield operate more efficiently. **Exhibit 4.1-11** illustrates the following taxiways:

- A cross-field taxiway parallel to Taxiway Y to minimize head-to-head conflicts with aircraft that cross from one side of the airfield to another.
- A bypass taxiway or hold pad at Runway 34L to allow additional aircraft queuing and the capability for aircraft that are ready to depart to bypass aircraft that are queued but not ready for departure.
- Full-length taxiways parallel to Taxiways A and D, creating a dual parallel system for each runway to minimize head to head aircraft conflicts.

An additional taxiway between Taxiway Y and the Terminal A apron to serve as an entrance to the apron.



Sacramento County Airport System

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TAXIWAY REQUIREMENTS

EXHIBIT 4.1-11

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- An additional acute-angled taxiway exit on Runway 16R/34L, located farther from the 16R threshold to allow more aircraft to exit the runway expeditiously, enhancing capacity.

Additional taxiway improvements to improve operational flow will be included in the alternatives development phase of the Master Plan Study, depending on the alternative under investigation.

4.1-9 Navigational Aids

The Airport is currently supported by instrument approaches to allow for continuous operations in IMC weather. Runway 16R is currently supported by Category (CAT) I, II, and III instrument landing systems (ILS). A CAT III ILS approach offers approach capabilities in zero ceiling and visibility conditions. Runways 16L and 34L are supported by a CAT I ILS approach. High Intensity Runway Lights (HIRLs) are currently in place for both runways and the runway ends are outfitted with appropriate approach lighting systems. The Airport's existing NAVAIDs should be upgraded to provide CAT III ILS approaches to Runways 16L, 34R and 34L. Additionally, the ILS glide slope transmitter for Runway 34L should be relocated from the east side of the runway, where aircraft on Taxiway A are required to hold short, in order to avoid interfering with the signal.

The visual approach slope indicator (VASI) lighting system serving Runway 34L should be upgraded to a precision approach path indicator (PAPI) when it reaches the end of its useful life.

Global positioning system (GPS) navigation uses signals transmitted by a series of satellites orbiting the earth. Unfortunately, the GPS service does not have sufficient accuracy and signal integrity to be used for precision instrument approaches to airports. The FAA is developing the Local Area Augmentation System (LAAS), a ground-based station to enable precision instrument approaches with GPS. A major benefit of LAAS is that one station can provide instrument approach capabilities to numerous airports.

According to the FAA, full deployment of LAAS will begin in year 2003 and will be completed by year 2007.

4.2 Access Requirements

This section assesses existing and forecast requirements for the Airport's access system. The capacities of the Airport's circulation systems, including its roadways and terminal curbfront, are identified and compared to forecast demand. The demand and capacity analysis addresses the location and timeframe for system improvements to achieve acceptable levels of service. Opportunities for managing transportation demand and light rail access to the Airport are also examined. Future Airport ground access demand will be used to plan and evaluate future Airport ground transportation facilities.

4.2.1 Ground Transportation Demand

Future trip volumes for the Airport's internal roadway system were calculated using the traditional four-step forecasting process: trip generation, mode split, trip distribution, and trip assignment. Off-Airport roadway volumes are calculated separately as part of the Master Plan Study environmental services contract, using the Sacramento Area Council of Governments' (SACOG) computer travel demand forecasting model.

4.2.2.1 Trip Generation

Airport trip generation rates were calculated by comparing existing passenger volumes, employee levels, cargo tonnage and general aviation operations to current traffic volumes at a screenline location. For this analysis, the screenline was located at the primary gateway into and out of the Airport.

Separate trip generation rates were calculated for passenger, employee, cargo and general aviation activity, and for four time periods:

- AM Peak Hour (8-9 AM)
- Midday Peak Hour (noon-1 PM)
- PM Peak Hour (4-5 PM)
- Daily (24 hour)

The AM and PM peak hour rates reflect peak levels of activity outside of the Airport during the morning and evening commute hours. Traffic counts (collected on Friday, June 9, 2000) indicated that the peak level of activity on the Airport's internal roadway system occurs midday between noon and 1 PM. The traffic counts also reflect seasonal variation as they were collected during the peak month and represent the highest peak hour for an average week during the peak month. The peak hour also represents the highest combined ingress and egress at the Airport's gateway near the I-5 Interchange. These time periods do not "capture" all employee trips to and from the Airport. Recent surveys indicate that there is a trend away from the traditional "nine to five" schedule.

To determine trip generation rates, current levels of activity for the four different trip purposes were compared to existing traffic volumes. Passenger volumes (total enplanements), cargo tonnage (freight pounds), general aviation operations and number of employees were provided by the Sacramento County Airport System for existing conditions (1999).

To determine separate trip generation rates for each trip type, it was first necessary to estimate the number of trips at the Airport's entrance associated with each trip type. The share of traffic for each trip type was calculated based on traffic volumes at access points to various Airport facilities. The following assumptions were made about the relationship between roadways and trip purposes:

- Airport Boulevard is the main Airport entrance roadway linking I-5 with the terminal and other key airport functions
- Earhart Drive provides a route to the airport exit for vehicles accessing Terminal A and the administration building
- McNair Circle provides access to the Rental Car Terminal
- The Terminal A Access Road provides access to Terminal A
- Crossfield Drive (East) and Aviation Drive are used to access the rental car and long-term parking facilities (remote lot)
- Lindberg Drive is used by vehicles accessing general aviation and cargo facilities
- Lear Drive is used by vehicles accessing general aviation facilities
- The driveway adjacent to the employee parking lot is shared by Airport employees and vehicles accessing the cargo facilities

For roadways where more than one trip purpose is present, ratios were estimated based on size and intensity of destination uses. **Table 4.2-1** summarizes the calculated number of vehicle trips at the Airport gateway by trip type for the morning, midday, and afternoon peak hours.

TABLE 4.2-1

Sacramento International Airport

EXISTING INBOUND AND OUTBOUND VEHICLE TRIPS AT AIRPORT ENTRANCE ROADWAY BY TRIP TYPE

	Inbound		Outbound	
AM Peak Hour (8-9 AM)				
	Percent	Number of Trips	Percent	Number of Trips
Passenger	91.0%	946	90.8%	600
Cargo	3.8	40	3.7	25
General Aviation	2.4	25	3.1	21
Employee	2.8	29	2.4	16
Total	100.0	1040	100.0	662
Midday Peak Hour (Noon-1 PM)				
	Percent	Number of Trips	Percent	Number of Trips
Passenger	90.6%	1247	92.9%	976
Cargo	4.0	55	3.0	32
General Aviation	2.1	29	1.7	18
Employee	3.4	47	2.4	26
Total	100.1	1378	100.0	1052
PM Peak Hour (4-5 PM)				
	Percent	Number of Trips	Percent	Number of Trips
Passenger	95.3%	1065	93.6%	902
Cargo	2.3	26	2.8	27
General Aviation	0.9	11	1.4	14
Employee	1.5	17	2.1	21
Total	100.0	1119	99.9	964

Source: PB Aviation Analysis

Note: Traffic counts were taken at Airport Boulevard and Crossfield Drive. Totals may not add to 100% due to rounding.

Once the existing number of trips for each trip type was determined, trip generation rates were calculated using existing passenger, employee, cargo, and general aviation activity levels. Inbound and outbound trip generation rates for AM peak hour passenger trips were calculated by dividing the number of AM peak hour inbound passenger trips (946) by the number of annual passengers using the Airport (7.5 million). The result of .0001252 passenger trips per passenger is included in **Table 4.2-2**. The outbound trip generation rate for the same peak hour is .0000794. These rates are assumed to remain constant for the Master Plan Study forecast years (2005, 2010, and 2020).

TABLE 4.2-2 ***Sacramento International Airport*** ***TRIP GENERATION RATES***				
	Trip Purpose			
	Passenger Trip Per passenger	Employee Trip Per employee	Cargo Trip Per freight pound	GA Trip Per GA operation
AM Peak Hour Rate				
Inbound	.0001252	.01075	.0000002991	.0005881
Outbound	.0000794	.005926	.000000187	.000494
Midday Rate				
Inbound	.0001651	.01743	.0000004118	.0006822
Outbound	.0001292	.00963	.0000002393	.0004234
PM Peak Hour Rate				
Inbound	.000141	.006297	.0000001944	.0002588
Outbound	.0001194	.007778	.0000002019	.0003293
Daily Rate				
Inbound	.0023856	.2267	.000005901	.00697
Outbound	.0020874	.1185	.000003522	.00555

Source: PB Aviation Analysis

4.2.1.2 Mode Split

Mode split was identified for each trip type. Mode split data for air passengers were taken from the *1998 Sacramento International Airport Patron Survey*. Cargo mode split data were determined from the June 2000 traffic volume and vehicle classification counts. The mode split for employee trips was determined from information collected for the *Surveys of Patrons and Employees Relative to Public Transit Service to Sacramento International Airport* report (January 1999). Mode split data was not available for general aviation-related trips; therefore, it was assumed that all trips for this type of activity would be made by private automobile. **Table 4.2-3** summarizes mode split information.

Finally, vehicle trip volumes at the Airport entrance were calculated for each trip type using the appropriate trip generation rates and mode split data. Tables 1-4 in Appendix A summarize vehicle trip volumes by trip type, directionality, time of day, and mode of travel for existing and future conditions. Future trip volumes are based on airport activity forecasts developed for the Master Plan Study and represented in Chapter 3.0.

TABLE 4.2-3

Sacramento International Airport

PASSENGER MODE SPLIT SUMMARY BY TRIP PURPOSE

	Trip Purpose			
Mode	Air Passenger (1)	Employee (2)	Cargo (3)	General Aviation (4)
Private Vehicle	73.0%	87.0%	67.6%	100.0%
Hotel Shuttle	1.0	-	-	-
Van	5.0	2.0	-	-
Carpool	-	10.0	-	-
Taxi	2.0	-	-	-
Transit	*	1.0	-	-
Rental Vehicle	17.0	-	-	-
Heavy Vehicle	-	-	32.4	-

Sources: (1) 1998 Sacramento International Airport Patron Survey

(2) *Surveys of Patrons and Employees Relative to Public Transit Service to Sacramento International Airport*, January 1999

(3) June 2000 traffic and vehicle classification counts

(4) n/a

* 38% of Passengers in private vehicles arrived by carpooling.

** Transit trips include bus and fly-in trips

4.2.1.3 Trip Distribution and Assignment

The distribution of future traffic volumes onto the Airport's roadway system was based on the traffic counts and license plate survey data collected in June 2000 (described in Chapter 2.0).

4.2.2 Access System Capacity

In general, airports have unique roadway characteristics that are related to their distinct ground circulation and roadway operations. Roadway characteristics such as capacities, speeds, densities are very different from customary transportation thresholds and requirements. For instance, airport roadways have lower capacities and speeds due to the significant amount of weaving and stopping of the general circulation flow. The roadway features utilized in the traffic analysis are documented in the *Intermodal Ground Access to Airports – A Planning Guide* which summarizes the roadway characteristics specifically for airports. **Table 4.2-4** summarizes the typical characteristics of airport roadways such as the desirable hourly volumes, average speeds, desirable demand-to-capacity ratios, and roadway geometry for various types of airport roadways. The capacities of the different types of airport roadways also reflect the requirements such as density and distances needed for weaving, merging and diverging of vehicles.

4.2.3 Access System Requirements

Access system requirements are based on an analysis of the Airport's existing and forecast traffic demand. Traffic analysis was performed on all of the Airport's major circulation roadways for the existing and forecast peak hour demands. Results of the traffic analysis will assist in quantifying the required roadway improvements and the potential effectiveness of each improvement or mitigation. As described in Chapter 1.0, the Master Plan Study's inventory efforts included an inventory of three peak periods consisting of the morning, mid-day, and evening peak periods. Field observations and traffic volume counts indicate that Monday mornings and Friday evenings attract the most demand over a three-hour peak period. Mondays and Fridays typically are the most common days for business-related air patronage. However, on average, the largest traffic peak hour occurs during the mid-day peak period between 11:30 AM and 1:30 PM. The following analysis evaluates the current or existing

TABLE 4.2-4 ***Sacramento International Airport*** ***TYPICAL CHARACTERISTICS OF AIRPORT ROADWAYS***					
Characteristics	Primary Airport Access Roads	Terminal Area Access Roads	Recirculation Roads	Terminal Frontage Roads	Service Roads
Desirable hourly lane capacity (vehicles/hr/lane)	Arterials: 700-800 Freeways: 1,200 - 1,600	900 – 1,000	600	Inside lane: 0 Outside lane: 300 Additional through-lanes: 600	600 – 1,200
Average Speed (mph)	Arterials: 20 - 25 Freeways: 40 - 50	20 – 25	N/A	10 – 20	15 - 20
Desirable demand volume-to-capacity ratio	Arterials: 0.80 Freeways: 0.60	0.60 – 0.70	N/A	N/A	N/A
Desirable minimum number of lanes and lane width	2 lanes, 12 feet	2 lanes, 12 feet	1 lane, 20 feet, 2 or more lanes, 12 feet	4 lanes: Adjacent to curb (8 feet + 12 feet) Through-lanes (12 feet + 12 feet)	2-lane, 2-way, 12 feet

Source: *Intermodal Ground Access to Airports – A Planning Guide, Final Report December 1996.* Prepared for the Federal Highway Administration Intermodal Division and the Federal Aviation Administration National Planning Division. Prepared by Bellomo-McGee, Inc.

conditions and the forecast growth for 2005, 2010, and 2020. Although all daily peak hours for each scenario were evaluated, only the “worst case” or highest peak hour scenario is discussed. A summary of all the results for each daily peak is presented in Appendix A.

The Airport’s circulation system is comprised of different types of roadway segments, each having a specific vehicle capacity. The Airport’s roadway capacities, summarized in Table 4.2-4, were utilized to evaluate the Airport’s potential for accommodating the existing as well as forecast peak hour traffic demand. The traffic analysis methodology relates a roadway segment’s volume-to-capacity (V/C) to a Level of Service (LOS) grade that defines the traffic service operation. **Table 4.2-5** is a summary of the relationship between LOS and V/C ratios.

TABLE 4.2-5
Sacramento International Airport
ROADWAY LEVELS OF SERVICE (LOS) AND VOLUME-TO-CAPACITY (V/C) RATIOS

Level of Service LOS)	*Volume-to-Capacity (V/C) Ratio*	*Description*
A	< 0.60	Free Flow Conditions. General level of comfort and convenience provided to motorist is excellent.
B	0.61 - 0.70	Stable flow. The level of comfort and convenience provided is somewhat less than a LOS A
C	0.70 - 0.80	Stable flow with increases in vehicle density noticed. The general level of comfort and convenience declines noticeably at this level.
D	0.81 - 0.90	High density, but stable flow. Restricted speeds and maneuverability severely restricted with generally poor driver comfort levels and convenience.
E	0.91 – 1.00	Operating conditions near or at capacity. Low speeds and maneuverability extremely difficult. Comfort and convenience levels are extremely poor, and driver frustration is generally high.
F	1.00	Forced or unstable traffic flow. This condition exists wherever the amount of traffic approaching a point exceeds the facility capacity. Queues and significant driver delays are experienced.

Source: Transportation Research Board, 1985 *Highway Capacity Manual, Special Report 209.*

The resulting peak hour service levels for the Airport’s internal circulation roadways are summarized in **Table 4.2-6**. As shown in the table, the Airport’s existing roadway network provides adequate capacity to serve the current vehicle demands during the average peak periods of the peak month. Existing roadway operations range from free-flow to stable operations for the Airport's roadway system. Typically, all Airport roadways currently operate below capacity with unrestricted maneuverability, and average vehicle speeds are maintained at the posted limits. Significant congestion and unstable traffic flow was not observed along the Airport's roadway system except at the curbsides in front of Terminal A during the peak periods. The roadway segments leading to and leaving Terminal A provide adequate service, whereas traffic congestion and unstable operations occur adjacent to Terminal A at the crest of the peak period. The traffic jams and restricted vehicle movements are due to the significant curbside activity in front of Terminal A especially by passenger check-in for Southwest Airlines. This activity extends until mid-morning on Mondays and after 9 PM on Fridays and typically peaks relative to the arrival and departure schedule of the airlines. From a *pure* roadway segment analysis, the unstable traffic flow and traffic jams occurring in front of Terminal A are difficult to measure; thus, the peak traffic operational deficiencies adjacent to Terminal A are addressed in the terminal curbfront assessments provided in Section 4.2.7.

TABLE 4.2-6
Sacramento International Airport
PEAK HOUR LEVELS OF SERVICE
ON SACRAMENTO INTERNATIONAL AIRPORT ROADWAYS

Airport Roadway Segment (1)	Existing Conditions		Year 2005		Year 2010		Year 2020	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Airport Blvd. (In-Bound) south of Crossfield Drive	.57	A	.76	C	.89	D	1.17	F
Airport Blvd. (Out-Bound) south of Crossfield Drive	.66	B	.87	D	1.01	F	1.34	F
Airport Blvd. (In-Bound) north of Crossfield Drive	.46	A	.61	B	.71	C	.94	E
Airport Blvd. (Out-Bound) north of Crossfield Drive	.42		56	A	.65	B	.86	D
Terminal A Access Road	.43	A	.57	A	.66	B	.87	D
Terminal A Access Road (Adjacent to Terminal A)	.33	A	.44	A	.56	A	.68	B
Aviation Drive*	<.20	A	.23	A	.26	A	.35	A
Earhart Drive (within Airport Terminal Area)	.40	A	.51	A	.59	A	.78	C
Airport Blvd. (In-Bound) to Terminal B	.20	A	.24	A	.28	A	.37	A
Airport Blvd. Adjacent to Terminal B	.19	A	.25	A	.29	A	.38	A
Airport Blvd. (Out-Bound) from Terminal B	.21	A	.28	A	.32	A	.43	A
Lindberg Drive*	.42.	A	.56	A	.66	B	.87	D

Source: PB Aviation Analysis, November 19, 2000.
(1) All roadway segments one-way unless otherwise noted. * Two-way roadway – LOS considers both directions

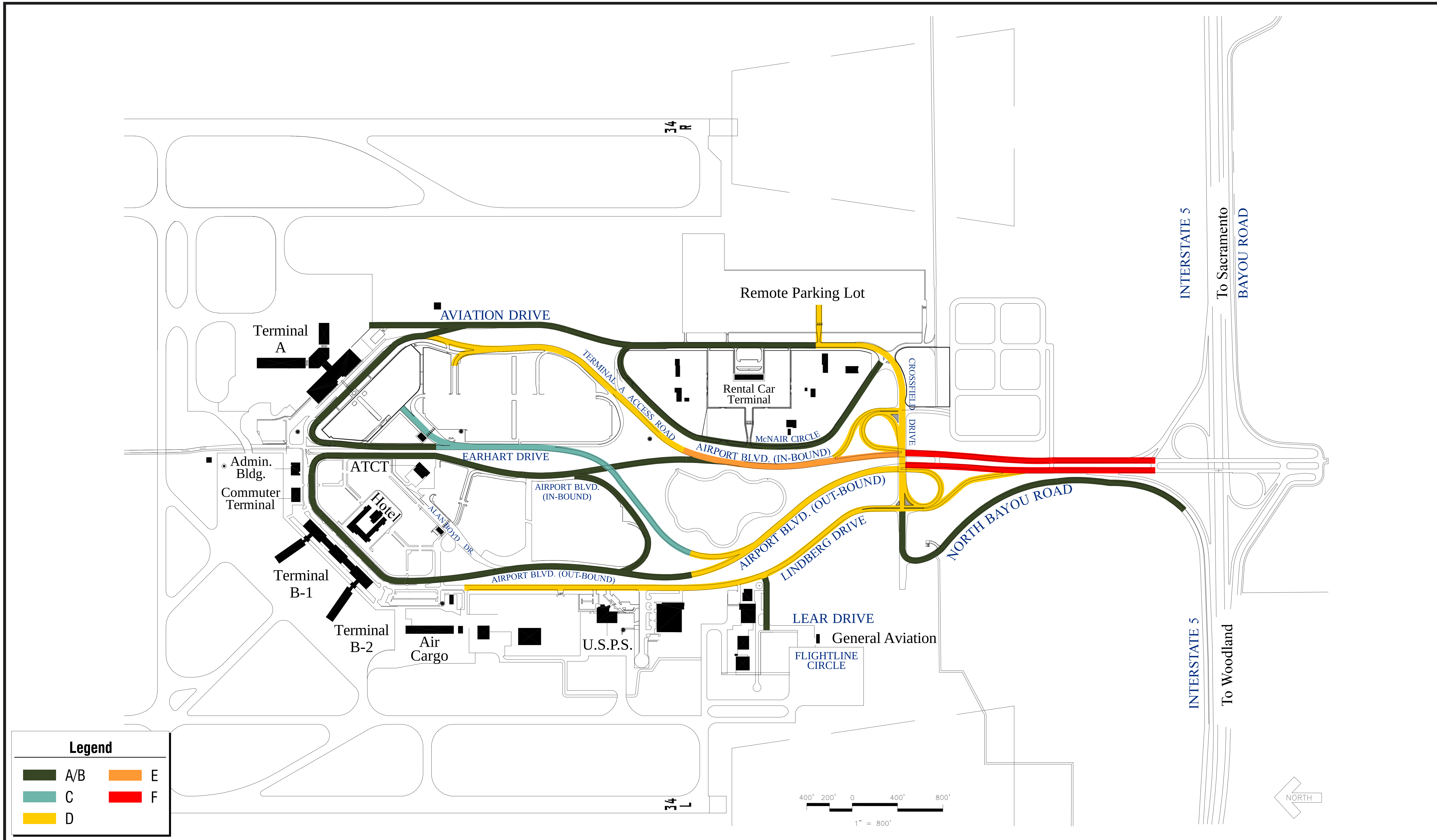
Analysis of the forecast demand for the Airport indicates that by 2010 the main entry point to the Airport (Airport Boulevard) will be at capacity for the peak hour out-bound traffic and nearing capacity for in-bound traffic. The remaining roadway segments within the Airport are expected to operate at acceptable service levels. By 2020, both in-bound and out-bound segments of Airport Boulevard near the Interstate 5 Interchange will be congested and at capacity conditions; in addition, north of Crossfield Drive, both directions of Airport Boulevard are anticipated to experience heavy demands while at times nearing capacity. Terminal A Drive, Lindberg Drive and Earhart Drive are also expected to approach unstable traffic flow with high peak hour demands. **Exhibit 4.2-1** graphically portrays the LOS projected in 2020 for the Airport's circulation system during peak hour demand.

4.2.4 Transportation Demand Management (TDM) Opportunities

Transportation Demand Management (TDM) measures are aimed at reducing traffic impacts by affecting the intensity, timing and distribution of travel demand. These programs can focus on short-term actions to mitigate congestion, or they can be part of a strategy to avoid future congestion. Demand management techniques require broad and extensive implementation to be truly successful. Otherwise, their benefits may be localized and limited.

For airports, travelers and employees may not be responsive to the same TDM measures. This is because these groups usually do not travel at the same time and are often coming from different areas.

TDM measures for airport employees must take into account the trend for them to arrive and depart outside of the traditional "9 to 5" workday. However, because employees make regular trips, usually on a consistent timetable, and can develop good familiarity with the transportation system, they are good candidates for alternative access to the Airport.



Sacramento County Airport System

Sacramento International Airport Master Plan Study

2020 AIRPORT PEAK HOUR LEVEL OF SERVICE

EXHIBIT 4.2-1

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Implementing successful TDM measures for air passengers is more difficult because they are particularly sensitive to convenience, reliability and travel time. Many business travelers are only somewhat price sensitive; pleasure travelers may be accompanied by "well-wishers." Lack of familiarity with the system is another obstacle. However, state employees, because of their common travel characteristics as a group, may be better candidates for TDM measures than individual air passengers.

Candidate TDM options include the following:

Employee-oriented:

- Design elements (e.g. bicycle parking; showers and lockers; carpool/vanpool preferential parking)
- Telecommuting
- Alternative work schedule (e.g. flextime; staggered work hours; compressed work weeks)
- Transit subsidies
- Vanpool subsidies (including privately operated transit services)
- Carpool incentives (e.g. preferred parking; subsidies)
- Hotel shuttle (shared use with hotel guests)
- Accountability – Enforcement procedures
- Enhanced bus service
- Rail service

Passenger-oriented:

- Design elements (e.g. passenger loading zones; transit facilities design; parking design)
- Toll charges for drop off and pick up
- Remote terminal
- Multi-modal services
- Enhanced bus service
- Vanpool subsidies (including privately operated transit service)
- Rail service

Enhanced bus service has been identified by SACOG and the Placer County Transportation Planning Agency as part of the I-80 Corridor Investment Strategy.

It calls for bus service to the Airport to be expanded to provide service every 30 minutes to and from downtown Sacramento. This service would be developed by Sacramento Regional Transit District (RT), and it would complement current Yolobus service. It should be noted that added buses would exacerbate curb front space problems projected for future years.

In 1995, a Comprehensive Transportation Systems Management (TSM) plan was developed for Sacramento County. The TSM addressed TDM measures and ground transportation programs designed to increase alternative transportation use to the Airport by County and tenant employees and passengers in addition to reducing harmful emissions.

The Airport is taking steps to make significant reductions in vehicle emissions to comply with California Air Resources Board (CARB) requirements. Measures include reducing vehicle trips and converting Airport-operated vehicles to emit less pollution. Currently, the on-Airport parking shuttle service is comprised of 100 percent low emissions Compressed Natural Gas (CNG) vehicles. The shuttles serving the rental car facility are in the process of conversion to CNG vehicles.

4.2.5 Light Rail Transit (LRT) Opportunities

Light rail access to the Airport is an important consideration to the many stakeholders that have been involved in the Master Plan Study. Over the past decade, various extensions to the Airport have been studied and evaluated. For example, in January 1991, RT published a study that evaluated a number of alignment alternatives between downtown and the Airport. A follow-on route refinement study led to the selection of a preferred alignment. The North Natomas/Airport extension via Truxel Road was identified as the preferred route to the Airport and the North Natomas Community Plan, adopted by the City of Sacramento, includes land use patterns that could potentially support this alignment. In addition, SACOG has formerly recommended that RT strongly consider the North Natomas/Airport extension as the next priority for fixed guideway expansion. Efforts are underway to preserve right-of-way (ROW) for the North Natomas/Airport extension.

4.2.5.1 LRT Physical Requirements

This section examines the requirements that should be considered for siting an alignment and a station on Airport property. Many of the criteria in this discussion come from a Sacramento Regional Transit District (RT) publication entitled *Light Rail Design Criteria* which was published by RT in May 1993. LRT development embraces four key design principals: use available right-of-way; limit the investment in facilities to essentials; utilize to the extent possible, proven "off-the-shelf" equipment; and operate the system on an efficient, no frills basis. Three types of LRT right-of-way are possible:

- A fully exclusive right-of-way with at-grade crossings, protected between crossings by a fence or substantial barrier, if appropriate to the location.

- A semi-exclusive right-of-way such as within a street right-of-way protected by six-inch high curbs and safety fences between crossings with fencing located outside the tracks; or within a street right-of-way protected by six-inch high curbs and safety fences between crossings with fencing located between the tracks; or within a street right-of-way, but protected by mountable curbs, striping or lane designation.

- A non-exclusive right-of-way such as mixed traffic operation (surface streets) on a pedestrian mall (such as K Street in Sacramento).

The preferred alignment extends LRT service from downtown Sacramento through North Natomas to the Airport. The LRT extension would:

- Originate at the existing Amtrak Station in downtown Sacramento and travel north along 7th Street through Richards Boulevard to a new bridge over the American River at the intersection of Garden Highway and Truxel Road;
- Cross the American River via the new bridge into South Natomas and continue up the median of Truxel Road, beyond San Juan Road, and cross over Interstate 80;
- Continue on Truxel to Del Paso Road;
- Continue from the intersection of Truxel and Del Paso, with the tracks curving to the west and extending 450 feet north of Del Paso Road to a planned Meister Way overcrossing at State Route 99; and
- Continue west in the median of Meister Way and to the southern side of a relocated Elkhorn Boulevard to the median of Airport Boulevard.

Several criteria are important when considering the right-of-way alignment for LRT. These include:

- The light rail vehicle (LRV) should be capable of operating within a side width clearance of 5 feet 6 inches of centerline on tangent track in the worst case dynamic condition of vehicle and track exclusive of wheels and track wear.
- Minimum turning radius is 82 feet.
- Horizontal clearances vary between 12 and 14 feet, depending if poles are present.
- Vertical clearances vary between 14feet 6inches and 19 feet 6 inches, depending on type of right-of-way.
- Standard Gauge with 4 feet 8-1/2 inches measured between the inner sides of the rail heads at a distance of 5/8 inch below the top-of-rails.
- Horizontal alignment of mainline tracks consists of tangents joined to circular curves by spiral transition curves. Minimal length of tangent between curved sections shall generally be 200 feet, with 45 feet the minimum length of tangent track preceding a point of switch. Horizontal and vertical alignment should be tangent at all station platforms with a desirable minimum length of 75 feet.
- Power is supplied to the traction power substations by the local utility, Sacramento Municipal Utilities District (SMUD) at either 12 kV or 21 kV, 60 Hz. The system must support the following minimum operating criteria: design headways, 7.5 minutes; dwell time, 15 seconds at each station; and train consist, one to four cars per station.

LRT stations may be divided into two general classes: urban stations and suburban stations. Urban stations are located within urban land uses and are usually the ultimate destination point of a trip. Little or no parking is provided to encourage most patrons to walk to it. A suburban station is located in an outlying area that is, generally, residential in nature. While passengers are encouraged to walk to and from the station, the station may provide for bus transfers, layovers and turnarounds, and parking for park-and-ride/kiss-and-ride patrons. The most appropriate type of station for the Airport is an urban type station assuming the station is located within the Airport.

Key criteria to consider for a LRT station include:

- Platform layout should be governed by passenger volume, integration with bus service, local site considerations (i.e., available space, physical environment, opportunities for linkages to generators, etc.), pedestrian access, and joint development opportunities.
- The length of the platform shall be able to accommodate four-car trains and handicap ramps from 360 to 400 feet depending on ramp design and anticipated activity levels at the station.
- The total station width is approximately 60 feet providing a platform with LRT train berthing positions on each side and a central circulation width of approximately 40 feet.

- Space, equipment and facilities for LRT fare collection.
- Horizontal circulation to and from the terminal(s) and vertical circulation directly to and from airline ticketing and baggage claim.
- Wayfinding should be straightforward and simple.
- LRT riders should not be required to use roadway crosswalks.

The specific physical requirements for LRT must be considered to adequately plan for future Airport facilities. Past planning efforts have already established an alignment for light rail on the Airport's property. However, it is possible that this Master Plan Study may revise the alignment to obtain a better "fit" with the Airport's long-term development plan, and in particular, with future improvements to the terminal and access systems.

4.2.5.1 Ridership

The success of implementing light rail transit (LRT) service to the Airport as an alternative to the private vehicle depends on several factors. For LRT to be a viable option at the Airport, the LRT service will need to be a convenient and cost-effective alternative for people who currently use private vehicles to access the Airport. Other critical factors include parking availability and costs, congestion levels on the regional and local roadways, frequency of service, and access to the terminals and LRT (i.e., direct service with no additional mode changes). Land use patterns and density must also support transit use. At U.S. airports that can be accessed by rail, airport passenger mode share typically ranges between three and nine percent. For example, airports such as Atlanta Hartsfield and Washington National have a mode share of nearly nine percent using rail transit, while at Cleveland Hopkins and Chicago O'Hare, the mode share is about three percent. For this analysis, the mode share for LRT service at the Airport is assumed to be in this lower range. Ridership will be positively affected by business travelers from the central Sacramento area and traveling government employees. Airport employees are good candidates for alternative transportation; the mode split for employees may be as high as ten percent.

If implemented, the earliest LRT service would be available would be 2010. The potential benefits and constraints of implementing LRT service to the Airport are discussed in more detail in Chapter 5.0, which addresses alternatives for the future of the Airport's facilities, including light rail.

4.2.6 Rental Car Parking

Rental car operations are consolidated at one location on the Airport. This area consists of approximately 750 ready/return spaces and 23.5 acres of vehicle service/storage area. Each rental car agency manager was interviewed in order to gather data concerning operating characteristics and space needs for ready/return spaces, maintenance operations, and fleet storage. These characteristics and future fleet plans differed among the individual rental car agencies and are presented for the facility as a whole because of the sensitivity of the individual information. Activity at the rental car facility is reflective of business travel with the peak number of rentals taking place on Monday mornings while peak returns occur on Friday afternoons. Therefore, storage requirements for vehicles peak over the weekend.

The space set aside under the proposal to add one to three rental car agencies was considered as occupied and, therefore, not available to accommodate future needs. Requirements for the agencies in place are based on their existing lease areas. The rental car service/storage area operates at approximately 85 percent of capacity during the peak month, based on operator interviews. The existing number of spaces required for the actual number of rentals and returns during peak periods is 645 spaces. The additional number of spaces allows the rental car agencies to provide priority renter services such as kiosk check-out (without the need to wait in line at the counter), and secure area where keys are left in the cars for renters to pick up and check out through a kiosk. This information, combined with projected passenger levels, was used to estimate requirements for rental car parking.

Table 4.2-7 presents requirements for ready/return spaces and service area. These requirements assume that future rental car operations will remain consolidated as they are today. As indicated, the rental car area will reach capacity by 2005. By 2020, an additional 347 ready/return spaces will be required along with 10.8 acres of additional space for rental car service/storage. Additionally, a requirement for rental car storage overflow was developed based on recent requests from the rental car agencies to the Airport for such space. This increases from 2.3 acres in 2005 to 3.4 acres in 2020.

Table 4.2-7 *Sacramento International Airport* *RENTAL CAR REQUIREMENTS*					
Year	2000	2005	2010	2015	2020
Peak Month Originations	377,011	454,230	525,780	639,540	706,770
Ready/Return Spaces Required	645	750	851	1002	1097
Ready/Return Surplus/(Deficit)	105	0	(101)	(252)	(347)
Rental Car Service/Storage Area Required	20.0	23.4	26.6	31.3	34.3
Service/Storage Area Surplus/(Deficit)	3.5	0.1	(3.1)	(7.8)	(10.8)
Rental Car Overflow Area (acres)	-	2.3	2.7	3.1	3.4

Source: PB Aviation Analysis

4.2.7 Employee Parking

The deployment of the TSA at the Airport has changed the requirements for employee parking. To respond to this increased demand, the Airport is now using the parking lot previously dedicated to valet parking operation, which has been discontinued and is not expected to restart, for employee parking. Employee parking is provided in surface lots west of Terminal B-2 and on the west side of Terminal A. In total, 1,074 employee spaces are available. Employee parking requirements were projected based on the projected number of employees in the Airline/Airport Services sector with adjustments for the TSA workforce which is projected to reach approximately 500 employees. Currently, 3,000 terminal area employees are cardholders for the employee lots. However, because the Airport operates around the clock with full- and part-time employees, spaces do not need to be provided for each cardholder.

Employee parking requirements are presented in **Table 4.2-8**. The 2003 parking requirement is 1,023 spaces while 1,542 employee parking spaces will be required by the end of the planning period. Two assumptions are important to note regarding these requirements. First, it was assumed that the existing mode splits for transportation to the Airport (predominately private automobile) would not change significantly over the planning period. Estimates of the reduction in required employee parking spaces with the light rail service under discussion will be presented in the alternatives evaluation. Second, these estimates are based on unconstrained conditions. If parking facilities become constrained, it is possible that some employees might consider other alternatives such as ride sharing or public transportation.

TABLE 4.2-8

Sacramento International Airport

EMPLOYEE PARKING REQUIREMENTS

Year	2003	2005	2010	2015	2020
Annual Passenger Enplanements	3,859,663	5,170,957	6,009,765	7,261,788	7,980,933
Employee Parking Required	1,023	1,128	1,248	1,455	1,542
Employee Parking Surplus/(Deficit)	(51)	(54)	(174)	(381)	(468)

Source: PB Aviation Analysis

4.2.8 Taxi/Limousine/Shuttle Staging Area

Taxi, limousine, and shuttle van staging lanes totaling approximately 1,040 linear feet are provided in the ground transportation area adjacent to Terminal A. Additionally, approximately 155 linear feet of curb space in front of Terminal B are allocated to taxi, limousine, and shuttle staging and a 50-space taxi staging area is located south of Crossfield Drive (equivalent to approximately 1,500 linear feet).

In order to reserve adequate space in the Master Plan Study for this function, the required taxi and limousine staging area was calculated with the maximum number of peak hour outbound trips in these categories as determined in the traffic analyses. **Table 4.2-9** presents staging area requirements for the planning period. A surplus of staging area currently exists. However, by 2010 an additional 235 linear feet will be required. This deficit increases to 1,195 feet by 2020 when a total of 3,890 linear feet will be required.

TABLE 4.2-9 Sacramento International Airport TAXI, LIMOUSINE, AND SHUTTLE STAGING AREA REQUIREMENTS					
Year	2003	2005	2010	2015	2020
Peak Hour Taxi Departures	20	26	30	35	40
Peak Hour Shuttle/Limo Departures	49	64	75	87	99
Taxi/Limo/Shuttle Staging Requirements (lf)	1,910	2,500	2,930	3,410	3,890
Taxi/Limo/Shuttle Staging Surplus/(Deficit)	785	195	(235)	(715)	(1,195)

Source: PB Aviation Analysis

4.3 Cargo Facility Requirements

In light of the current focus on developing Mather Airport as the region's principal cargo airport, it is difficult to prescribe future cargo facility requirements at the Airport. It is expected that a certain segment of the region's air cargo demand will continue to be processed at this site. Producers of time-sensitive items that are located in the Yolo area of the I-5 corridor and along the Roseville and Rocklin area of the I-80 corridor find that the Airport is more conveniently located for their overnight shipments. The all-cargo carriers may decide to continue operations at the Airport for business reasons. It should be noted that the passenger air carriers serving the Airport will continue to carry a small portion of the region's cargo as belly freight.

This analysis presents the requirements that will be necessary to accommodate the cargo volumes that are forecast in Chapter 3.0. It will be important for the Sacramento County Airport System to monitor the growth in air cargo at the Airport and to revise the forecast of cargo facility requirements as necessary, depending on an acceleration or deceleration in the rate of growth and the ability of Mather Airport to fulfill its role.

4.3.1 Air Cargo Building Requirements

The measure typically used to define the capacity and efficiency of an air cargo facility is "warehouse utilization rate". Warehouse utilization rates are expressed as square feet per annual enplaned ton of cargo. Airmail and freight statistics that were reported to the Sacramento County Airport System by the airlines serving the Airport in 1999 totaled 37,458 enplaned tons. Based on a total Airport air cargo facility space of

59,000 square feet, results of the warehouse space utilization rate is 0.63 square feet per annual enplaned ton of cargo.

The current warehouse utilization rate was compared to other airports and other industry-wide planning parameters to determine if existing facilities are well utilized. The analysis concluded that the average warehouse utilization rate for the top 50 cargo airports nationally was 1.73 square feet per enplaned ton based on 1990 data. The comparison also indicated that adequacy standards for primary airports may fall within a range of 1.00 to 2.5 square feet per annual enplaned ton.

A study completed for the FAA in 1984 established in empirical long-term space requirement criteria that appears to compare favorably with throughput capacity of actual cargo terminals. The FAA study indicated that about one square foot of cargo building is required to process one annual enplaned ton of cargo, within a factor of two either way, as indicated by data on actual facilities.

A comparison of the utilization rate for the Airport to ten major air cargo airports is provided in **Table 4.3-1**. As shown, the data indicate that warehouse utilization for the Airport falls below the range of adequacy for larger airports. It should be noted that some carriers bypass the cargo warehouse with direct truck-to-aircraft transfers and this can affect the utilization rate. Other factors that effect warehouse utilization rates that do not necessarily show up in reported statistics include: freight forwarders, custom brokers, and trucking companies that may occupy space in the air cargo buildings. Although the space these companies occupy may be well utilized, their activity is not reported to the Sacramento County Airport System. Typically, as available space on an airport becomes limited, most companies, such as the freight forwarders that do not necessarily require direct access to the airside aircraft parking aprons, may find it too expensive to operate on the airport and move to off-airport facilities that have lower costs. This trend has been observed at other major airports over the past several years and will likely continue in the future.

TABLE 4.3-1 Sacramento International Airport COMPARISON OF WAREHOUSE UTILIZATION RATES			
Airport	Cargo Warehouse Space (s.f.)	1990 Freight: Enplaned Tons	Warehouse Utilization
New York Kennedy	2,500,000	2,267,652	1.10
Los Angeles International (1992)	2,118,712	1,238,198	1.71
Chicago O'Hare International	1,357,000	1,303,663	1.04
Miami International	1,500,000	1,699,763	0.90
San Francisco International	807,725	802,257	1.01
Portland International	175,000	148,128	1.18
Atlanta-Hartsfield International	447,000	705,715	0.63
Baltimore/Washington International	286,132	316,372	1.10
Boston Logan International	725,000	452,579	1.60
Dallas/Fort Worth International	1,348,166	674,189	1.99
Average			1.01
Comparison of Top 50 Airports (1989)			1.73+
FAA Analysis			1.00
Sacramento International Airport (1999)	59,000	37,458	0.63

Source: PB Aviation Analysis

Current air cargo industry trends indicate that due to cargo carrier schedules (peaking), handling techniques, containerization rates, share of connecting cargo, and local factors, a range of 0.5 to 2.0 square feet per annual enplaned ton is considered applicable to cargo buildings that support small to medium size airports. At large airports that process 500,000 to 1,000,000 enplaned tons of cargo, the lower ratios of 1.0 square foot per ton are possible. It is recommended that the average building rate of 2.0 square feet per enplaned ton be utilized for long-range planning purposes at the Airport.

As shown from the cargo activity forecast in Section 3.3.1, total air freight tonnage is projected to increase from 51,065 tons in 1999 to 122,266 tons in 2010 for the annual growth rate of 8.3 percent. Total air freight tonnage is expected to increase to 177,485 tons in 2020 for a ten-year growth rate of 3.8 percent.

Based on the recommended ratio of 2.0 square feet per annual enplaned ton of cargo, the estimated cargo volume for 2020 will exceed existing warehouse capacity by approximately 167,602 square feet. Assuming that no additional air cargo carriers move to Mather Airport, the capacity of the Airport's cargo warehouse space will need to be increased significantly by 2020. The projected air cargo building space requirements for the Airport are shown on **Table 4.3-2**.

TABLE 4.3-2 ***Sacramento International Airport*** ***AIR CARGO BUILDING REQUIREMENTS***		
Year	Annual Enplaned Cargo (tons)	Building Requirements (sq. feet)
1999	36,837	59,000
2005	64,796	129,592
2010	79,836	159,672
2020	113,301	226,602

Source: PB Aviation Analysis

For the foreseeable future, design of air cargo facilities should provide a large degree of flexibility, recognizing that the industry is still maturing, and therefore, still subject to large changes in both traffic and technology. Actual space requirements will depend primarily on the need of individual carriers using the cargo facilities at the Airport and the type of cargo they process. For example, the express integrator carriers deal with time sensitive express freight, which is usually transported in full container loads passing through highly automated facilities. In contrast, passenger carrier belly hold cargo, more often than not, moves in smaller lot sizes and in break-bulk form, requiring more storage space per annual ton.

The degree of automation planned for a particular facility also affects warehouse space requirements. At many airports, cargo warehouses have become storage facilities because of the inability to process and distribute cargo in a timely manner. The majority of air cargo shipment time is spent in various ground systems (e.g. trucks).

4.3.2 Air Cargo Apron Requirements

The air cargo apron must be sized in order to accommodate peak demand. The existing air cargo building apron is 600 feet in length and the new DHL apron is 500 feet in length. Assuming the depth of the future air cargo buildings will be 100 feet, an air cargo building length of approximately 2,300 linear feet will be required in 2020. Apron requirements are listed in **4.3-3** and will accommodate the future cargo aircraft fleet mix that is presented in Chapter 3.0.

TABLE 4.3-3
Sacramento International Airport
AIR CARGO APRON REQUIREMENTS

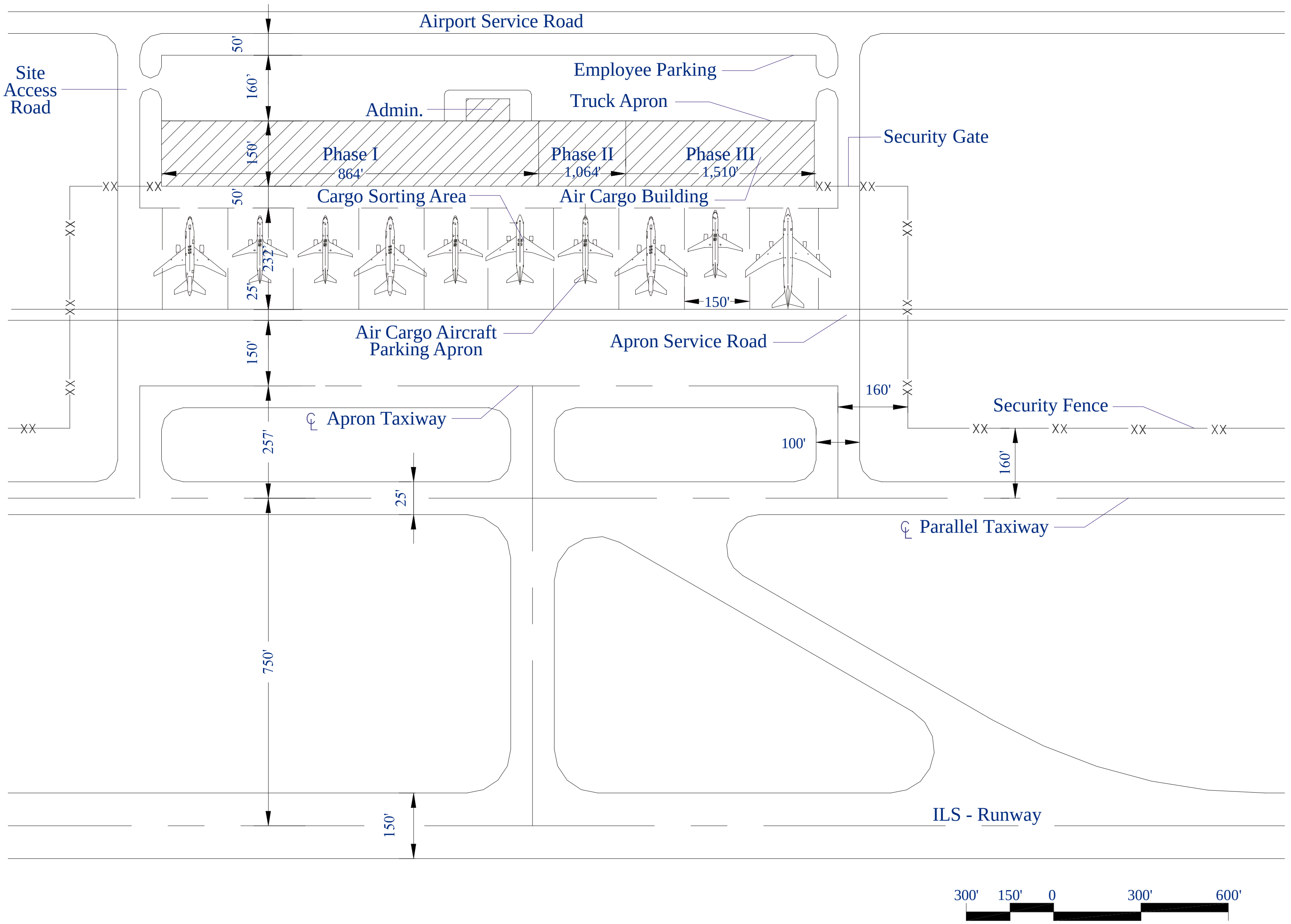
Year	Building Area (sq. feet)	Apron Length (LF)
1999	59,000	1,100
2005	129,592	864
2010	159,672	1,064
2020	226,602	1,510

Source: PB Aviation Analysis

It is most important to maintain flexibility in planning for future cargo fleet. For example, the apron requirements listed in 4.3-3 are capable of accommodating up to nine 757 aircraft during a peak period. A 757 is a typical air cargo aircraft and requires a parking position of 150 feet wide.

To maintain as much flexibility as possible, it is suggested that future apron facilities be designed to accommodate a 747. The width of the apron must be able to accommodate the design aircraft plus an additional 25 feet for service vehicle by-pass and 50 feet for cargo staging. The 747-400 measures 232 feet in length, and requires a ramp width of 282 feet. With a tail height of 65 feet, the 747 can be parked no closer than 955 feet from the centerline of Runway 16R/34L. The existing cargo area is capable of accommodating this spacing requirement. A runway length of 11,000 feet would be necessary to accommodate non-stop flights from Sacramento to destinations such as the Pacific Rim by a 747-400. This length is calculated assuming maximum gross take-off weight for a flight to Tokyo's Narita airport on a hot day.

The importance of adequate air cargo apron space that is directly adjacent to the face of the air cargo building cannot be overemphasized. For marketability and operational efficiency, this air cargo facility design parameter is considered the primary factor used by air cargo operators when leasing space. **Exhibit 4.3-1** depicts a prototype layout for a cargo facility.



Sacramento County Airport System

Sacramento International Airport Master Plan Study

PROTOTYPE AIR CARGO FACILITY SITE PLAN

EXHIBIT 4.4-1

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PB AVIATION, INC.

4.4.3 Truck Apron Requirements

Landside truck facility design considerations should be addressed in the planning of new facilities because trucks are becoming more prominent in the cargo business. Some general design considerations include:

- Adequate turning radii at entrances to individual cargo lots
- Truck parking and maneuvering room to accommodate fleets of small vans and large over-the-road 45- and 54-foot tractor-trailer trucks
- Large truck docking with suitable surface access roads
- Space to accommodate overnight tractor-trailer parking
- Employee/customer parking sized on an individual basis

The pavement strength of those Airport roadways that are used by truck traffic will need to be increased to accommodate increasing truck volumes. Opportunities for providing a separate truck access should be examined as well.

In preparing a site plan, particular attention must be given to the "working" area required by the carriers operating the freighters. The area must include (in addition to the parking position of the truck) support equipment of all types: conveyors, loaders, container transporters, trucks, tugs, container staging racks, and so on.

The area reserved for freight truck and employee parking typically extends the length of the air cargo building. Typically a truck apron depth of 100 feet is required to accommodate the maneuvering space for large trucks to back into the loading docks. In addition, an additional 60 feet wide parking area is required for employee parking and freight truck staging areas.

The projected landside freight truck and employee parking spaces are shown on the following **Table 4.3-4**.

TABLE 4.3-4 ***Sacramento International Airport*** ***AIR CARGO TRUCK APRON REQUIREMENTS***		
Year	Truck Apron (spaces/docks)	Employee Parking and Truck Staging (spaces)
1999	40	40
2005	72	172
2010	89	213
2020	126	302

Source: PB Aviation Analysis

4.4 Support Facility Requirements

Support facility requirements enable normal operation and services of the Airport to go uninterrupted. It is, therefore, important to assess whether these facilities are capable and apt to perform their respective activities, especially in case of emergency. The supporting facilities that are examined in this section are as follows:

- Airport Rescue and Firefighting (ARFF)
- Fuel Farms
- Airport Maintenance
- Flight Kitchens
- General Aviation

4.4.1 Airport Rescue and Firefighting (ARFF)

The Airport Rescue and Firefighting Facilities (ARFF) requirements are outlined in Federal Aviation Regulation (FAR) Part 139 Subpart D – Operations. The criteria was set forth by the FAA and ICAO Rescue and Firefighting Panel (RFFP II), which conducted studies that identified the practical as well as theoretical fire areas of an aircraft and the corresponding amounts of extinguishing agents required to extinguish the fires. This data led to the identification of five airport classes known as an "Index" and the corresponding ARFF equipment requirements. The applicable airport index is determined by the length of the longest aircraft operated by a passenger air carrier an average of five scheduled departures per day (compiled on an annual basis). **Table 4.4-1** shows the five indices and the corresponding equipment requirements developed by both the FAA and ICAO.

TABLE 4.4-1 *Sacramento International Airport* *MINIMUM ARFF REQUIREMENTS UNDER FAR PART 139*			
Airport Category	Type Aircraft	Vehicle	***Extinguishing Agent***
Index A	Less than 90’	One lightweight	500 pounds of dry chemical or 450 pounds of dry chemical and 50 gallons of water for foam production.
Index B	More than 90’ but less than 126’	One lightweight and one self-propelled fire extinguishing vehicle	Same dry chemical requirements as Index A and 1,500 gallons of water for foam production.
Index C	More than 126’ but less than 160	One lightweight and two self-propelled fire extinguishing vehicles	Same dry chemical requirements as Index A and 3,000 gallons of water for foam production.
Index D	More than 160’ but less than 200’	Same as Index C	Same dry chemical requirements as Index A and 4,000 gallons of water for foam production.
Index E	More than 200’	Same as Index C	Same dry chemical requirements as Index A and 6,000 gallons of water for foam production.

Source: FAR Part 139

The longest aircraft projected to be operated at the Airport having an average of at least five daily scheduled departures is the 757-300. The 757-300 has a maximum length of 178.6 feet, therefore placing it into the Index D category. For Index D the ARFF requirement as stated in Table 4.4-1 are one lightweight vehicle and two self-propelled fire extinguishing vehicles. Added to the fire fighting vehicles is an extinguishing agent requirement of 450 to 500 pounds of dry chemical and 4,000 gallons of water for foam production. At present, the Airport ARFF requirement is an Index of C. The Airport maintains extinguishing agents and vehicles that meet Index E requirements, thus the Airport exceeds current requirements.

The service requirements of FAR Part 139 also specify that at least one firefighting vehicle be capable of reaching the midpoint of the farthest runway from its assigned post, or reaching any other specified point of comparable distance on the movement area which is available to air carriers, and applying extinguishing agent within three minutes from the time of alarm. Within four minutes from the time of alarm, all other required vehicles must reach the above point and begin application of extinguishing agent. The Airport's existing ARFF station is located so that response times to the midpoint of the two existing runways are within allowable limits. Additional ARFF stations may be necessary to meet response time criteria if additional runways are constructed or if current runways are extended.

4.4.2 Fuel Farms

Future jet fuel storage requirements for the Airport were calculated based on historic fuel sales and operations. The fuel storage facility, commonly called the "Fuel Farm," is comprised of four storage tanks: one 320,000-gallon tank, one 58,000-gallon tank and two 25,000-gallon tanks giving the Airport a total storage capacity of 428,000 gallons.

Based on a three-day reserve requirement for fuel storage, **Table 4.4-2** shows an existing deficiency of approximately 87,000 gallons of fuel or 2.5 days of reserve storage (based on actual usage data). If the capacity of the fuel transport trucks is included, the Airport has 3.5 days of reserve storage. Through the planning period this deficit is projected to increase as both operations and the average gallons of fuel required per departure increase. By 2020, an additional 554,800 gallons of jet fuel storage will be required. It should be noted that the average gallons per departure are assumed to increase slightly as longer stage length destinations are served from Sacramento.

TABLE 4.4-2 Sacramento International Airport JET FUEL STORAGE FACILITY REQUIREMENTS					
Year	1999	2005	2010	2015	2020
Peak Month Average Day Departures[1]	156	171	184	203	252
Average Gallons per Departure	1,100	1,150	1,200	1,250	1,300
Daily Demand	171,600	196,650	220,800	253,750	327,600
Three-Day Reserve Requirement[2]	514,800	589,950	662,400	761,250	982,800
Fuel Storage Surplus/(Deficit)	(86,800)	(161,950)	(234,400)	(333,250)	(554,800)

Sources: PB Aviation Analysis

Airport records

Notes: [1] Aircraft requiring jet fuel only

[2] The Airport's existing fuel storage (428,000 gallons) provides approximately 2.5 days of fuel storage.

4.4.3 Airport Maintenance

Airport maintenance functions under the direction of the Sacramento County Airport System are divided into three groups: Airfield Maintenance, responsible for the upkeep of the airfield and landside grounds; Equipment Maintenance, responsible for maintaining the Airport's fleet of vehicles including shuttle buses; and General Services, responsible for such functions as electrical, plumbing, painting, and sanitary engineers. In addition to the 16,000-square foot Air Service Building shared by Airfield Maintenance and Equipment Maintenance, these functions are segregated among several modular offices and storage sheds in several locations across the Airport property. Existing repair, storage, and field office space totals approximately 36,000 square feet. The primary site for airport maintenance (containing the air services building, several other modular buildings, and storage yard) is approximately seven acres in size.

The requirements for airport maintenance space were developed through discussions with the group managers. In order to reserve adequate space for future growth, it was assumed that all functions currently carried out by Airfield Maintenance, Equipment Maintenance, and General Services will continue to be located on the Airport, although some could be operated through third-party contracting. Equipment maintenance storage needs may change due to significant changes in the number of shuttle buses required to serve the terminal area (i.e., the addition of another remote parking lot).

Each category of airport maintenance currently experiences a deficiency in space. For example, General Services is in need of warehouse space to take advantage of bulk purchases of supplies. In total, an additional 17,500 square feet of space are required to meet the Airport's existing maintenance needs. A site of approximately 11 acres would be needed to accommodate the existing Airport maintenance operations in one functional area. This requirement includes space for the storage/maintenance yard and the collection of refuse and recycling. By 2020 101,700 square feet of airport maintenance space on an 18-acre site will be required. Airport maintenance requirements are listed in **Table 4.4-3**.

TABLE 4.4-3
Sacramento International Airport
AIRPORT MAINTENANCE FACILITY REQUIREMENTS

Year	Existing	2000	2005	2010	2015	2020
Airfield Maintenance	13,398	19,400	23,600	26,100	29,900	32,000
Equipment Maintenance	11,645	18,200	26,800	35,400	40,500	43,500
General Services	10,960	15,900	19,300	21,300	24,400	26,200
Total Airport Maintenance Requirements (sf)	36,003	53,500	69,700	82,800	94,800	101,700
Airport Maintenance Surplus/(Deficiency)	-	(17,500)	(33,700)	(46,800)	(58,800)	(65,700)
Airport Maintenance Site Requirements (acres)	7	11	13	15	17	18
Site Surplus/(Deficiency)	-	(4)	(6)	(8)	(10)	(11)

Source: PB Aviation, Inc. Analysis
Notes: Existing space based on inventory conducted by maintenance managers
Site requirements includes storage/maintenance yard

4.4.4 Flight Kitchens

Sky Chefs provides catering services to the airlines requiring food preparation at the Airport. The flight kitchen is located on the west side of the terminal complex adjacent to the air cargo buildings. Sky Chefs prepares an average of 7,000 meals per day in its 30,000 square foot facility.

Discussions with Sky Chefs indicate that the Sacramento flight kitchen is operating at 65 percent capacity, meaning 35 percent of the kitchen's capacity remains to accommodate future food preparation requirements. **Table 4.4-4** presents the annual number of meals anticipated through the planning period and the corresponding number of square feet of flight kitchen required. The annual number of meals is based on maintaining the existing ratio of 0.66 meals per enplaned passenger annually. The flight kitchen square footage requirement is then calculated based on the square footage required per 1,000 meals prepared (7.8 square feet).

As indicated, the existing flight kitchen is operating with excess capacity. By 2010, however, the required flight kitchen space equals the existing facility space. In 2020 an additional 9,600 square feet of flight kitchen will be required to meet food preparation demands. It should be noted that the current airline trend is to provide fewer meals due to economic considerations, although some airlines are experimenting with offering meals to passengers for an additional charge. These trends should be monitored as they have the potential to influence the need for flight kitchen facilities.

TABLE 4.4-4
Sacramento International Airport
FLIGHT KITCHEN FACILITY REQUIREMENTS

Year	1999	2005	2010	2015	2020
Enplaned Passengers	3,764,623	4,989,256	5,786,743	6,983,460	7,649,384
Meals Prepared per Enplaned Passenger	0.66	0.66	0.66	0.66	0.66
Annual Meals Prepared	2,492,000	3,302,649	3,830,547	4,622,716	5,063,526
Flight Kitchen Requirements (sf)	19,500	25,843	29,974	36,173	39,622
Flight Kitchen Surplus/(Deficit)	10,500	4,157	26	(6,173)	(9,622)

Sources: PB Aviation Analysis
LSG Sky Chefs

4.4.5 General Aviation

General aviation facility requirements were developed for the Airport based on projected general aviation demand. Facility needs were estimated for the following functional areas:

- Aircraft Storage Buildings
- Transient Aircraft Apron
- General Aviation Terminal and Administration

4.4.5.1 Aircraft Storage Buildings

Storage needs for general aviation reflect local climatic conditions, and the size and sophistication of the Airport's based aircraft fleet. Typically, aircraft with higher values are more likely to be stored in larger, more secure facilities.

Existing hangar space at the Airport includes 12,000 square feet used by Sacramento Jet, 14,440 square feet operated by Beneto Oil, and the Cessna Citation Center occupying 40,000 square feet of space. Altogether, hangar space at the Airport is 66,440 square feet. To project future hangar storage requirements, it was assumed that all based aircraft would continue to be stored in hangars.

Based on the projections presented in Chapter 3.0 and the expectation that an increasing percentage of the general aviation activity will be accommodated by other airports in the region, limited corporate and general aviation hangar development is anticipated at the Airport. However, the Master Plan should include space for additional corporate hangars if demands for such facilities arise during the planning period. Consequently, this study recommends reserving space for the construction of two corporate hangars (approximately 10,000 square feet each).

4.4.5.2 Aircraft Parking Apron

An apron for aircraft parking is required for passenger loading and unloading of transient aircraft using the general aviation terminal and for parking aircraft that are not based at the Airport. The existing aircraft apron is approximately 37,942 square yards in size.

The future aircraft parking apron requirements were based on the peak day itinerant aircraft projections and the aircraft apron space required. **Table 4.5-5** shows ramp space requirements throughout the planning period. At present, the Airport has surplus aircraft parking apron space of 23,602 square yards. A continued surplus is projected with a surplus of 21,992 square yards indicated in 2020.

Taxiways G1 and G2 and the general aviation apron are restricted to aircraft with a gross weight of 60,000 pounds or less. This is sufficient pavement strength for most typical general aviation aircraft. However, if the need arises to handle larger corporate jets such as the Gulfstream, or the Boeing Business Jet (BBJ), a modified 737, additional pavement strength might be needed.

TABLE 4.4-5

Sacramento International Airport

GENERAL AVIATION PARKING APRON SPACE REQUIREMENT

Year	2005	2010	2015	2020
Peak Hour Itinerant Operations	11	12	12	13
Itinerant Ramp Space Required (sy)	7,540	7,900	7,900	9,150
Based Aircraft Apron Space Required (sy)	6,800	6,800	6,800	6,800
Total General Aviation Apron Required (sy)	14,340	14,700	14,700	15,950
Aircraft Parking Apron Surplus/(Deficit)	23,602	23,242	23,242	21,992

Source: PB Aviation

4.4.5.3 General Aviation Terminal and Administration

The existing general aviation terminal and administration building is a modular office adjacent to the general aviation apron and is approximately 1,800 square feet in size. General aviation terminal building space requirements were developed by estimating the number of passengers and pilots per peak hour aircraft and then applying a square footage factor per passenger. Based on records kept by the Airport, general aviation aircraft average approximately three people (passengers and pilots) per aircraft. Typical general aviation terminal facilities require approximately 49 square feet per person. **Table 4.4-6** presents the resulting general aviation terminal requirements. As indicated, approximately 1,600 square feet of terminal space is required for general aviation in 2005. This increases to 1,911 square feet in 2020.

As part of this Master Plan Study, consideration was also given to the space requirements for the potential development of a fixed base operator (FBO) at the Airport. To provide for adequate space for such a general aviation facility, the sizes of recently constructed general aviation terminal at air carrier airports were examined. These facilities ranged in size from 7,500 square feet to 10, 000 square feet. Additionally, these facilities included common-use hangar space associated with FBO. If the Airport is interested in developing such a facility, the Master Plan should reserve space for a 10,000 square foot general aviation terminal/administration building along with a 50,000 square foot hangar.

TABLE 4.4-6 *Sacramento International Airport* *GENERAL AVIATION TERMINAL SPACE REQUIREMENT*				
Year	2005	2010	2015	2020
Peak Hour Itinerant Operations	11	12	12	13
Estimated Passengers and Pilots	33	36	36	39
General Aviation Terminal Space Required (sf)	1,617	1,764	1,764	1,911

Sources: PB Aviation
Airport records

4.4.6 Summary of Support Facility Requirements

In conclusion, the support facilities at the Airport are generally adequate with the exception of airport maintenance facilities which need additional space at the present time. With the projected increase in activities most facilities will require upgrading.

The present fuel storage facilities are operating at a deficit in terms of the three-day reserve and will require expansion through the planning period. In addition to the 428,000 gallons of fuel storage in place today, an additional 554,800 gallons of fuel storage will be required by 2020. The existing flight kitchen will reach capacity at approximately 5.8 million enplaned passengers which is projected in 2010. With the 2020 enplanement projection of 7.6 million, enplaned passengers with an additional 9,600 square feet of flight kitchen space will be required.

General aviation facilities, including aircraft storage buildings, aircraft aprons and general aviation terminal/administration space are adequate throughout the planning period, although space should be reserved in the Master Plan for two additional corporate hangars should demand warrant. As for Airport Administration requirements, there is an anticipated need for additional space from 2005 to the end of the planning period, corresponding with growth in operations at the Airport.

4.5 Summary

Overall, the analysis of demand/capacity facility requirements indicates that many of the Airport's systems will need additional capacity in order to meet forecast demands. The requirements for additional facilities are summarized in **Table 4.5-1**. Each of these facilities and areas are summarized below. Other related plans and factors which will impact on future needs are also described.

4.5.1 Airfield

The airfield is generally capable of accommodating projected demands throughout the planning period. However, several actions need to occur in order for the Airport to accommodate the air travel needs of the region, continue to operate safely and efficiently, and better connect Sacramento to the global economy.

The need for precision runway approach capability on Runway 34R is evident from the simulations and the Airport's NAVAIDs should be upgraded to provide all-weather, CAT III, instrument approach capability. The results also demonstrate the need to balance runway utilization in the future, as well as providing FAA ATC personnel flexibility to make runway assignments based on origin and destination of the flights, as air traffic levels increase over the planning period. During the latter portion of this planning period, peak hour arrival delays will increase unless peak hour arrival capacity enhancement actions are identified during subsequent alternatives analysis efforts. Additionally, runway length must be provided in order for the Airport to serve as an international gateway to Europe in the future. A length of 11,000 feet is needed to meet this requirement.

Table 4.5-1 ***Sacramento International Airport*** ***FACILITY REQUIREMENTS SUMMARY***				
Facility	Current Capacity	Required		
		2005	2010	2020
Annual Passenger Enplanements	4,026,000	5,170,900	6,009,800	7,980,900
Airfield (Operations)				
Peak Hour Capacity	93	59[1]	71[1]	86[1]
Annual Capacity	355,000	235,990[1]	261,230[1]	320,950[1]
Employee	1,074	1,128	1,248	1,542
Rental Car				
Ready Return (spaces)	750	750	851	1,097
Service/Storage (acres)	23.5	23.4	26.6	34.3
Overflow (acres)	-	2.3	2.7	3.4
Taxi/Limo/Shuttle				
Staging Area (linear feet)	2,695	2,500	2,930	3,890
Cargo				
Cargo Building (square feet)	59,000	129,592	159,672	226,602
Cargo Apron (linear feet)	1,100	864	1,064	1,510
Truck (spaces)	40	72	89	126
ARFF (no. of stations)	1	1[4]	1[4]	1[4]
Jet Fuel Storage				
3-day Reserve (gallons)	428,000	589,950	662,400	982,800
Airport Maintenance (square feet)				
Airfield Maintenance	13,398	23,600	26,100	32,000
Equipment Maintenance	11,645	26,800	35,400	43,500
General Services	10,960	19,300	21,300	26,200
Flight Kitchens (square feet)	30,000	25,843	29,974	39,622
General Aviation (square yards)				
Total Apron	37,942	14,340	14,700	15,950

[1]Future capacity requirements are calculated as 80 percent of projected demand in order for the airfield to operate at an acceptable level of delay. Best practices suggest beginning construction on capacity improvements when activity levels reach 80 percent of demand.

[4] Additional facility may be needed due to future runway layout.

Source: PB Aviation Analysis

4.5.2 Access

Typically, all Airport roadways currently operate below capacity with unrestricted maneuverability. The roadway segments leading to and leaving Terminal A provide adequate service, but traffic congestion and unstable operations occur adjacent of Terminal A at the crest of peak periods at the curbfront.

By 2010, forecasts indicate that the main entry to the Airport will reach capacity for peak period outbound traffic, and nearing capacity for in-bound traffic. By 2020, both inbound and outbound segments of Airport Boulevard (near the I-5 interchange) will be congested. Other roads anticipated to reach and exceed capacity are a section of Airport Boulevard (north of Crossfield Drive); Terminal A Drive, Lindberg Drive and Earhart Drive.

Transportation Demand Measures (TDM) are currently in use at the Airport. These types of measures will need to continue and be augmented in the future as Airport activity increases. Analyses in the next chapter will assess the impact of TDM and Light Rail Transit (LRT) on airport-related traffic and the access requirements identified in this chapter.

4.5.3 Parking

The Airport currently features a consolidated rental car parking area. Space set aside under the current proposal to add one to three rental car agencies were considered as occupied at not available for future needs. Rental car service and storage area operates at approximately 85 percent of capacity during the peak month. The rental car area is forecast to reach capacity by 2005. Additionally, by 2020 an additional 347 spaces and 10.8 acres of additional space for rental car storage/return will be needed. Two additional acres will also be needed for storage overflow by 2020.

Employee parking lots currently located in surface lots west of Terminal B-2 and on the west side of Terminal A. Forecasts indicate that there is a current deficit in employee parking, which will increase throughout the planning period. Important factors concerning future planning for employee parking will be the continuation and enhancement of TDM practices at the Airport, planning for light rail access, and the need for parking facilities to accommodate TSA employees.

Taxi, limousine and shuttle van staging lanes, currently totaling approximately 1,040 linear feet, are located in the ground transportation area adjacent to Terminal A. Approximately 155 linear feet of curb space in front of Terminal B is also allocated for these purposes, and a 50-space taxi staging area is located south of Crossfield Drive. An overall surplus of staging area currently exists. However, by 2010, an additional 235 linear feet will be required. This deficit is forecast to increase to 1,195 linear feet by 2020.

4.5.4 Cargo

The focus of air cargo activities in the Sacramento region is anticipated to shift to Mather Airport. However, a segment of the overall market will continue to be processed at the Airport. The Airport's air cargo buildings, as well as air cargo and truck aprons will need to accommodate future demand levels for this segment of the market. The forecast indicates that growth throughout the planning period will require additional cargo buildings and related space. The estimated cargo volume will exceed existing warehouse capacity by more than 167,000 square feet by 2020. An air cargo building length of approximately 1,510 square feet will be required within this timeframe. Planning considerations for the size and configuration of future air cargo facilities and areas should maintain sufficient flexibility to accommodate a variety of aircraft types in the future.

4.5.5 Support

Support facilities examined include Airport Rescue and Firefighting (ARFF), fuel farms, airport maintenance, flight kitchens, and general aviation.

The Airport's existing ARFF station is located so that response times to the midpoint of all existing runways are within allowable FAA limits. Additional ARFF stations may be necessary in the future, if additional airfield facilities are constructed such that the existing station cannot meet these response requirements.

Based upon a three-day reserve requirement for fuel storage, there is a current deficiency of approximately 87,000 gallons of fuel (2.5 days of reserve storage). Throughout the planning period this deficiency is forecast to increase, as both operations and the average gallons of fuel per departure increase. By 2020, an additional 554,800 gallons of jet fuel storage will be required.

Airfield Maintenance, Equipment Maintenance and General Services are located in several modular offices and storage sheds on Airport property. Each category of Airport Maintenance currently experiences a deficiency in space. In total, 17,497 square feet of space are necessary to meet current needs. A site of approximately 11 acres would be needed, if all existing facilities were to be accommodated in one functional area. It is forecast that 101,700 square feet of space will be required to accommodate future requirements, necessitating a site of approximately 18 acres.

The current Sky Chefs flight kitchen is located on the west side of the terminal complex, adjacent to the air cargo buildings, in a 30,000 square foot facility. It is operating currently at approximately 65 percent of full capacity. Forecasts indicate that the existing capacity surplus will be exhausted by the year 2010. By 2020, an additional 9,600 square feet will be needed to meet food preparation demands.

Based upon forecasts, and the expectation that general aviation activity will primarily be accommodated by other airports in the region, it is anticipated that limited corporate and general aviation hangar space will be required. Uncertainties in the future market demand for additional corporate hangar space indicate, however, that it would be prudent to reserve space for the future construction of two corporate hangars. Also the analysis concludes that space be preserved for a general aviation terminal/administration building and a common-use hangar in the event that the Sacramento County Airport System desires to enhance service to corporate general aviation users.

4.5.6 Conclusion

The assessment of demand/capacity relationships and facility requirements clearly indicates the need to examine options for expanding the Airport to accommodate forecast demand. The magnitude of requirements to accommodate a doubling in passenger demand by 2020 substantiates the need to examine concepts for the Airport's future. These significant concerns are the focus of the ensuing chapter of the Master Plan Study.

ENDNOTES

[i] "Surveys of Patrons and Employees Relative to Public Transit Service to Sacramento International Airport," Sacramento International Airport, January 1999.

[ii] "Sacramento International Airport Transit Access Study," Draft, June 30, 2000, SACOG.

[iii] ibid.