Chapter Three

FACILITY REQUIREMENTS

Proper airport planning requires the translation of forecast aviation demand into the specific types and quantities of facilities that can adequately serve the identified demand. This chapter will analyze the existing capacities of Chandler Municipal Airport (CHD) facilities. The existing capacities will then be compared to the forecast activity levels prepared in Chapter Two to determine the adequacy of existing facilities, as well as to identify if deficiencies currently exist or may be expected to materialize in the future. The chapter will present the following elements:

- Planning Horizon Activity Levels
- Airfield Capacity
- Airport Physical Planning Criteria
- Airside and Landside Facility Requirements

The objective of this effort is to identify, in general terms, the adequacy of existing airport facilities, outline what new facilities may be needed, and determine when these may be needed to accommodate forecast demands. Having established these facility requirements, alternatives for providing these facilities will be evaluated to determine the most practical, cost-effective, and efficient means for implementation.

CHANDLER MUNICIPAL AIRPORT CHD

The facility requirements for CHD were evaluated using guidance contained in several Federal Aviation Administration (FAA) publications, including the following:

- Advisory Circular (AC) 150/5300-13A, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B (and Draft 4C), *Runway Length Requirements for Airport Design*
- Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order 5090.5, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*

DEMAND-BASED PLANNING HORIZONS

An updated set of aviation demand forecasts for CHD has been established and was detailed in Chapter Two. These activity forecasts include passenger enplanements, annual aircraft operations, based aircraft, aircraft fleet mix, and peaking characteristics. With this information, specific components of the airfield and landside system can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, efficient, and orderly development of an airport should rely more upon actual demand at an airport than on a time-based forecast figure. In order to develop a master plan that is demand-based rather than time-based, a series of planning horizon milestones have been established that take into consideration the reasonable range of aviation demand projections. The planning horizons are the short term (years 1-5), the intermediate term (years 6-10), and the long term (years 11-20).

It is important to consider that the actual activity at the airport may be higher or lower than what the annualized forecast portrays. By planning according to activity milestones, the resultant plan can accommodate unexpected shifts or changes in the area's aviation demand by allowing airport management the flexibility to make decisions and develop facilities based upon need generated by actual demand levels. The demand-based schedule provides flexibility in development, as development schedules can be slowed or expedited according to demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and needs-based program. **Table 3A** presents the short-, intermediate-, and long-term planning horizon milestones for each aircraft activity level forecasted in Chapter Two.

TABLE 3A
Aviation Demand Planning Horizons
Chandler Municipal Airport

	Base Year (2019)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
BASED AIRCRAFT				
Single Engine	379	424	469	552
Multi-Engine	26	24	20	15
Turboprop	6	7	9	13
Jet	8	10	13	20
Helicopter	22	25	29	40
TOTAL BASED AIRCRAFT	441	490	540	640
ANNUAL OPERATIONS				
Itinerant				
Air Taxi	2,990	3,900	4,400	5,100
General Aviation	67,647	72,500	77,300	87,400
Military	199	213	213	213
Total Itinerant	70,836	76,613	81,913	92,713
Local				
General Aviation	149,754	158,300	165,800	181,900
Military	72	62	62	62
Total Local	149,826	158,362	165,862	181,962
TOTAL OPERATIONS	220,662	234,975	247,775	274,675

Source: Coffman Associates analysis

AIRFIELD CAPACITY

An airport's airfield capacity is expressed in terms of its annual service volume (ASV). ASV is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors. As aircraft operations near or surpass the ASV, delay factors increase exponentially. The airport's ASV was examined utilizing FAA AC 150/5060-5, *Airport Capacity and Delay*.

FACTORS AFFECTING ANNUAL SERVICE VOLUME

This analysis takes into account specific factors about the airfield in order to calculate the airport's ASV. These various factors are depicted in **Exhibit 3A**. The following describes the input factors as they relate to CHD and include airfield layout, weather conditions, aircraft mix, and operations.

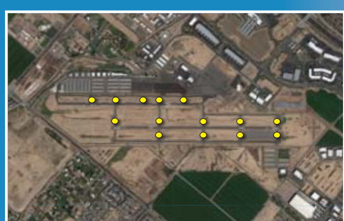
- **Runway Configuration –** The existing airfield configuration consists of parallel runways supported by full-length and partial-length parallel taxiways. Runway 4R-22L is 4,870 feet long and 75 feet wide. Runway 4L-22R is 4,401 feet long and 75 feet wide. The runways have a separation distance of 700 feet, which allows for simultaneous visual flight rule (VFR) operations.

AIRFIELD LAYOUT

Runway Configuration

Runway Use

Number of Exits



WEATHER CONDITIONS

VMC- Visual Meteorological Conditions

IMC- Instrument Meteorological Conditions

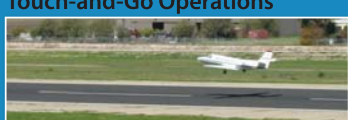
PVC- Poor Visibility Conditions

OPERATIONS

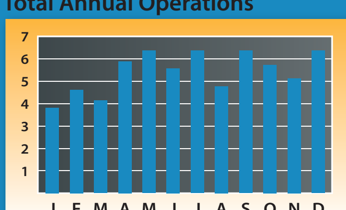
Arrivals

Departures

Touch-and-Go Operations



Total Annual Operations



AIRCRAFT MIX

Category A & B Aircraft

Single Engine

Small Turboprop

Twin Piston

Category C Aircraft

Business Jet

Regional Jet

Commuter

Commercial Jet

Category D Aircraft

Wide Body Jets

Exhibit 3A
AIRFIELD CAPACITY FACTORS

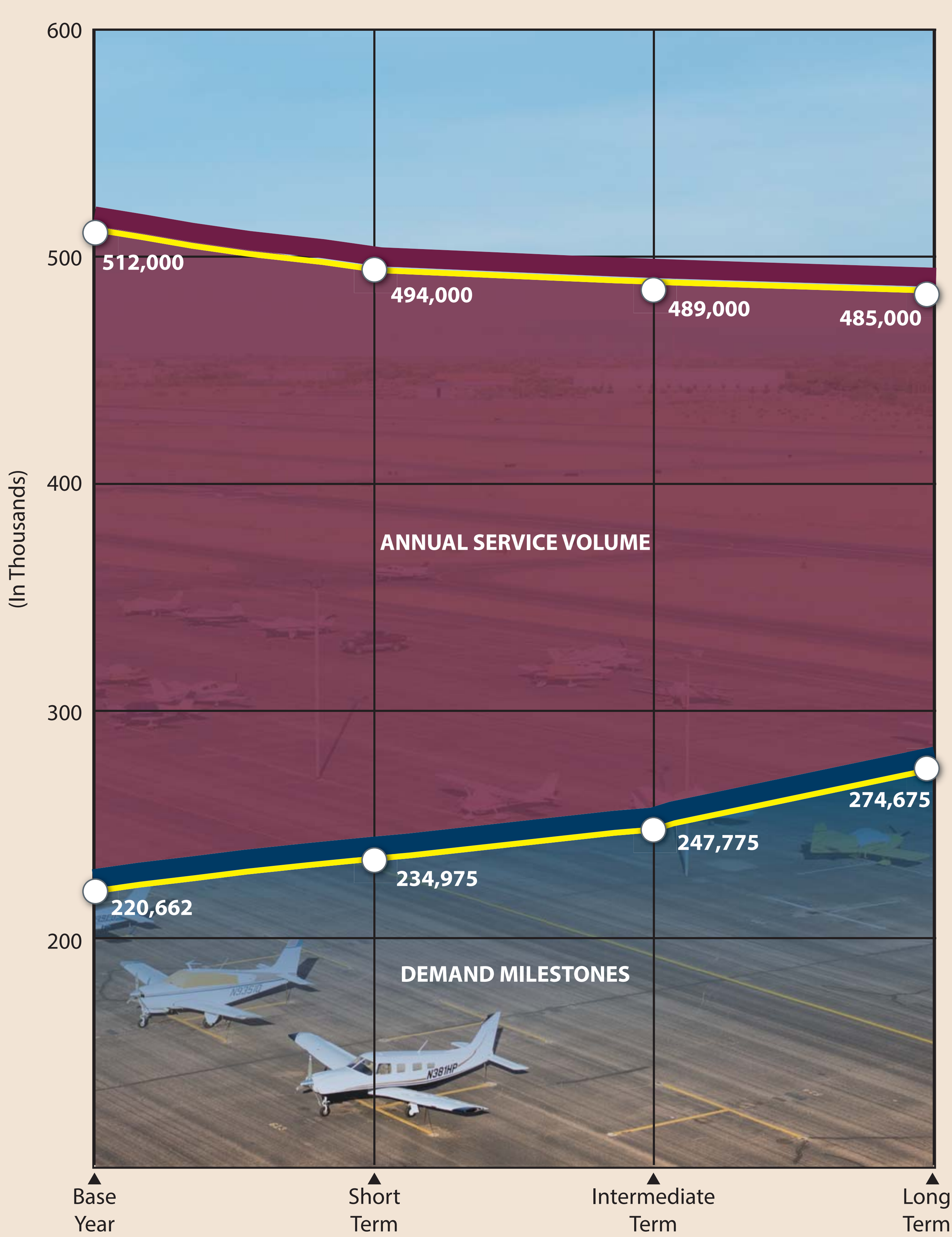


Exhibit 3A continued
AIRFIELD DEMAND VS CAPACITY

- **Runway Use –** Runway use in capacity conditions is controlled by wind and/or airspace conditions. For CHD, the direction of takeoffs and landings is typically determined by the speed and direction of the wind or as directed by the airport traffic controller. It is generally safest for aircraft to takeoff and land into the wind, avoiding a crosswind (wind that is blowing perpendicular to the travel of the aircraft) or tailwind components during these operations.

  Discussions with the CHD airport traffic control tower indicate that Runway 4R-22L is used primarily for touch-and-go activity, which positions flight training traffic patterns on the south side of the airport. Runway 4L-22R, is used more frequently for transient operations since it is closer to the FBO/SASO operations on the north side. Direction of operations is equally split between Runways 4 and 22 as dictated by wind conditions and ATCT.

- **Exit Taxiways –** Exit taxiways have a significant impact on airfield capacity since the number and location of exits directly determine the occupancy time of an aircraft on the runway. The airfield capacity analysis gives credit to taxiway exits located within the prescribed range from a runway's threshold. This range is based upon the mix index of the aircraft that use the runways. Based upon mix, only exit taxiways between 2,000 feet and 4,000 feet from the landing threshold count in the exit rating at CHD. The exits must be at least 750 feet apart to count as separate exit taxiways. Utilizing these criteria, both runways are credited with two exit taxiways in each direction.

- **Weather Conditions –** Weather conditions can have a significant impact on airfield capacity. Airport capacity is usually highest in clear weather when flight visibility is at its best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety and air traffic vectoring. The increased distance between aircraft reduces the number of aircraft which can operate at the airport during any given period, thus reducing overall airfield capacity.

  According to local meteorological data, the airport operates under visual meteorological conditions (VMC) approximately 99 percent of the time. VMC exist whenever the cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is greater than three statute miles. Instrument meteorological conditions (IMC) are defined when cloud ceilings are between 500 and 1,000 feet AGL or visibility is between one and three miles. Poor visibility conditions (PVC) apply for cloud ceilings below 500 feet and visibility minimums below one mile. According to the weather observations, IMC and PVC prevailed less than one percent of the time. **Table 3B** summarizes the weather conditions experienced at the airport over a 10-year period of time.

TABLE 3B
Weather Conditions
Chandler Municipal Airport

Condition	Cloud Ceiling	Visibility	Percent of Total
VMC	≥ 1,000' AGL	> 3 statute miles	99.64%
IMC	≥ 500' AGL to < 1,000' AGL	1-3 statute miles	0.25%
PVC	< 500' AGL	< 1 statute mile	0.11%

VMC- Visual Meteorological Conditions
IMC- Instrument Meteorological Conditions
PVC- Poor Visibility Conditions
AGL- Above Ground Level
Source: 50,436 All Weather Observations from Jan 1, 2010 thru Dec 31, 2019, Chandler Municipal Airport Weather Station

- **Aircraft Mix** – The aircraft mix for the capacity analysis is defined in terms of four aircraft classifications. Classes A and B consist of small- and medium-sized propeller and some jet aircraft, all weighing 12,500 pounds or less. These aircraft are associated primarily with general aviation activity, but do include some air taxi, air cargo, and commuter aircraft. Most operations at CHD are by Classes A and B aircraft. Class C consists of aircraft weighing between 12,500 pounds and 300,000 pounds. These aircraft include most business jets and some turboprop aircraft which utilize the airport on a regular basis. According to the FAA's Traffic Flow Management System Count (TFMSC) data for 2019, there were approximately 1,200 total operations by Class C aircraft at CHD, which represents approximately 0.5 percent of all operations. Over the course of the planning period it is anticipated that Class C operations will increase as these aircraft become more prevalent in the local and national fleet mix. Despite this, Class C operations are not anticipated to make up more than two percent of total operations by the long-range planning horizon. Class D aircraft consist of aircraft weighing more than 300,000 pounds. The airport does not experience operations by Class D aircraft.

- **Percent Arrivals** – The percentage of arrivals as they relate to total operations of the airport is important in determining airfield capacity. Under most circumstances, the lower the percentage of arrivals, the higher the hourly capacity. The aircraft arrival-departure percentage split is typically 50/50, which is the case at CHD.

- **Touch-and-Go Activity** – A touch-and-go operation involves an aircraft making a landing and then an immediate takeoff without coming to a full stop or exiting the runway. As previously discussed in Chapter Two, these operations are normally associated with general aviation training activity and classified as a local operation. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and takeoff occurs within a shorter time period than individual operations. Touch-and-go operations at CHD accounted for 68 percent of total annual operations in 2019. This percentage is anticipated to drop slightly as itinerant operations are expected to grow at a slightly faster pace; however, touch-and-go operations will still account for most operations in the future.

- **Peak Period Operations** – Average daily operations and average peak hour operations during the peak month are utilized for the airfield capacity analysis. Operations activity is important in the calculation of an airport's ASV as "peak demand" levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times throughout the year.

CALCULATION OF ANNUAL SERVICE VOLUME

The preceding information was used in conjunction with the airfield capacity methodology developed by the FAA to determine airfield capacity for CHD.

Hourly Runway Capacity

The first step in determining ASV involves the computation of the hourly capacity of the runway configuration. The percentage use of the runway, the amount of touch-and-go activity, and the number and locations of runway exits are the important factors in determining hourly capacity.

As the operational mix of aircraft at the airport changes to include a higher percentage of large aircraft weighing over 12,500 pounds, the hourly capacity of the system declines slightly. This is a result of the additional spacing and time required by larger aircraft in the traffic pattern and on the runway.

The current and future weighted hourly capacities are presented in **Table 3C**. Weighted hourly capacity is the measure of the maximum number of aircraft operations that can be accommodated on the airfield in a typical hour. It is a composite of estimated hourly capacities for different airfield operating configurations adjusted to reflect the percentage of time in an average year that the airfield operates under each specific configuration. The current weighted hourly capacity on the airfield is 267 operations; likewise, the capacity is expected to decline slightly to 258 operations by the long-term horizon.

TABLE 3C
Airfield Capacity Summary
Chandler Municipal Airport

	Base Year (2019)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
Operational Demand				
Annual	220,662	234,975	247,775	274,675
Capacity				
Annual Service Volume	512,000	494,000	489,000	485,000
Percent Capacity	43.1%	47.6%	50.7%	56.6%
Weighted Hourly Capacity	267	263	260	258

Source: FAA AC 150/5060-5, *Airport Capacity and Delay*

Annual Service Volume

The ASV is determined by the following equation:

Annual Service Volume = C x D x H
C = weighted hourly capacity
D = ratio of annual demand to the average daily demand during the peak month
H = ratio of average daily demand to the design hour demand during the peak month

The current ASV for the airfield has been estimated at 512,000 operations. The increasing percentage of larger Class C aircraft over the planning period will attribute to a decline in ASV, lowering it to a level of approximately 485,000 operations by the end of the planning period. With 2019 operations at 220,662, the airport is currently at 43.1 percent of its ASV. Long range annual operations are forecast to reach 274,675, which would equate to 56.6 percent of the Airport's ASV.

Table 3C and the back side of **Exhibit 3A** summarize and compare the airport's ASV and projected annual operations over the short, intermediate, and long-range planning horizons.

AIRCRAFT DELAY

The affect that the anticipated ratio of demand to capacity will have on users of CHD can be measured in terms of delay. As the number of annual aircraft operations approaches the airfield's capacity, increasing operational delays begin to occur. Delays occur to arriving and departing aircraft in all weather conditions. Arriving aircraft delays result in aircraft holding outside the airport traffic pattern area. Departing aircraft delays result in aircraft holding at the runway end until they can safely takeoff.

Aircraft delay can vary depending on different operational activities at an airport. At airports where large air carrier aircraft dominate, delay can be greater given the amount of time these aircraft require in the traffic pattern and on approach to land. For airports that accommodate primarily small general aviation aircraft, such as CHD, experienced delay is typically less since these aircraft are more maneuverable and require less time in the airport traffic pattern.

Table 3D summarizes the potential aircraft delay for CHD. Estimates of delay provide insight into the impacts that steady increases in aircraft operations have on the airfield and signify the airport's ability to accommodate projected annual aircraft operations. The delay per operation represents an average delay per aircraft. It should be noted that delays of five to ten times the average could be experienced by individual aircraft during peak periods. As an airport's percent capacity increases toward the ASV, delay increases exponentially. Furthermore, complexities in the airspace system that surrounds an airport can also factor into additional delay experienced at the facility.

TABLE 3D
Airfield Delay Summary
Chandler Municipal Airport

	Base Year (2019)	Short Term (1-5 years)	Intermediate Term (6-10 years)	Long Term (11-20 years)
Percent Capacity	43.1%	47.6%	50.7%	56.6%
Delay				
Per Operation (Minutes)	0.28	0.30	0.39	0.43
Total Annual (Hours)	1,030	1,175	1,611	1,969

Source: FAA AC 150/5060-5, *Airport Capacity and Delay*

Current annual delay is estimated at 0.28 minutes per aircraft operation or 1,030 annual hours. Analysis of delay factors for the long-term planning horizon indicates that annual delays can be expected to reach 0.43 minutes per aircraft operation, or 1,969 annual hours.

CAPACITY ANALYSIS CONCLUSION

FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 to 75 percent of the ASV. This is an approximate level to begin the detailed planning of capacity improvements. When 80 percent of the ASV is reached, capacity improvement projects should become higher priority capital improvements. According to this analysis, operations levels at CHD are not anticipated to reach these percentages in the next 20 years. While no significant capacity improvements will be necessary, options to improve airfield efficiency will still be considered as part of this master plan.

AIRSIDE FACILITY REQUIREMENTS

Airside facilities include those facilities related to the arrival, departure, and ground movement of aircraft. Airside facility requirements are based primarily upon the Runway Design Code (RDC) for each runway. Analysis in Chapter Two identified the existing/ultimate RDC as RDC B-II-5000 for Runway 4R-22L and RDC B-II-VIS (small Aircraft) Runway 4L-22R.

RUNWAYS

Runway conditions, such as orientation, length, width, and pavement strength, were analyzed at CHD. From this information, requirements for runway improvements were determined for the airport.

Runway Orientation

Key considerations in the runway configuration of an airport involve the orientation for wind coverage and the operational capacity of the runway system. FAA AC 150/5300-13A, *Airport Design*, recommends that a crosswind runway should be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecast to use the airport on a regular basis.

The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 mph) for ARC A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; 16 knots (18 mph) for ARC A-III, B-III, and C-I through D-II; and 20 knots (23 mph) for ARC C-III through D-IV.

Exhibit 3B presents the all-weather wind rose for the airport. The previous 10 years of wind data[1] was obtained from the on-airport AWOS and has been analyzed to identify wind coverage provided by the existing runway orientations. At CHD, the orientation of the parallel runways (4-22) provides 94.97 percent coverage for the 10.5-knot component, 97.52 percent coverage for 13 knots, and greater than 99 percent coverage for 16- and 20-knot components. Thus, the current runway orientation at CHD provides adequate wind coverage for all-weather conditions.

Runway Length

AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides guidance for determining runway length needs. A draft revision of this AC is currently available (150/5325-4C) and the FAA is utilizing the draft revision in most cases when evaluating runway length needs for airports.

The determination of runway length requirements for the airport is based on five primary factors:

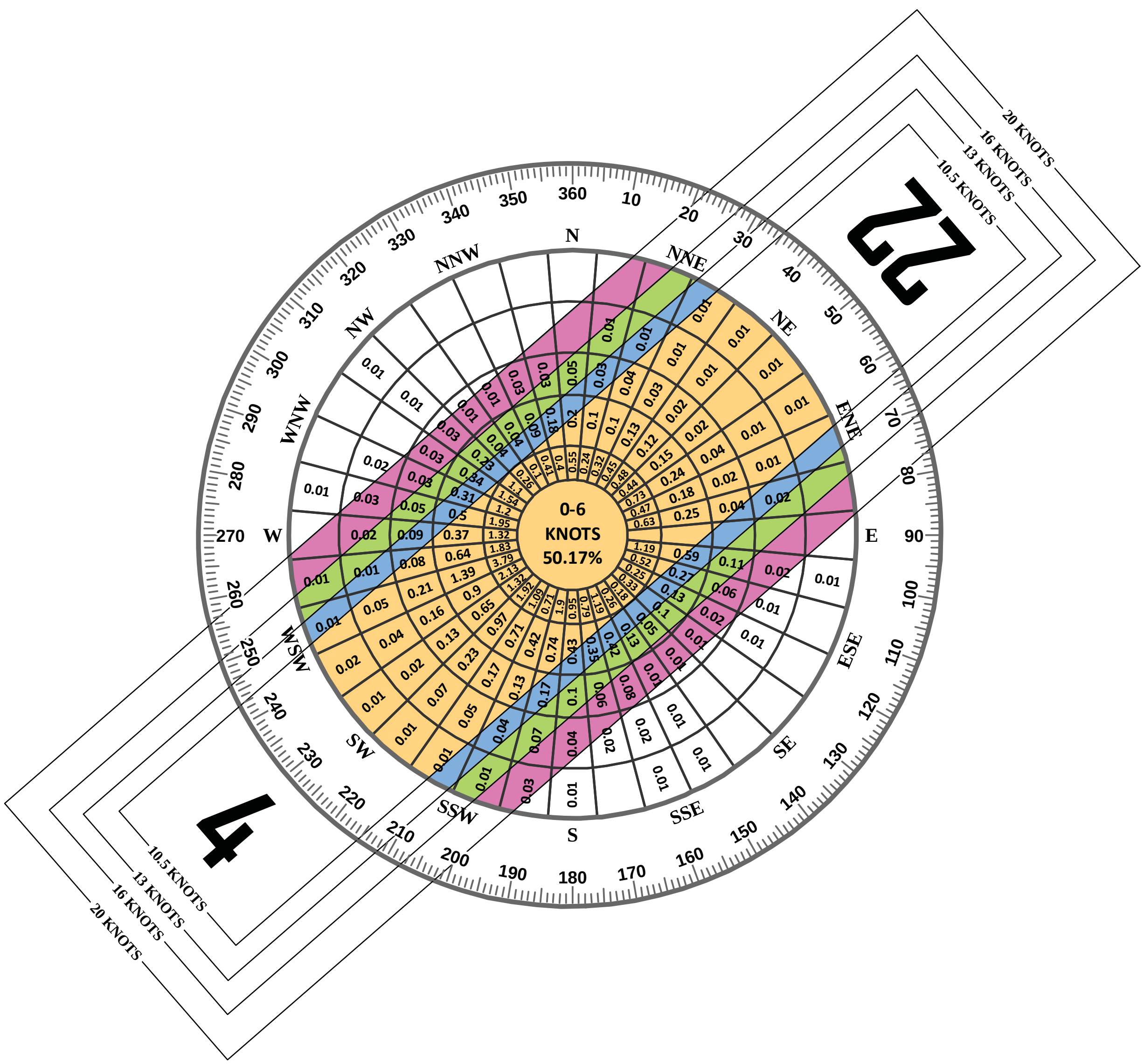
- Mean maximum temperature of hottest month
- Airport elevation
- Runway gradient
- Critical aircraft type expected to use the runway
- Stage length of the longest nonstop destination (specific to larger aircraft)

The mean maximum daily temperature of the hottest month for CHD is 106.1 degrees Fahrenheit (F), which occurs in July. The airport elevation is 1,243.1 feet mean sea level (MSL). The primary runway (4R-22L) has a gradient of 0.15 percent and secondary runway (4L-22R) has a gradient of 0.12 percent. As such, both runways conform to FAA design standards for gradient.

Airplanes operate on a wide variety of available runway lengths. Many factors will govern the sustainability of runway lengths for aircraft, such as elevation, temperature, wind, aircraft weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures. Airport operators can pursue policies that maximize the sustainability of the

[1] 50,436 observations were collected for the period January 1, 2010 through December 31, 2019.

ALL WEATHER WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 4-22	94.97%	97.52%	99.21%	99.75%



Magnetic Declination
10° 02' 00" East (January 2020)
Annual Rate of Change
00° 06' 00" West (January 2020)

SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Chandler Municipal Airport
Chandler, AZ

OBSERVATIONS:
50,436 All Weather Observations
Jan. 1, 2010 - Dec, 31 2019

runway length. Policies such as area zoning and height and hazard restricting can protect an airport's runway length. Airport ownership (fee simple easement) of land leading to the runway ends reduces the possibility of natural growth or man-made obstructions. Planning of runways should include an evaluation of aircraft types expected to use the airport now and in the future. Future planning should be realistic and supported by the FAA-approved forecasts and should be based on the critical design aircraft (or family of aircraft).

General Aviation Aircraft

Most operations at CHD are conducted using smaller single engine piston-powered aircraft weighing less than 12,500 pounds. Following guidance from AC 150/ 5325-4B, to accommodate 95 percent of these small aircraft with less than 10 passenger seats, a runway length of 3,700 feet is recommended. For 100 percent of these small aircraft, a runway length of 4,400 feet is recommended. For small aircraft with 10 or more passenger seats, 4,800 feet of runway length is also recommended.

The airport is also utilized by aircraft weighing more than 12,500 pounds, including small- to medium-sized business jet aircraft. Runway length requirements for business jets weighing less than 60,000 pounds have also been calculated. These calculations take into consideration the runway gradient and landing length requirements for contaminated runways (wet). Business jets tend to need greater runway length when landing on a wet surface because of their increased approach speeds. AC 150/5325-4B stipulates that runway length determination for business jets consider a grouping of airplanes with similar operating characteristics. The AC provides two separate "family groupings of airplanes," each based upon their representative percentage of aircraft in the national fleet. The first grouping is those business jets that make up 75 percent of the national fleet, and the second group is those making up 100 percent of the national fleet. **Table 3E** presents a partial list of common aircraft in each aircraft grouping. A third group considers business jets weighing more than 60,000 pounds. Runway length determination for these aircraft must be based on the performance characteristics of the individual aircraft.

TABLE 3E
Business Jet Categories for Runway Length Determination

75 Percent of the National Fleet	MTOW (lbs.)	75-100 Percent of the National Fleet	MTOW (lbs.)	Greater than 60,000 Pounds	MTOW (lbs.)
Lear 35	20,350	Lear 55	21,500	Gulfstream II	65,500
Lear 45	20,500	Lear 60	23,500	Gulfstream IV	73,200
Cessna 550	14,100	Hawker 800XP	28,000	Gulfstream V	90,500
Cessna 560XL	20,000	Hawker 1000	31,000	Global Express	98,000
Cessna 650 (VII)	22,000	Cessna 650 (III/IV)	22,000	Gulfstream 650	99,600
IAI Westwind	23,500	Cessna 750 (X)	36,100		
Beechjet 400	15,800	Challenger 604	47,600		
Falcon 50	18,500	IAI Astra	23,500		

MTOW: Maximum Takeoff Weight
Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

Table 3F presents the results of the runway length analysis for business jets developed following the guidance provided in AC 150/5325-4B. To accommodate 75 percent of the business jet fleet at 60 percent useful load, a runway length of 5,500 feet is recommended. This length is derived from a raw length of 5,200 feet that is adjusted, as recommended, for runway gradient and consideration of landing length needs on a contaminated runway (wet and slippery). To accommodate 100 percent of the business jet fleet at 60 percent useful load, a runway length of 7,100 feet is recommended.

Utilization of the 90 percent category for runway length determination is generally not considered by the FAA unless there is a demonstrated need at an airport. This could be documented activity by a business jet operator that flies out frequently with heavy loads. To accommodate 75 percent of the business jet fleet at 90 percent useful load, a runway length of 8,300 feet is recommended. To accommodate 100 percent of business jets at 90 percent useful load, a runway length of 11,100 feet is recommended.

TABLE 3F
Runway Length Requirements
Chandler Municipal Airport

Airport Elevation	1,243.1 feet MSL			
Average High Monthly Temperature	106.1 degrees F (July)			
Primary Runway End Elevation Difference	7.4’			
Fleet Mix Category	**Raw Runway Length from FAA AC**	**Runway Length with Gradient Adjustment (+74')**	**Wet Surface Landing Length for Jets (+15%)***	**Final Runway Length**
75% of fleet at 60% useful load	5,200	5,274	5,500	5,500
100% of fleet at 60% useful load	7,000	7,074	5,500	7,100
75% of fleet at 90% useful load	8,200	8,274	7,000	8,300
100% of fleet at 90% useful load	11,000	11,074	7,000	11,100

*Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet condition.
Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

Another method to determine runway length requirements for aircraft at CHD is to examine aircraft flight planning manuals under conditions specific to the airport. Several aircraft were analyzed for takeoff length required with a design temperature of 106.1 degrees F at a field elevation of 1,243.1 feet MSL. **Table 3G** provides a detailed runway length analysis for several of the most common turbine aircraft in the national fleet. This data was obtained from Ultranav software, which computes operational parameters for specific aircraft based on flight manual data. The analysis includes the maximum takeoff weight (MTOW) allowable and the percent useful load from 60 percent to 100 percent. This analysis shows that the length of 4,870 feet on Runway 4R-22L presents weight restrictions for 16 of the 39 aircraft evaluated beginning at 60 percent useful load. The average takeoff length needed for all turbine aircraft analyzed at 60 percent useful load is 4,500 feet. Progressively fewer turbine aircraft can operate on the available runway at CHD as the useful load increases. Only 10 evaluated turbine aircraft can operate at 90 percent useful load and only seven can operate at 100 percent useful load. Ultimately, the average length needed in the 70 percent useful load and higher categories exceeds the available runway length at CHD.

TABLE 3G
Business Aircraft Takeoff Length Requirements
Chandler Municipal Airport

Aircraft Name	MTOW lbs.	Takeoff Length Requirements (feet) — Useful Load 60%	70%	80%	90%	100%
Pilatus PC-12	9,921	2,312	2,508	2,714	2,930	3,156
King Air C90B	10,100	2,789	3,402	3,638	3,899	4,183
Citation Ultra	16,300	3,160	3,441	3,727	4,037	4,372
Beechjet 400A	16,300	3,288	4,870	5,249	5,659	O/L
Citation CJ3	13,870	3,316	3,581	3,875	4,228	4,642
Citation Sovereign	30,300	3,430	3,676	3,942	4,232	4,578
Citation Mustang	8,645	3,508	3,944	4,433	5,174	O/L
Citation Encore	16,630	3,563	3,928	4,333	4,781	5,283
Citation (525A) CJ2	12,375	3,645	3,938	4,253	4,602	O/L
Citation II (550)	13,300	3,689	4,101	4,543	5,015	5,514
Citation V (Model 560)	15,900	3,810	3,466	3,769	4,088	4,429
King Air 200 GT	12,500	3,818	3,976	4,118	4,242	4,353
Citation Bravo	14,800	3,836	4,143	4,499	4,902	5,342
Citation 560 XLS	20,200	3,942	4,265	4,629	5,046	O/L
King Air 350	15,000	4,004	4,168	4,330	4,646	5,002
King Air 1900D	17,120	4,276	4,551	4,875	4,964	5,602
Lear 40XR	21,000	4,290	4,634	5,034	5,514	6,086
Lear 45XR	21,500	4,446	4,836	5,273	5,884	6,494
Hawker 900 XP	28,000	4,668	5,144	5,661	6,229	O/L
Hawker 4000	39,500	4,725	5,129	5,588	6,121	9,500
Gulfstream 350	70,900	4,770	5,207	5,686	6,202	6,748
Premier 1A	12,500	4,807	5,230	5,659	6,156	6,838
Gulfstream 300	72,000	4,844	5,163	5,745	6,304	6,917
Global 5000	92,500	4,894	5,443	6,020	6,626	O/L
Falcon 900EX	49,200	4,920	5,500	6,140	6,830	7,510
Falcon 7X	70,000	4,929	5,468	6,079	6,741	7,459
Challenger 300	38,850	5,070	5,552	6,053	6,586	7,210
Citation X	35,700	5,128	5,609	6,168	O/L	O/L
Gulfstream 450	74,600	5,131	5,664	6,244	6,858	7,557
Gulfstream 550	91,000	5,320	6,044	6,893	7,757	8,754
Global Express	98,000	5,346	5,991	6,671	O/L	O/L
Falcon 2000	35,800	5,361	5,826	6,298	6,998	8,398
Challenger 604/605	48,200	5,538	6,094	6,740	7,442	8,165
Gulfstream 100	24,650	5,680	6,303	6,956	7,603	O/L
Embraer 135	49,604	5,682	6,223	6,467	7,272	7,929
Lear 60	23,500	6,008	6,552	7,187	7,876	8,615
Gulfstream 200	35,450	6,157	6,902	7,728	O/L	O/L
Lear 55	21,500	6,485	7,245	8,068	O/L	O/L
Gulfstream II/IISP	65,500	6,626	7,205	O/L	O/L	O/L
Average Takeoff Length		**4,500**	**5,000**	**5,400**	**5,700**	**6,300**

Green figures are less than or equal to the length of the primary runway at CHD. Red figures are greater than the length of the primary runway at CHD. O/L indicates the input data is outside the operating limits of the aircraft planning manual.
Runway length calculation assumptions: 1,243.1 MSL field elevation; 106.1° F ambient temperature; 0.15% runway grade.
MTOW - Maximum Takeoff Weight
Source: Ultranav software

Table 3H presents the runway length required for landing under three operational categories: Title 14 Code of Federal Regulations (CFR) Part 25, CFR Part 135, and CFR Part 91k. CFR Part 25 operations are those conducted by individuals or companies which own their aircraft. CFR Part 135 applies to all for-hire charter operations, including most fractional ownership operations. CFR Part 91k includes operations in fractional ownership which utilize their own aircraft under direction of pilots specifically assigned to said aircraft. Part 91k and Part 135 rules regarding landing operations require operators to land at the destination airport within 60 percent of the effective runway length. An additional rule allows for operators to land within 80 percent of the effective runway length if the operator has an approved destination airport analysis in the airport's program operating manual. The landing length analysis conducted accounts for both scenarios.

The landing length analysis shows that all but one aircraft can land on the available runway length at CHD under Part 25 or under the 80 percent rule during dry runway conditions. Only 14 of 39 aircraft evaluated can land at CHD under the 60 percent rule during dry runway conditions. Under wet runway conditions, the number of aircraft that are capable of landing at CHD is further restricted. In fact, none of the jet aircraft evaluated are capable of landing under the 60 percent rule.

Runway Length Summary

Many factors are considered when determining appropriate runway length for safe and efficient operations of aircraft at CHD. The airport should strive to accommodate business jets and turboprop aircraft to the greatest extent possible as demand would dictate. Runway 4R-22L is currently 4,870 feet long and can accommodate many of these aircraft under moderate loading conditions, especially with shorter trip lengths and during cool to warm temperatures. It is the hotter days and heavier useful loads that limit business jets at CHD.

Justification for any runway extension to meet the needs of turbine aircraft would require regular use on the order of 500 annual itinerant operations. This is the minimum threshold required to obtain FAA grant funding assistance. The current Airport Layout Plan (ALP) for CHD includes an extension to 5,550 feet for Runway 4R-22L to meet the needs of turbine aircraft operators. Analysis in the next chapter will examine potential extensions on Runway 4R-22L, while considering appropriate safety design standards (these standards will be detailed later in this chapter).

At 4,401 feet, Runway 4L-22R can accommodate all small general aviation piston-powered aircraft and some small turbine aircraft. Since the secondary runway is intended to serve primarily small aircraft, its current length is adequate and should be maintained through the planning period.

Runway Width

Runway width design standards are primarily based on the critical aircraft but can also be influenced by the visibility minimums of published instrument approach procedures. For Runway 4R-22L, existing RDC B-II-5000 design criteria stipulate a runway width of 75 feet. For Runway 4L-22R, RDC B-II-VIS (small aircraft) standards stipulate a runway width of 75 feet. Both runways are 75 feet wide and therefore meet the existing and ultimate design standards.

TABLE 3H
Business Aircraft Landing Length Requirements
Chandler Municipal Airport

Aircraft Name	MLW lbs.	Landing Length Requirements (feet)					
		Dry Runway Condition			Wet Runway Condition		
		Part 25	80% Rule	60% Rule	Part 25	80% Rule	60% Rule
King Air 200 GT	12,500	1,276	1,595	2,127	N/A	N/A	N/A
King Air C90B	9,600	1,312	1,640	2,187	N/A	N/A	N/A
Pilatus PC-12	9,921	2,451	3,064	4,085	N/A	N/A	N/A
Citation II (550)	12,700	2,567	3,209	4,278	N/A	N/A	N/A
Citation Mustang	8,000	2,637	3,296	4,395	3,706	4,633	6,177
Challenger 300	33,750	2,671	3,339	4,452	5,119	6,399	8,532
Hawker 800XP	23,350	2,726	3,408	4,543	4,247	5,309	7,078
Global 5000	78,600	2,730	3,413	4,550	3,139	3,924	5,232
Global Express	78,600	2,730	3,413	4,550	3,139	3,924	5,232
Embraer 135	40,785	2,757	3,446	4,595	3,161	3,951	5,268
Gulfstream 550	75,300	2,843	3,554	4,738	5,177	6,471	8,628
Challenger 604/605	38,000	2,871	3,589	4,785	4,554	5,693	7,590
King Air 350	15,000	2,901	3,626	4,835	N/A	N/A	N/A
Citation Sovereign	27,100	2,906	3,633	4,843	3,698	4,623	6,163
Lear 40XR	19,200	2,962	3,703	4,937	3,809	4,761	6,348
Falcon 7X	62,400	3,000	3,750	5,000	3,450	4,313	5,750
Falcon 50 EX	35,715	3,002	3,753	5,003	3,453	4,316	5,755
King Air 1900D	16,765	3,019	3,774	5,032	3,472	4,340	5,787
Citation CJ3	12,750	3,080	3,850	5,133	4,194	5,243	6,990
Citation III	19,000	3,100	3,875	5,167	4,377	5,471	7,295
Citation Encore	15,200	3,116	3,895	5,193	4,674	5,843	7,790
Citation Ultra	15,200	3,151	3,939	5,252	4,681	5,851	7,802
Citation V	15,200	3,180	3,975	5,300	4,720	5,900	7,867
Gulfstream 150	21,700	3,192	3,990	5,320	4,604	5,755	7,673
Falcon 2000	33,000	3,205	4,006	5,342	3,685	4,606	6,142
Citation (525A) CJ2	11,500	3,257	4,071	5,428	4,722	5,903	7,870
Citation VII	20,000	3,264	4,080	5,440	4,423	5,529	7,372
Hawker 4000	33,500	3,302	4,128	5,503	3,797	4,746	6,328
Gulfstream 350	66,000	3,344	4,180	5,573	3,845	4,806	6,408
Gulfstream 450	66,000	3,344	4,180	5,573	5,800	7,250	9,667
Citation 560 XLS	18,700	3,512	4,390	5,853	5,533	6,916	9,222
Premier 1A	11,600	3,531	4,414	5,885	4,538	5,673	7,563
Lear 55	18,000	3,535	4,419	5,892	5,656	7,070	9,427
Gulfstream 200	30,000	3,648	4,560	6,080	4,195	5,244	6,992
Citation Bravo	13,500	3,754	4,693	6,257	5,900	7,375	9,833
Falcon 900EX	44,500	3,763	4,704	6,272	4,328	5,410	7,213
Lear 60	19,500	3,773	4,716	6,288	5,102	6,378	8,503
Beechjet 400A	15,700	3,879	4,849	6,465	5,693	7,116	9,488
Citation X	31,800	3,925	4,906	6,542	5,603	7,004	9,338
Average Landing Length		**3,200**	**4,000**	**5,300**	**4,400**	**5,500**	**7,400**

Green figures are less than or equal to the length of the primary runway at CHD. Red figures are greater than the length of the primary runway at CHD.
Runway length calculation assumptions: 1,243' MSL field elevation; 106.1° F ambient temperature; 0.15% runway grade.
MLW – Maximum Landing Weight
N/A – Not Applicable. Turboprop aircraft landing lengths are not adjusted for wet runway conditions.
Source: Ultranav software

Pavement Strength

An important feature of airfield pavement is its ability to withstand repeated use by aircraft. The FAA reports the pavement strength for both runways at 30,000 pounds single wheel loading (SWL). SWL indicates an aircraft with a single wheel on each landing gear.

The strength rating of a runway does not preclude aircraft weighing more than the published strength rating from using the runway. All federally obligated airports must remain open to the public, and it is typically up to the pilot of the aircraft to determine if a runway can support their aircraft safely. An airport sponsor cannot restrict an aircraft from using the runway simply because its weight exceeds the published strength rating. On the other hand, the airport sponsor has an obligation to properly maintain the runway and protect the useful life of the runway, typically for 20 years.

The strength rating of a runway can change over time. Regular usage by heavier aircraft can decrease the strength rating, while periodic runway resurfacing can increase the strength rating. The current runway strength ratings are adequate to accommodate most aircraft that currently operate at the airport and are forecast to continue utilizing the airport in the future.

Runway Stopways

A runway stopway is a surface beyond the end of the runway that can support an aircraft during an aborted takeoff without causing structural damage to the aircraft. Runway 4R-22L has 90-foot long and 90-foot wide stopways off both ends of the runway. The stopways should be maintained in their current location until such time that the runway is extended.

SAFETY AREA DESIGN STANDARDS

The FAA has established several imaginary surfaces to protect aircraft operational areas and keep them free from obstructions. These include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (ROFZ), and runway protection zone (RPZ).

The entire RSA, ROFA, and ROFZ must be under the direct ownership of the airport sponsor to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. RPZs should also be under airport ownership. An alternative to outright ownership of the RPZ is the purchase of avigation easements (acquiring control of designated airspace within the RPZ) or having sufficient land use control measures in place which ensure the RPZ remains free of incompatible development. The various airport safety areas are presented on **Exhibit 3C**. **Table 3J** presents the FAA design standards as they apply to each runway at CHD.

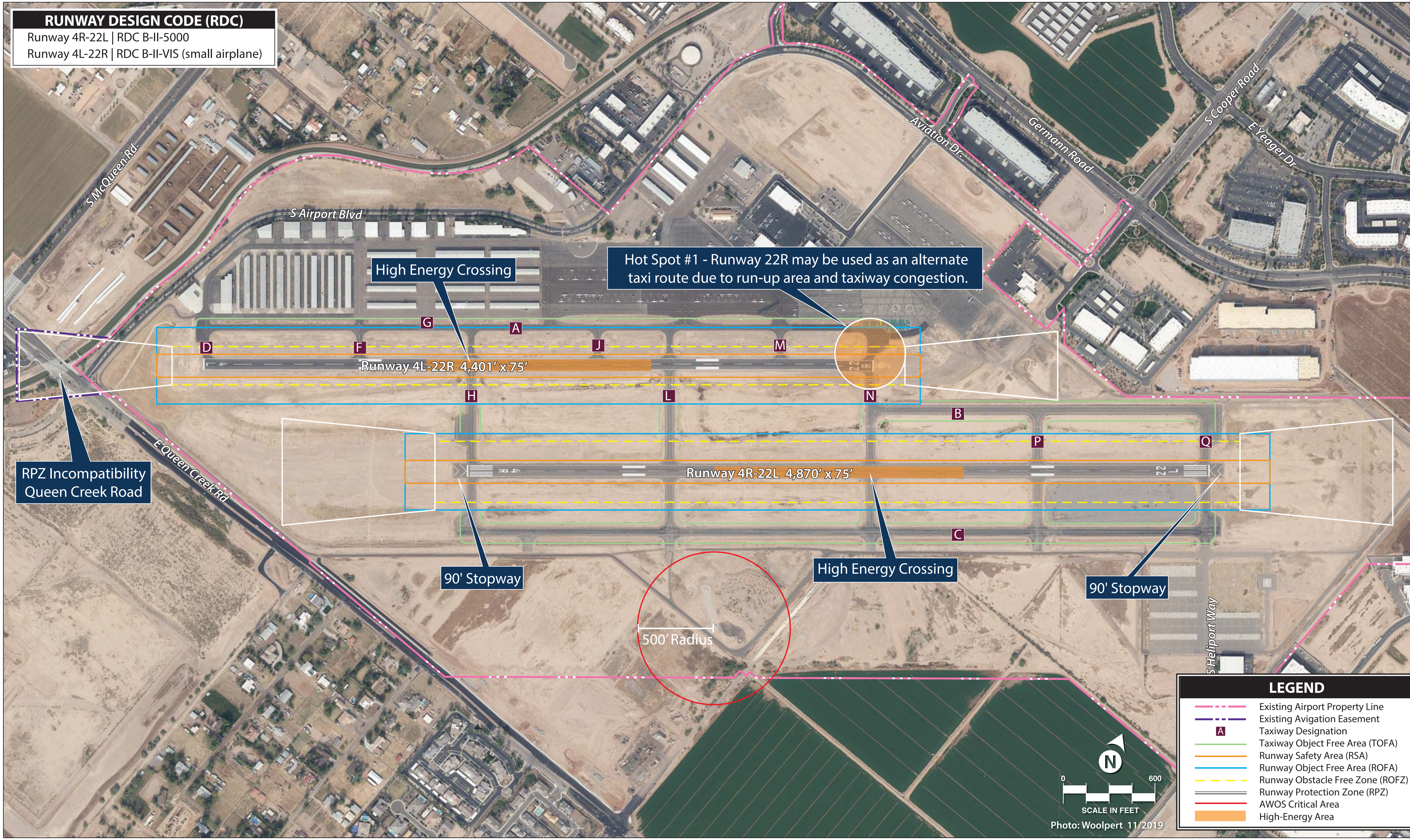

RUNWAY DESIGN CODE (RDC)
Runway 4R-22L | RDC B-II-5000
Runway 4L-22R | RDC B-II-VIS (small airplane)
S McQueen Rd
S Airport Blvd
Aviation Dr.
Germann Road
S Cooper Road
E Yeager Dr
High Energy Crossing
Hot Spot #1 - Runway 22R may be used as an alternate taxi route due to run-up area and taxiway congestion.
Runway 4L-22R 4,401' x 75'
Runway 4R-22L 4,870' x 75'
RPZ Incompatibility Queen Creek Road
E Queen Creek Rd
90' Stopway
High Energy Crossing
90' Stopway
500' Radius
S Heliport Way
A
B
C
D
F
G
H
J
L
M
N
P
Q
LEGEND
Existing Airport Property Line
Existing Avigation Easement
Taxiway Designation
Taxiway Object Free Area (TOFA)
Runway Safety Area (RSA)
Runway Object Free Area (ROFA)
Runway Obstacle Free Zone (ROFZ)
Runway Protection Zone (RPZ)
AWOS Critical Area
High-Energy Area
N
0
600
SCALE IN FEET
Photo: Woolpert 11/2019

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TABLE 3J
Runway Design Standards
Chandler Municipal Airport

	Runway 4R-22L (Existing/Ultimate)	Runway 4L-22R (Existing/Ultimate)
Runway Design Code	B-II-5000	B-II-VIS (small aircraft)
Visibility Minimums	≥ 1 mile (4R end)	Visual only (both ends)
Runway Design		
Runway Width	75	75
Stopway Length/Width	90'x90'	None
Runway Protection		
Runway Safety Area		
Width	150	150
Length Beyond Departure End	300	300
Length Prior to Threshold	300	300
Runway Object Free Area		
Width	500	500
Length Beyond Departure End	300	300
Length Prior to Threshold	300	300
Runway Obstacle Free Zone		
Width	400	250
Length Beyond Runway End	200	200
Approach Runway Protection Zone		
Inner Width	500	250
Outer Width	700	450
Length	1,000	1,000
Departure Runway Protection Zone		
Inner Width	500	250
Outer Width	700	450
Length	1,000	1,000
Runway Separation		
Runway Centerline to:		
Hold Line Position	200	125
Parallel Taxiway	240	240
Aircraft Parking Apron	250	250

Note: All dimensions in feet unless otherwise noted.
Source: FAA AC 150/5300-13A, *Airport Design*

Runway Safety Area

The RSA is defined in FAA AC 150/5300-13A, *Airport Design,* as a "surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of undershoot, overshoot, or excursion from the runway." The RSA is centered on the runway and dimensioned in accordance to the approach speed of the critical design aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating the design aircraft and fire and rescue vehicles, and free of obstacles not fixed by navigational purpose such as runway edge lights or approach lights.

The FAA has placed a higher significance on maintaining adequate RSA at all airports. Under Order 5200.8, effective October 1, 1999, the FAA established the *Runway Safety Area Program.* The Order states, "The objective of the Runway Safety Area Program is that all RSAs at federally-obligated airports…shall conform to the standards contained in AC 150/5300-13, *Airport Design*, to the extent practicable." Each Regional Airports Division of the FAA is obligated to collect and maintain data on the RSA for each runway at the airport and perform airport inspections.

For RDC B-II-5000 and B-II-VIS (small aircraft) design standards, the FAA calls for the RSA to be 150 feet wide and extend 300 feet beyond the runway ends. An examination of the RSAs for both runways did not identify any non-standard conditions.

Runway Object Free Area

The ROFA is "a two-dimensional ground area, surrounding runways, taxiways, and taxilanes, which is clear of objects except for objects whose location is fixed by function (i.e., airfield lighting)." The ROFA does not have to be graded and level like the RSA; instead, the primary requirement for the ROFA is that no object in the ROFA penetrates the lateral elevation of the RSA. The ROFA is centered on the runway, extending out in accordance to the critical design aircraft utilizing the runway.

For RDC B-II-5000 and B-II-VIS (small aircraft) design, the FAA calls for the ROFA to be 500 feet wide, extending 300 feet beyond each runway end. An evaluation of both ROFAs did not identify any non-standard conditions.

Runway Obstacle Free Zone

The ROFZ is an imaginary surface which precludes object penetrations, including taxiing and parked aircraft. The only allowance for ROFZ obstructions is navigational aids mounted on frangible bases which are fixed in their location by function, such as airfield signs. The ROFZ is established to ensure the safety of aircraft operations. If the ROFZ is obstructed, the airport's approaches could be removed or approach minimums could be increased.

For all runways serving aircraft over 12,500 pounds, the ROFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the runway ends. This standard applies to Runway 4R-22L at CHD. For Runway 4L-22R, a smaller ROFZ applies since the runway is served by aircraft weighing 12,500 pounds or less. In this case, the ROFZ is dimensioned at 250 feet wide and extends 200 feet beyond the runway ends. Under current evaluation with available data, there are no ROFZ obstructions at the airport. Future planning should maintain the ROFZ for the appropriate runway type.

Runway Protection Zone

The RPZ is a trapezoidal area centered on the runway, beginning 200 feet beyond the runway end. The RPZ has been established by the FAA to provide an area clear of obstructions and incompatible land uses, to enhance the protection of people and property on the ground. The RPZ is comprised of the central portion of the RPZ and the controlled activity area. The central portion of the RPZ extends from the beginning to the end of the RPZ, is centered on the runway, and is the width of the ROFA. The controlled activity area is any remaining portions of the RPZ. The dimensions of the RPZ vary per the visibility minimums serving the runway and the type of aircraft (design aircraft) operating on the runway.

While the RPZ is intended to be clear of incompatible objects or land uses, some uses are permitted with conditions and other land uses are prohibited. According to AC 150/5300-13A, the following land uses are permissible within the RPZ:

- Farming that meets the minimum buffer requirements;
- Irrigation channels, as long as they do not attract birds;
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator;
- Underground facilities, as long as they meet other design criteria, such as RSA requirements, as applicable; and
- Unstaffed navigational aids (NAVAIDs) and facilities, such as required for airport facilities that are fixed by function in regard to the RPZ.

Any other land uses considered within RPZ land owned by the airport sponsor must be evaluated and approved by the FAA Office of Airports. The FAA has published *Interim Guidance on Land Uses within a Runway Protection Zone* (September 2012), which identifies several potential land uses that must be evaluated and approved prior to implementation. The specific land uses requiring FAA evaluation and approval include:

- Buildings and structures. Examples include, but are not limited to residences, schools, churches, hospitals or other medical care facilities, commercial/industrial buildings, etc;
- Recreational land use. Examples include, but are not limited to golf courses, sports fields, amusement parks, other places of public assembly, etc;
- Transportation facilities. Examples include, but are not limited to:
  - Rail facilities - light or heavy, passenger or freight,
  - Public roads/highways, and
  - Vehicular parking facilities;
- Fuel storage facilities (above and below ground);
- Hazardous material storage (above and below ground);
- Wastewater treatment facilities; and
- Above-ground utility infrastructure (i.e., electrical substations), including any type of solar panel installations.

The *Interim Guidance on Land within a Runway Protection Zone* states, "RPZ land use compatibility also is often complicated by ownership considerations. Airport owner control over the RPZ land is emphasized to achieve the desired protection of people and property on the ground. Although the FAA recognizes that in certain situations the airport sponsor may not fully control land within the RPZ, the FAA expects airport sponsors to take all possible measures to protect against and remove or mitigate incompatible land uses."

Currently, the RPZ review standards are applicable to any new or modified RPZ. The following actions or events could alter the size of an RPZ, potentially introducing an incompatibility:

- An airfield project (e.g., runway extension, runway shift);
- A change in the critical design aircraft that increases the RPZ dimensions;
- A new or revised instrument approach procedure that increases the size of the RPZ; and/or
- A local development proposal in the RPZ (either new or reconfigured).

Since the interim guidance only addresses a new or modified RPZ, existing incompatibilities are generally (but not always) grandfathered under certain circumstances. While it is still necessary for the airport sponsor to take all reasonable actions to meet the RPZ design standard, FAA funding priority for certain actions, such as relocating existing roads in the RPZ, will be determined on a case-by-case basis.

RPZs have been further designated as approach and departure RPZs. The approach RPZ is a function of the Aircraft Approach Category (AAC) and approach visibility minimums associated with the approach runway end. The departure RPZ is a function of the AAC and departure procedures associated with the runway. For a particular runway end, the more stringent RPZ requirements (usually associated with the approach RPZ) will govern the property interests and clearing requirements that the airport sponsor should pursue.

As shown on **Exhibit 3C**, the airport owns all property within the Runway 4R, 22L and 22R RPZs. A portion of the Runway 4L RPZ extends beyond airport property but is controlled by an avigation easement. E. Queen Creek Road, a public-use road, extends through the Runway 4L RPZ. Public roadways are considered an incompatible land use within an RPZ; however, since it is an existing condition the FAA can "grandfather" the condition so that no corrective action is necessary. The perimeter service road passes through the Runway 22L and 22R RPZs but since this is a non-public use road it is not considered an incompatible RPZ land use.

RUNWAY SEPARATION STANDARDS

There are several other standards related to separation distances from runways. Each of these is designed to enhance the safety of the airfield.

Runway/Taxiway Separation

The design standard for the separation between runways and parallel taxiways is a function of the critical design aircraft and the instrument approach visibility minimum. The separation standard for both runways at CHD is 240 feet from the runway centerline to the parallel taxiway centerline. Parallel Taxiway A is 240 feet north of Runway 4L-22R, and Taxiways B and C are both 400 feet from the Runway 4R-22L centerline.

Hold Line Position Separation

Hold line position markings are placed on taxiways leading to runways. When instructed, pilots are to stop short of the holding position marking line. For Runway 4R-22L, hold line position markings are situated 200 feet from the runway centerline, which meets the B-II-5000 standard. For Runway 4L-22R, hold line position markings are situated 125 feet from the runway centerline, which meets the B-II-VIS (small airplane) standard.

Aircraft Parking Area Separation

Aircraft parking areas at CHD should be at least 250 feet from either runway centerline. The nearest parking positions on the north side are greater than 350 feet from the Runway 4L-22R centerline and the helicopter parking positions south of Runway 4R-22L are over 600 feet from the centerline. Therefore, the standard is met.

TAXIWAYS

The design standards associated with taxiways are determined by the Taxiway Design Group (TDG) or the ADG of the critical design aircraft. As determined previously, the applicable ADG for both runways is ADG II. **Table 3K** presents the various taxiway design standards related to ADG II.

TABLE 3K
Taxiway Dimensions and Standards
Chandler Municipal Airport

STANDARDS BASED ON WINGSPAN	*ADG II*	
Taxiway Protection		
Taxiway Safety Area width (feet)	79	
Taxiway Object Free Area width (feet)	131	
Taxilane Object Free Area width (feet)	115	
Taxiway Separation		
Taxiway Centerline to:		
Fixed or Movable Object (feet)	65.5	
Parallel Taxiway/Taxilane (feet)	105	
Taxilane Centerline to:		
Fixed or Movable Object (feet)	57.5	
Parallel Taxilane (feet)	97	
Wingtip Clearance		
Taxiway Wingtip Clearance (feet)	26	
Taxilane Wingtip Clearance (feet)	18	
STANDARDS BASED ON TDG	*TDG 1A/1B*	*TDG 2*
Taxiway Width Standard (feet)	25	35
Taxiway Edge Safety Margin (feet)	5	7.5
Taxiway Shoulder Width (feet)	10	15

ADG: Airplane Design Group
TDG: Taxiway Design Group
Source: FAA AC 150/5300-13A, Change 1, *Airport Design*

An examination of the taxiway system at CHD identified no taxiway safety area (TSA) or taxiway object free area (TOFA) incompatibilities. One area of note is that the separation distance between Taxiway A and the edge taxilane on the south side of the T-Hangar complex is 74 feet. This distance does not meet the ADG II standard of 105 feet; however, it does meet the ADG I separation standard of 70 feet. Aircraft should use caution in this area to ensure wingtip clearance is maintained with other aircraft particularly when Taxiway A is in use by an ADG II aircraft. The effected area is identified in **Figure 3A**.

FIGURE 3A – ADG I TAXIWAY CENTERLINE SEPARATION AREA

The table also shows those taxiway design standards related to TDG. The TDG standards are based on the Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance of the critical design aircraft expected to use those taxiways. Different taxiway and taxilane pavements can and should be planned to the most appropriate TDG design standards based on usage.

The current taxiway design for both runways should be TDG 2. As such, the taxiways on the airfield should be at least 35 feet wide. The entire taxiway system at CHD is at least 40 feet wide. Certain portions of the landside area that are utilized exclusively by small aircraft, such as the T-hangar areas, should adhere to TDG 1A/1B standards.

All taxiway widths on the airfield should at least be maintained unless financial constraints dictate. As such, the width could remain until such time as rehabilitation is needed and financial resources to support such are not available. FAA grant availability can only be provided if the project meets eligibility thresholds as determined by the FAA.

Taxiway Design Considerations

FAA AC 150/5300-13A, Change 1, *Airport Design*, provides guidance on recommended taxiway and taxilane layouts to enhance safety by avoiding runway incursions. A runway incursion is defined as "any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft."

The taxiway system at CHD generally provides for the efficient movement of aircraft; however, AC 150/5300-13A, Change 1, *Airport Design*, provides recommendations for taxiway design. The following is a list of the taxiway design guidelines and the basic rationale behind each recommendation.

1. **Taxi Method**: Taxiways are designed for "cockpit over centerline" taxiing with pavement being sufficiently wide to allow a certain amount of wander. On turns, sufficient pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, upgrading existing intersections should be undertaken to eliminate "judgmental over-steering," which is where the pilot must intentionally steer the cockpit outside the marked centerline in order to assure the aircraft remains on the taxiway pavement.
2. **Steering Angle**: Taxiways should be designed such that the nose gear steering angle is no more than 50 degrees, the generally accepted value to prevent excessive tire scrubbing.
3. **Three-Node Concept**: To maintain pilot situational awareness, taxiway intersections should provide a pilot a maximum of three choices of travel. Ideally, these are right and left angle turns and a continuation straight ahead.
4. **Intersection Angles**: Turns should be designed to 90 degrees wherever possible. For acute angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.
5. **Runway Incursions**: Taxiways should be designed to reduce the probability of runway incursions.
    - *Increase Pilot Situational Awareness*: A pilot who knows where he/she is on the airport is less likely to enter a runway improperly. Complexity leads to confusion. Keep taxiway systems simple using the "three-node" concept.
    - *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, avoid direct access to a runway.
    - *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold – through simple reduction in the number of occurrences and through a reduction in air traffic controller workload.
    - *Avoid "High Energy" Intersections*: These are intersections in the middle third of runways. By limiting runway crossings to the first and last thirds of the runway, the portion of the runway where a pilot can least maneuver to avoid a collision is kept clear.
    - *Increase Visibility*: Right-angle intersections, both between taxiways and runways, provide the best visibility. Acute angle runway exits provide for greater efficiency in runway usage but should not be used as runway entrance or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of approaching a runway.
    - *Avoid "Dual Purpose" Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway and only a runway.
    - *Indirect Access*: Do not design taxiways to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.
    - *Hot Spots*: Confusing intersections near runways are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other "hot spots" should be corrected as soon as practicable.

6. **Runway/Taxiway Intersections**:
   - *Right-Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for a high-speed exit. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so they are visible to pilots.
   - *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high-speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage.
   - *Large Expanses of Pavement*: Taxiways must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, making it difficult to provide proper signage, marking, and lighting.
7. **Taxiway/Runway/Apron Incursion Prevention**: Apron locations that allow direct access into a runway should be avoided. Increase pilot situational awareness by designing taxiways in such a manner that forces pilots to consciously make turns. Taxiways originating from aprons and forming a straight line across runways at mid-span should be avoided.
   - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and makes lighting and marking more difficult.
   - *Direct Access from Apron to a Runway*: Avoid taxiway connectors that cross over a parallel taxiway and directly onto a runway. Consider a staggered taxiway layout that forces pilots to make a conscious decision to turn.
   - *Apron to Parallel Taxiway End*: Avoid direct connection from an apron to a parallel taxiway at the end of a runway.

FAA AC 150/5300-13A, Change 1, *Airport Design*, states that "existing taxiway geometry should be improved whenever feasible, with emphasis on designated 'hot spots.'" To the extent practicable, the removal of existing pavement may be necessary to correct confusing layouts. CHD has taken steps to correct non-standard taxiway geometry conditions including relocating some taxiways to eliminate direct-access points from the north apron to Runway 4L-22R. There are, however, additional taxiway geometry issues still to be addressed.

The FAA has identified one taxiway hot spot at CHD. It is located at the Runway 22R threshold and is described as follows: Runway 22R may be used as an alternate taxi route due to run-up area and taxiway congestion.

Additional non-standard taxiway geometry conditions at CHD include:

- Taxiways F, M, and Q provide direct access to a runway from an apron area (see **Figure 3B**).
- Taxiway H crosses Runway 4L-22R in the high-energy area.
- Taxiway N crosses Runway 4R-22L in the high-energy area.

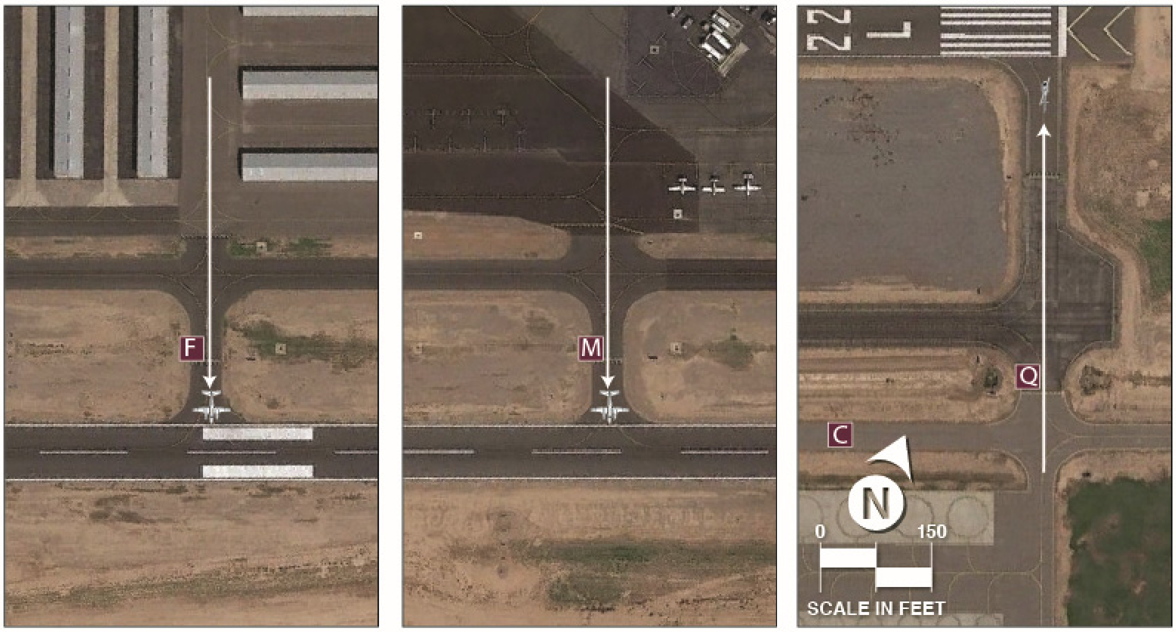

FIGURE 3B – DIRECT-ACCESS TAXIWAY POINTS

In the alternatives chapter, potential solutions to these non-standard conditions will be presented. Analysis in the next chapter will also consider improvements which could be implemented on the airfield to minimize runway incursion potential, improve efficiency, and conform to FAA standards for taxiway design. Any future taxiways planned will also take into consideration the taxiway design standards.

Taxilane Design Considerations

Taxilanes are distinguished from taxiways in that they do not provide access to or from the runway system directly. Taxilanes typically provide access to hangar areas. As a result, taxilanes can be planned to varying design standards depending on the type of aircraft utilizing the taxilane. For example, a taxilane leading to a T-hangar area only needs to be designed to accommodate those aircraft typically accessing the T-hangar.

NAVIGATIONAL AND APPROACH AIDS

Navigational aids are devices that provide pilots with guidance and position information when utilizing the runway system. Electronic and visual guidance to arriving aircraft enhance the safety and capacity of the airfield. Such facilities are vital to the success of an airport and provide additional safety to passengers using the air transportation system. While instrument approach aids are especially helpful during poor weather, they are often used by pilots conducting flight training and operating larger aircraft when visibility is good.

Instrument Approach Aids

CHD has two published non-precision straight-in instrument approach procedures to Runway 4R. These procedures provide down to one-mile visibility minimums and 500-foot cloud ceilings. Each of the procedures include circling approaches, allowing for minimums to any runway end at the airport. Analysis in the next chapter will consider improvements necessary for enhancing instrument approach capabilities to the runway system including achieving lower visibility minimums.

Visual Approach Aids

In most instances, the landing phase of any flight must be conducted in visual conditions. To provide pilots with visual guidance information during landings to the runway, electronic visual approach aids are commonly provided at airports. Currently, each runway end at CHD is equipped with a four-box precision approach path indicator (PAPI-4). These approach aids should be maintained through the planning period.

Runway end identification lights (REILs) are flashing lights located at the runway threshold end that facilitate rapid identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify the runway thresholds and distinguish the runway end lighting from the other lighting on the airport and in the approach areas. The FAA indicates that REILs should be considered for all lighted runway ends not planned for more sophisticated approach lighting systems. There are currently REIL systems on each end of Runway 4R-22L. REILs should also be considered for Runway 4L-22R.

Weather Reporting Aids

CHD has a lighted wind cone and segmented circle. The wind cone provides information to pilots regarding wind speed and direction. Typically, the wind cone is centralized on the airfield system and often co-located within a segmented circle, which is the case at CHD. The segmented circle consists of a system of visual indicators designed to provide traffic pattern information to pilots.

CHD is equipped with an AWOS, which provides weather observations 24 hours per day. The system updates weather observations every minute, continuously reporting significant weather changes as they occur in real time. This information is then transmitted via a designated radio frequency at regular intervals. This system should be maintained through the planning period.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

There are several lighting and pavement marking aids serving pilots using the airport. These aids assist pilots in locating an airport and runway at night or in poor visibility conditions. They also serve aircraft navigating the airport environment on the ground when transitioning to/from aircraft parking areas to the runway.

Airport Identification Lighting | CHD's rotating beacon is located on top of the ATCT. The beacon is in good working order and should be maintained through the planning period.

Runway and Taxiway Lighting | Both runways at CHD are equipped with medium intensity runway lighting (MIRL) systems. These systems are adequate and should be maintained. The taxiway system is equipped with medium intensity taxiway lighting (MITL). This system is also adequate and should be maintained. Planning should consider expansion of the MIRL and MITL systems when/if new pavements are constructed.

Pavement Markings | Runway markings are typically designed to the type of instrument approach available on the runway. FAA AC 150/5340-1K, *Standards for Airport Markings*, provides guidance necessary to design airport markings. Runway 4R-22L has non-precision markings which aid in accommodating the instrument approach procedures to Runway 4R and provides enhanced identification for both ends of the runway. These runway markings should be maintained through the long-term planning horizon. Runway 4L-22R has basic markings, which are adequate for existing and ultimate conditions.

Airfield Signs | Airfield identification signs assist pilots in identifying their location on the airfield and directing them to their desired location. Lighted signs are installed on the runway and taxiway system on the airfield. The signage system includes runway and taxiway designations, holding positions, routing/directional, runway exits, and runway distance remaining. All these signs should be maintained throughout the planning period.

It should be noted that many airports are transitioning to light emitting diode (LED) lighting systems. LEDs have many advantages, including lower energy consumption, longer lifespan, increased durability, reduced size, greater reliability, and faster switching. While a larger initial investment is required upfront, the energy savings and reduced maintenance costs will outweigh any additional costs in the long run. As systems need to be repaired/replaced, consideration should be given to upgrading to LED systems.

A summary of the airside facilities at CHD are presented on **Exhibit 3D**.

LANDSIDE FACILITY REQUIREMENTS

Landside facilities are those necessary for the handling of aircraft and passengers while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacity of the various components of each element was examined in relation to projected demand to identify future landside facility needs. At CHD, this includes components for general aviation needs and support facilities.

GENERAL AVIATION ACTIVITIES

General aviation facilities are those necessary for handling general aviation aircraft, passengers, and cargo while on the ground. This section is devoted to identifying future general aviation facility needs during the planning period for the following types of facilities normally associated with general aviation terminal areas.

- General Aviation Terminal Services
- Aircraft Hangars
- Aircraft Parking Aprons

General Aviation Terminal Services

The general aviation terminal facilities at an airport are often the first impression of the community that corporate officials and other visitors will encounter. General aviation terminal facilities at an airport provide space for passenger waiting, pilot's lounge, flight planning, concessions, management, storage, and many other various needs. This space is not necessarily limited to a single, separate terminal building, but can include space offered by fixed base operators (FBOs) and other specialty operators for these functions and services. At CHD, general aviation terminal services are provided by the terminal building and the FBO, Chandler Air Service. The terminal building is 5,500 square feet (sf) and Chandler Air Service has approximately 2,000 sf of terminal services-equivalent space.

The methodology used in estimating general aviation terminal facility needs was based on the number of airport users expected to utilize general aviation facilities during the design hour. Space requirements for terminal facilities were based on providing 125 square feet per design hour itinerant passenger. A multiplier of 1.5 in the short term, increasing to 2.5 in the long term, was also applied to terminal facility needs to better determine the number of passengers associated with each itinerant aircraft operation. This increasing multiplier indicates an expected increase in larger aircraft operations through the long-term. These operations typically support larger turboprop and jet aircraft, which can accommodate an increasing passenger load factor. Such is the case at CHD, where an increasing number of turbine operations are anticipated.

Table 3L outlines the space requirements for general aviation terminal services at CHD through the long-term planning period. As shown in the table, up to 7,900 sf of additional space could be needed in the long-term for general aviation passengers. The amount of space currently offered by the terminal building and FBO combined is approximately 7,500 sf. Other SASOs on the airfield also provide space for pilots and passengers; however, these areas are not widely utilized by transient operators.

TABLE 3L
General Aviation Terminal Area Facilities
Chandler Municipal Airport

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need
General Aviation Services Facility Area (s.f.)	7,500	7,800	11,000	15,400
General Aviation Design Hour Passengers		62	88	123
Passenger Multiplier		1.5	2.0	2.5
Terminal Vehicle Parking Spaces	29	31	44	61
FBO/SASO Vehicle Parking Spaces	169	185	207	237

N/A - Approximate terminal space offered by FBOs is unknown.
[a] Includes total spaces at the terminal building and within the FBO/SASO areas.
Source: Coffman Associates analysis

	AVAILABLE	SHORT TERM	LONG TERM
RUNWAYS		**Runway 4R-22L**	
	RDC B-II-5000	RDC B-II-5000	RDC B-II-5000
	4,870' x 75'	Maintain	Examine potential extension alternatives
	30,000 lbs. SWL	Maintain	Maintain
	Standard RSA; ROFA; ROFZ	Maintain	Maintain
	RPZs: 100% Owned by Airport Sponsor	Maintain	Maintain
		Runway 4L-22R	
	RDC B-II-VIS (small aircraft)	RDC B-II-VIS (small aircraft)	RDC B-II-VIS (small aircraft)
	4,401' x 75'	Maintain	Maintain
	30,000 lbs. SWL	Maintain	Maintain
	Standard RSA; ROFA; ROFZ	Maintain	Maintain
	RPZs: 100% Owned/Controlled by Avigation Easements	Maintain	Maintain
TAXIWAYS			
	TDG-2	TDG-2	TDG-2
	All taxiways at least 40' wide	Maintain	Maintain
	FAA Hot Spot #1	Consider Corrective Measures	Maintain Corrected Condition
	Direct Access Points - Taxiways F, M, and Q	Consider Corrective Measures	Maintain Corrected Condition
	High-Energy Crossings - Taxiways H and N	Consider Corrective Measures	Maintain Corrected Condition
NAVIGATIONAL AND APPROACH AIDS			
	RNAV (GPS) 1-Mile Visibility Minimums (4R)	Consider Improving to 3/4-Mile Visibility Minimums	Maintain
	VOR 1-Mile Visibility Minimums (4R)	Maintain	Maintain
	Runways 4L, 22R, 22L - Visual Only	Consider One-Mile or Greater GPS-based Instrument Approach	Maintain
	AWOS	Maintain	Maintain
	ATCT	Maintain	Maintain
	Segmented Circle/Lighted Windcone	Maintain	Maintain
	PAPI-4s (4R-22L) (4L-22R)	Maintain	Consider gradual replacement with LED technology
	REILs (4R-22L)	Consider REILs (4L-22R)	Consider gradual replacement with LED technology
LIGHTING, MARKING, AND SIGNAGE			
	Rotating Beacon	Maintain	Maintain
	Non-Precision Markings (4R-22L)	Maintain	Maintain
	Basic Markings (4L-22R)	Maintain	Maintain
	MIRL - (4R-22L & 4L-22R)	Maintain	Consider gradual replacement with LED technology
	MITL - All Taxiways	Maintain	Consider gradual replacement with LED technology
	Holding Position Markings - 200' from Runway 4R-22L Centerline	Maintain	Maintain
	Holding Position Markings - 125' from Runway 4L-22R Centerline	Maintain	Maintain
	Lighted airfield location and directional signage	Maintain	Consider gradual replacement with LED technology

ABBREVIATIONS

ATCT -Airport Traffic Control Tower
AWOS - Automated Weather Observation System
GPS - Global Positioning System
LED - Light Emitting Diode
MIRL - Medium Intensity Runway Lighting
MITL - Medium Intensity Taxiway Lighting
PAPI - Precision Approach Path Indicator
RDC - Runway Design Code
REILs - Runway End Identification Lights
ROFA- Runway Object Free Area
ROFZ- Runway Object Free Zone
RPZ- Runway Protection Zone
RSA- Runway Safety Area
RNAV - Area Navigation
SWL - Single Wheel Loading
TDG - Taxiway Design Group
VOR- Very-high Frequency Omni-Directional Range

Exhibit 3D
AIRSIDE FACILITY REQUIREMENTS SUMMARY

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General aviation vehicle parking demands have also been determined for CHD. Space determinations for passengers were based on an evaluation of existing airport use, as well as standards set forth to help calculate projected terminal facility needs. There are currently 29 individual spaces at the terminal building and 169 spaces serving the FBO/SASOs at the airport. Parking requirements for general aviation activity call for approximately 29 terminal spaces in the short-term, increasing to approximately 61 spaces in the long-term planning horizon. For the FBO/SASO areas of the airport, vehicle parking needs are estimated at 185 in the short-term and 237 in the long-term reflecting growth in operational activity along with additional employee needs.

Aircraft Hangars

Utilization of hangar space varies as a function of local climate, security, and owner preference. The trend in general aviation aircraft is toward more sophisticated (and consequently, more expensive) aircraft; therefore, many aircraft owners prefer enclosed hangar space as opposed to outside tiedowns.

The demand for aircraft storage hangars is dependent upon the number and type of aircraft expected to be based at the airport in the future. For planning purposes, it is necessary to estimate hangar requirements based upon forecast operational activity. However, hangar development should be based upon actual demand trends and financial investment conditions. It was mentioned in Chapter Two that CHD maintains waiting lists for both T-hangars and the shade hangar. In total there are 112 individuals waiting for hangar space at CHD.

While most aircraft owners prefer enclosed aircraft storage, several based aircraft will still use outdoor tiedown spaces, usually due to lack of available hangar space, high hangar rental rates, or operational needs. Therefore, enclosed hangar facilities do not necessarily need to be planned for each based aircraft.

As discussed in Chapter One, hangar types vary greatly in size and function. T-hangars, box hangars, and shade hangars are popular with aircraft owners that need to store one private aircraft. These hangars often provide individual spaces within a larger structure or in standalone portable buildings. There is 289,069 sf of storage space at the airport comprised of T-hangars, box hangars, and shade hangars. For determining future aircraft storage needs, a planning standard of 1,200 square feet per aircraft is utilized for these types of hangars.

Executive box hangars are open space facilities with no interior supporting structure. These hangars can vary in size between 1,500 and 2,500 square feet, with some approaching 10,000 square feet. They are typically able to house single engine, multi-engine, turboprop, and jet aircraft, as well as helicopters. Executive box hangar space at CHD is estimated at 98,748 sf. For future planning, a standard of 3,000 sf per turboprop, 5,000 sf per jet, and 1,500 sf per helicopter is utilized for executive box hangars.

Conventional hangars are the large, open space facilities with no supporting interior structure. These hangars provide for bulk aircraft storage and are often utilized by airport businesses, such as an FBO or an aircraft maintenance operator. Conventional hangars are generally larger than executive box hangars and can range in size from 10,000 square feet to more than 20,000 square feet. Often, a portion of a conventional hangar is utilized for non-aircraft storage needs, such as maintenance or office space.

There are five conventional hangars at CHD totaling approximately 50,700 sf. The same aircraft sizing standards utilized for executive hangars is also utilized for conventional hangars. Since portions of the hangars are known to be used for aircraft maintenance servicing, requirements for maintenance/service hangar area were estimated using a planning standard of 125 square feet per based aircraft. In total, there is currently approximately 31,900 sf of conventional hangar space that is cross utilized for aircraft maintenance and storage on the airport.

Future hangar requirements for the airport are summarized in **Table 3M**. While some based aircraft will continue to utilize aircraft parking apron space as opposed to enclosed hangar space, the overall percentage of aircraft seeking hangar space is projected to increase during the long-term planning period.

TABLE 3M
Aircraft Hangar Requirements
Chandler Municipal Airport

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Total Based Aircraft	441	490	540	640	+199
Hangar Area Requirements					
T-Hangar, Box Hangar, Shade (sf)	289,069	322,900	373,800	475,700	+186,631
Executive Box Hangar Area (sf)	98,748	102,700	116,200	148,000	+49,252
Conventional Hangar Area (sf)	50,700	59,500	73,000	104,800	+54,100
- Aircraft Maintenance Area (sf)	31,900	61,300	67,500	80,000	+48,100
Total Hangar Area (sf)	438,517	485,100	563,000	728,500	+289,983

Source: Coffman Associates analysis

The analysis shows that future hangar requirements indicate a potential need for almost 290,000 sf of new hangar storage capacity through the long-term planning period. This includes a mixture of hangar area, with the largest needs projected in the T-hangar/box hangar/shade hangar category. Due to the projected increase in based aircraft, annual general aviation operations, and hangar storage needs, facility planning will consider additional hangars at the airport. It is expected that the aircraft storage hangar requirements will continue to be met through a combination of hangar types.

It should be noted that hangar requirements are general in nature and based upon the aviation demand forecasts. The actual need for hangar space will further depend on the usage within the hangars. For example, some hangars may be utilized entirely for non-aircraft storage, such as maintenance; yet from a planning standpoint, they have an aircraft storage capacity. Therefore, the needs of an individual user may differ from the calculated space necessary.

Aircraft Parking Aprons

The aircraft parking apron is an expanse of paved area intended for aircraft parking and circulation. FAA Advisory Circular 150/5300-13A, *Airport Design*, suggests a methodology by which transient apron requirements can be determined from knowledge of busy day operations. The number of itinerant parking spaces required was determined to be approximately 20 percent of the busy day itinerant operations for general aviation operations. A planning standard of 800 square yards (sy) per aircraft was applied to determine future transient apron requirements for single and multi-engine piston aircraft. For business jets, which oftentimes are much larger, a planning standard of 1,600 sy per aircraft position was used. In addition, CHD has aircraft that use outside aircraft tiedowns for storage. It is assumed that these aircraft require less space than transient aircraft; therefore, a planning standard of 650 sy per aircraft was applied. For local tiedown needs, an additional 10 percent was added for maintenance activities and temporary storage needs. Apron parking requirements are presented in **Table 3N**. Transient apron parking needs are divided into business jet needs and smaller single and multi-engine aircraft needs.

TABLE 3N
Aircraft Parking Apron Requirements
Chandler Municipal Airport

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Local Aircraft Parking (sy)		164,515	175,110	193,700	
Transient General Aviation (sy)		59,200	63,200	71,200	
Jet/Turboprop Aircraft Parking (sy)		8,000	9,600	14,400	
Total Apron Area (sy)	235,854	231,715	247,910	279,300	+43,446

Source: Coffman Associates analysis

Currently, existing general aviation aircraft parking aprons at the airport total approximately 235,854 sy of space and provide 302 marked fixed-wing and helicopter parking positions. This includes tiedowns on all four aprons (terminal, FBO, north, and heliport). As shown in the table, the apron area currently available is adequate through the short-term period; however, an additional 43,446 sy of capacity is needed by the long-term period.

A summary of the general aviation landside facilities previously discussed is presented on **Exhibit 3E**.

SUPPORT FACILITIES

Various other landside facilities that play a supporting role in overall airport operations have also been identified. These support facilities include:

- Aviation Fuel Storage
- Perimeter Fencing and Gates

Aviation Fuel Storage

Chandler Air Service and the City of Chandler are the airport's only public fuel service providers. Chandler Air Service has a 12,000-gallon Jet A tank and a 10,000-gallon 100LL tank. The City of Chandler provides 100LL fuel utilizing a 12,000-gallon tank.

Based upon historic fuel flowage records provided by airport management, in 2019, the airport pumped 304,967 gallons of Jet A and 407,747 gallons of 100LL. Utilizing operations reported by the FAA's Traffic Flow Management System Count database, the number of turbine operations in 2019 totaled

	AVAILABLE	SHORT-TERM	INTERMEDIATE-TERM	LONG-TERM
GENERAL AVIATION TERMINAL FACILITIES AND PARKING				
Building Space (sf)	7,500	7,800	11,000	15,400
Total GA Parking Spaces	198	216	251	298

	AVAILABLE	SHORT-TERM	INTERMEDIATE-TERM	LONG-TERM
AIRCRAFT STORAGE HANGAR REQUIREMENTS				
T-Hangar/Box/Shade Area (sf)	289,069	321,700	373,800	475,700
Executive Hangar Area (sf)	98,748	102,700	116,200	148,000
Conventional Hangar Area (sf)	50,700	59,500	73,000	104,800
Service/Maintenance Area (sf)	31,900	61,300	67,500	80,000
Total Hangar Storage Area (sf)	438,517	483,900	563,000	728,500

	AVAILABLE	SHORT-TERM	INTERMEDIATE-TERM	LONG-TERM
AIRCRAFT PARKING APRON				
Transient Single/Multi-Engine Aircraft (sy)		59,200	63,200	71,200
Transient Business Jet/Turboprop (sy)		8,000	9,600	14,400
Local Based (sy)		164,515	175,110	193,700
Total Apron Area (sy)	235,854	231,715	247,910	279,300

	AVAILABLE	SHORT-TERM	INTERMEDIATE-TERM	LONG-TERM
SUPPORT FACILITIES				
14-Day Fuel Storage - 100LL	22,000	16,600	17,400	18,900
14-Day Fuel Storage - Jet A	12,000	14,400	30,400	67,400

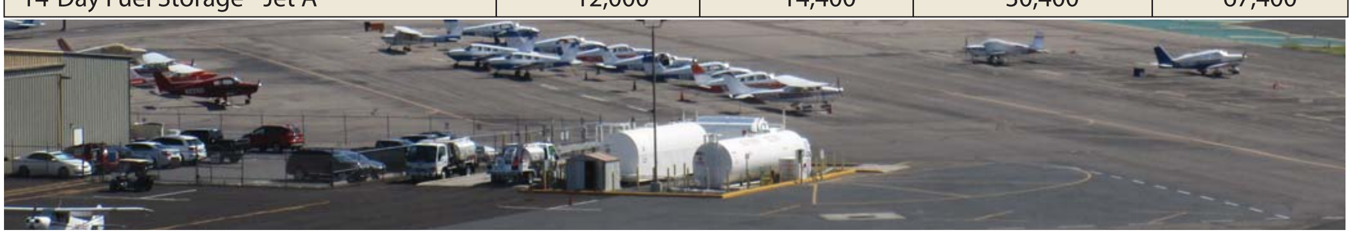

Exhibit 3E
LANDSIDE FACILITY REQUIREMENTS

approximately 1,986 with the remainder (218,676) being piston operations. Dividing the total fuel flowage by the total number of operations provides a ratio of fuel flowage per operation. In 2019, the airport pumped approximately 153.6 gallons of Jet A per turbine operation and 1.9 gallons of 100LL per piston operation. It is anticipated that, over the course of the planning period, the Jet A flowage ratio will remain around 160 gallons per operation and the AvGas flowage ratio will remain static at 1.9 gallons per operation.

Maintaining a 14-day fuel supply would allow the airport to limit the impact of a disruption of fuel delivery. Currently, the airport has enough static fuel storage to meet the 14-day supply criteria for 100LL fuel through the long-term horizon. The forecasted fuel storage requirements summarized in **Table 3P** show a need to expand Jet A fuel storage capacity by up to 55,400 gallons by the long-term horizon.

TABLE 3P
Fuel Storage Requirements
Chandler Municipal Airport

			Planning Horizon		
	Capacity	**2019 Need**	**Short-Term**	**Intermediate-Term**	**Long-Term**
Jet A					
Daily Usage (gal.)		836	1,030	2,172	4,816
14-Day Supply (gal.)	12,000	11,700	14,400	30,400	67,400
Annual Usage (gal.)		304,967	376,000	792,900	1,757,900
AvGas					
Daily Usage (gal.)		1,117	1,188	1,241	1,347
14-Day Supply (gal.)	22,000	15,600	16,600	17,400	18,900
Annual Usage (gal.)		407,747	433,800	452,800	491,700

Sources: Historic fuel flowage data provided by airport administration; Fuel supply projections prepared by Coffman Associates.

Fuel storage requirements are typically based upon keeping a two-week supply of fuel during an average month; however, more frequent deliveries can reduce the fuel storage capacity requirements. Generally, fuel tanks should be of adequate capacity to accept a full refueling tanker, which is approximately 8,000 gallons, while maintaining a reasonable level of fuel in the storage tank. Future aircraft demand experienced by the FBOs will determine the need for additional fuel storage capacity. It is important that airport personnel work with the FBOs to plan for adequate levels of fuel storage capacity through the long-term planning period of this study.

Perimeter Fencing and Gates

Perimeter fencing is used at airports primarily to secure the aircraft operational area. The physical barrier of perimeter fencing provides the following functions:

- Gives notice of legal boundary of the outermost limits of the facility or security sensitive area;
- Assists in controlling and screening authorized entries into a secured area by deterring entry elsewhere along the boundary;

- Supports surveillance, detection, assessment, and other security functions by providing a zone for installing intrusion detection equipment and closed-circuit television (CCTV);
- Deters casual intruders from penetrating the aircraft operations areas on the airport;
- Creates a psychological deterrent;
- Demonstrates a corporate concern for facilities; and
- Limits inadvertent access to the aircraft operations area by wildlife.

CHD operations areas are completely enclosed by a six-foot chain-link fence topped by three-strand barbed-wire. The fence does not always follow the airport property line due to the physical terrain of the area and the layout of the airport property. A series of controlled access gates are also available for use at the airport.

SUMMARY

This chapter has outlined the safety design standards and facilities required to meet potential aviation demand projected at CHD for the next 20 years. In an effort to provide a more flexible master plan, the yearly forecasts from Chapter Two have been converted to planning horizon levels. The short-term roughly corresponds to a 5-year timeframe, the intermediate-term is approximately 10 years, and the long-term is 20 years. By utilizing planning horizons, airport management can focus on demand indicators for initiating projects and grant requests rather than on specific dates in the future.

In Chapter Four, potential improvements to the airside and landside systems will be examined through a series of airport development alternatives. Most of the alternatives discussion will focus on those capital improvements that would be eligible for federal and state grant funds. Other projects of local concern will also be presented. Ultimately, an overall airport development plan that presents a vision beyond the 20-year scope of this master plan will be developed for CHD.