CHAPTER 3
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 Floyd W. Jones Lebanon Airport (LBO) facilities. The existing capacities will then be compared to the forecast activity levels prepared in Chapter Two to determine the adequacy of the existing facilities, as well as to identify any deficiencies that exist or may be expected to materialize in the future. This chapter will present the following elements:

- Demand-based Planning Horizons
- Airfield Capacity
- Airfield Requirements
- 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 to providing these facilities will be evaluated to determine the most practical, cost-effective, and efficient means for implementation.

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

- Advisory Circular (AC) 150/5300-13B, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order 5090.5, *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 LBO has been established and was detailed in Chapter Two. These activity forecasts include annual aircraft operations, based aircraft, aircraft fleet mix, and peaking characteristics. With this information, specific components of the airside 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 on actual demand at an airport rather than on a time-based forecast figure. To develop a master plan that is demand-based rather than time-based, a series of planning horizon milestones has been established that takes into consideration the reasonable range of aviation demand projections. The planning horizons are the short-term (1-5 years), the intermediate term (6-10 years), and the long-term (11-20 years).

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 on 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 | Planning Horizon Activity Levels

		PLANNING HORIZON		
	Base Year 2021	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
ANNUAL OPERATIONS				
Itinerant				
General Aviation	9,107	10,445	10,579	10,859
Air Taxi	585	631	677	773
Military	100	100	100	100
Local				
General Aviation	1,258	1,345	1,369	1,420
Military	0	0	0	0
Total Annual Operations	**11,050**	**12,522**	**12,726**	**13,152**
BASED AIRCRAFT	**28**	**30**	**32**	**36**

Source: Coffman Associates analysis

AIRFIELD CAPACITY

An airport's capacity is expressed in terms of its annual service volume (ASV) and is a reasonable estimate of the number of operations that can be accommodated in a year before significant delays occur. ASV accounts for runway use, aircraft mix, and weather conditions. The airport's ASV was analyzed following guidance from FAA AC 150/5060-5, *Airport Capacity and Delay*.

A single runway with less than 50 percent of operations by aircraft weighing more than 12,500 pounds has an unconstrained ASV of 195,000 annual operations. When factoring weather conditions in Lebanon, the ASV is no lower than 150,000 annual operations. In 2021, the airport is projected to have approximately 11,050 operations, which is approximately seven percent of the ASV. In the long-term, LBO is forecast to have approximately 13,152 operations, or eight percent of the ASV. According to FAA Order 5090.5, planning for capacity improvement projects should begin when operations reach approximately 60 percent of the ASV. Since this threshold is not projected to be crossed over the next 20 years, no projects specifically triggered by a capacity deficiency are planned.

AIRFIELD REQUIREMENTS

The analyses of the operational capacity and the critical design aircraft are used to determine airfield needs. This includes runway configuration, dimensional standards, and pavement strength, as well as navigational aids, lighting, and marking.

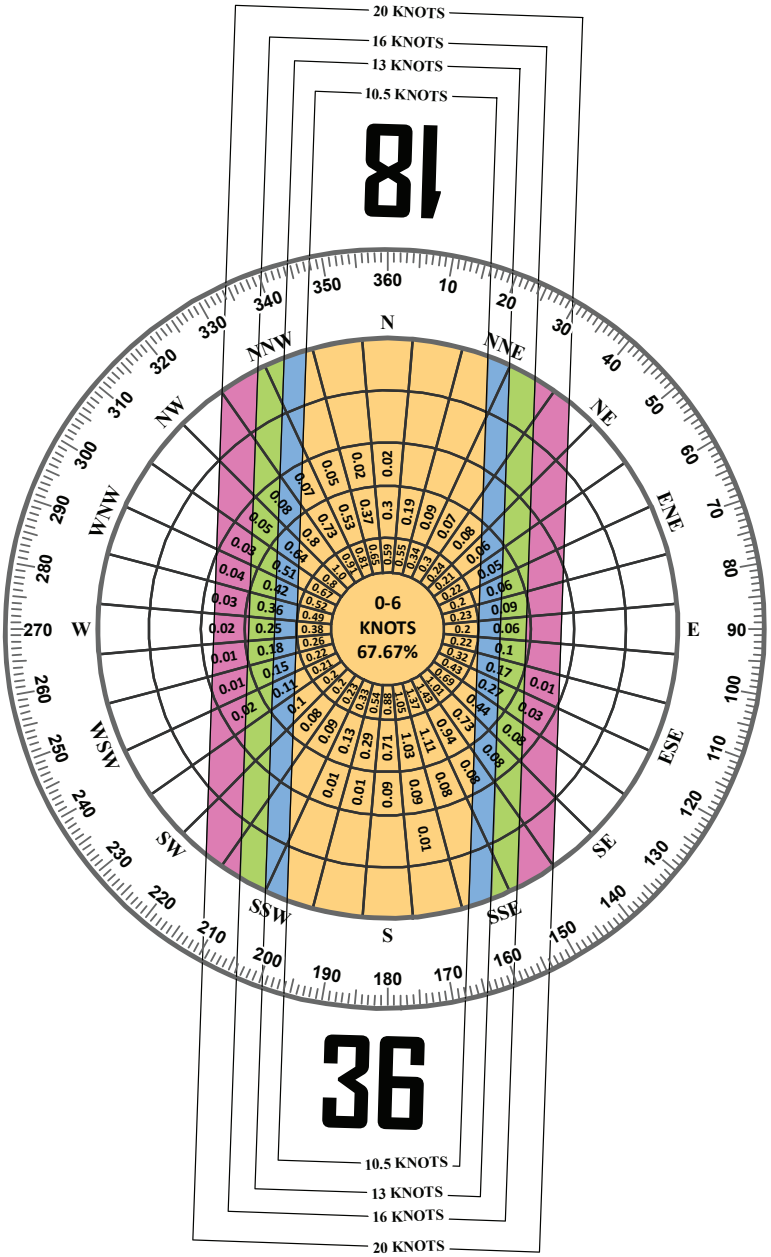
RUNWAY CONFIGURATION

Key considerations in the runway configuration of an airport involve orientation for wind coverage and the operational capacity of the runway system. FAA AC 150/5300-13B, *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.

The FAA recommends using at least 10 consecutive years of wind observations for a wind analysis. The AWOS at LBO was able to provide only approximately four years of wind data. Therefore, to better complete the analysis of wind coverage for the existing runway orientation, the AWOS at Fort Leonard Wood, 27 miles to the east, was used. The Fort Leonard Wood AWOS provided a full 10 years' worth of wind data. The analysis shows that the orientation of Runway 18-36 at LBO provides 95 percent coverage for a 10.5 knot crosswind, and greater than 98 percent coverage for 13 knots and greater. Thus, Runway 18-36 provides adequate wind coverage for all weather conditions, and a crosswind runway would not be AIP-eligible. Both the visual and instrument flight rules (VFR and IFR) wind roses are shown on **Exhibit 3A**.

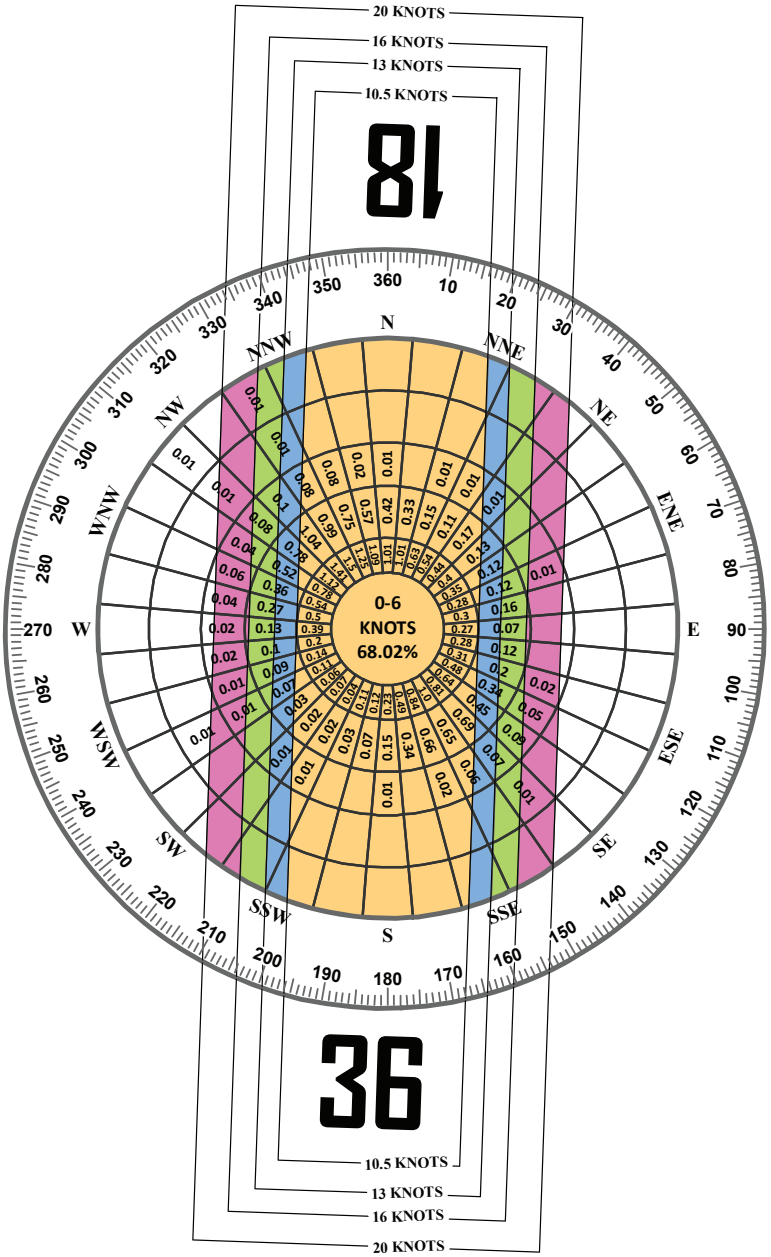
ALL WEATHER WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 18-36	95.93%	98.14%	99.67%	99.95%



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Waynesville-St. Robert Regional
Fort Leonard Wood, MO

OBSERVATIONS:
123,420 All Weather Observations
Jan. 1, 2011 - Dec, 31 2020

IFR WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 18-36	95.81%	98.11%	99.62%	99.94%



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Waynesville-St. Robert Regional
Fort Leonard Wood, MO

OBSERVATIONS:
31,237 IFR Observations
Jan. 1, 2011 - Dec, 31 2020

RUNWAY LENGTH REQUIREMENTS

Aircraft operate on a wide variety of available runway lengths. Many factors will govern the suitability of those runway lengths for aircraft, such as elevation, temperature, wind velocity, aircraft operating weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures.

FAA Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design*, provides a five-step process for determining runway length needs. Those steps are:

1. Identify the list of critical design airplanes or airplane group.
2. Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).
3. Determine which of the three methods, described in the AC, will be used for establishing the runway length.
4. Select the recommended runway length for the appropriate methodology.
5. Apply any necessary adjustments to the obtained runway length.

The three methodologies for determining runway length requirements are based on the MTOW of the critical design aircraft or the airplane group. The airplane group consists of multiple aircraft with similar design characteristics. The three weight classifications are those with a MTOW of 12,500 pounds or less, those airplanes weighing over 12,500 pounds but less than 60,000 pounds, and those weighing 60,000 pounds or more. **Table 3B** shows these classifications and the appropriate methodology to use in runway length determination.

TABLE 3B | Airplane Weight Classification for Runway Length Requirements

Airplane Weight Category (MTOW)		Design Approach	Methodology
12,500 pounds or less	*Approach speeds of less than 30 knots*	Family grouping of small airplanes	Chapter 2: para. 203
	Approach speeds of at least 30 knots but less than 50 knots	Family grouping of small airplanes	Chapter 2: para. 204
	Approach speeds of 50 knots or more With less than 10 passengers	Family grouping of small airplanes.	Chapter 2: para. 205, Figure 2-1
	Approach speeds of 50 knots or more With 10 or more passengers	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
Over 12,500 pounds but less than 60,000 pounds		Family grouping of large airplanes	Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2
60,000 pounds or more or Regional Jets		Individual large airplanes	Chapter 4: Airplane performance manuals

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Using FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, the following presents the five-step process for determining the recommended runway length for Runway 18-36.

Step 1: Identify the critical design airplanes or airplane group.

The first step in determining the recommended runway length for an airport is to identify the critical design aircraft or family grouping of aircraft with similar design characteristics. The critical design aircraft or airplane group accounts for at least 500 annual operations. The FAA's Traffic Flow Management System Counts (TFMSC) database documents those aircraft that fly IFR and/or file a flight plan to or from the airport. Local operations are not captured in the TFMSC. **Table 3C** summarizes the TFMSC data for jet and turboprop aircraft operating at LBO by weight class. All other operations at the airport are conducted by small piston-powered aircraft weighing less than 12,500 pounds.

TABLE 3C | Jet and Turboprop Operations by Weight Class

	OPERATIONS					
Weight Class	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
12,500 lbs. or less	252	206	230	266	182	604
Over 12,500 lbs. but less than 60,000 lbs.	284	336	252	296	120	166
60,000 lbs. or more	2	2	0	0	0	2
Total Jet and Turboprop Operations	**538**	**544**	**482**	**562**	**302**	**772**
Total Jet Operations	322	362	256	314	138	626
Total Turboprop Operations	216	182	226	248	164	146

Source: Traffic Flow Management System Counts

As can be seen in **Table 3C**, there is an average of 242 annual operations by aircraft with a MTOW over 12,500 but less than 60,000 pounds over the last six years. There is seldom an operation conducted by aircraft with a MTOW greater than 60,000 pounds. Also, over the last six years, the airport has averaged 336 business jet operations. Therefore, the appropriate runway length methodology is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B, which apply to airports with a significant level of business jet activity.

Step 2: Identify the airplanes or airplane group that require the longest runway length at maximum certified takeoff weight (MTOW).

Table 3C distinguishes between operations by jets and turboprops. Jet aircraft typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be used. Exhibit 2H previously documented the specific business jets and turboprops that operate at the airport.

Step 3: Determine which of the three methods, described in the AC, will be used for establishing the runway length.

The third step in the runway length recommendation guidance is to select the specific methodology to use. Chapter 3 of the AC groups business jets weighing over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet, and
- 100 percent of the fleet.

The AC states that the airplanes in the 75 percent of the fleet category generally need 5,000 feet or less of runway at mean sea level and standard day temperature (59° F), while those in the 100 percent of the fleet category need more than 5,000 feet of runway under the same conditions.

The AC indicates that the airport designer must determine which category to use for runway length determination. According to the AC, if relatively few airplanes under evaluation fall within the 100 percent of the fleet group, or the critical design aircraft fall within the group, then this category should be used for runway length determination. **Table 3D** presents the TFMSC operations data at LBO for the 100 percent of the fleet category. Over the past six years, there has been an average of 140 operations by jet aircraft in the top 25 percent of the fleet. Activity by these aircraft averaged over 50 percent of all jet operations at LBO, prior to the COVID pandemic. Given that the long-term effects of the pandemic are yet known, it is prudent to consider this anecdote as normal and that the airport can be expected to see a return of higher activity levels by these aircraft. Therefore, the 100 percent of the fleet category is used to determine runway length for LBO.

TABLE 3D | Jet Operations in the 100 Percent of the Fleet Category

		OPERATIONS					
Aircraft Type	**ARC**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Challenger 600/601/604	C-II	2	0	0	2	2	2
Citation II/SP/Latitude	B-II	62	66	52	64	12	10
Citation III/VI	C-II	0	2	0	2	0	0
Citation X	B-II	2	0	6	0	0	0
Falcon 900	B-II	0	2	4	0	4	2
Falcon 2000	B-II	0	2	4	2	0	2
Learjet 40 Series	C-I	8	2	6	6	4	2
Learjet 60 Series	C-I	0	0	0	0	0	0
Hawker 800XP	B-II	122	124	84	78	36	64
Hawker 1000	B-II	0	0	0	0	0	0
TOTAL OPERATIONS		**196**	**198**	**156**	**154**	**58**	**82**

ARC: Airport Reference Code
Note: FAA AC 150/5325-4B identifies the listed aircraft as being in the 75-100% category.

Source: Traffic Flow Management System Counts

There are two runway length curves presented in the AC under both the 75 and 100 percent of the fleet categories:

- 60 percent useful load, and
- 90 percent useful load.

The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may prefer to ferry fuel so that they do not have to refuel frequently. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category. Examples of needing to use the 90 percent

useful load category include regular air cargo flights, long haul flights (e.g., cross-country), or known fuel-ferrying needs. For this analysis, the default 60 percent useful load category will be used.

Step 4: Select the recommended runway length from the appropriate methodology.

The next step is to examine the 100 percent of the fleet at 60 percent useful load performance chart in Figure 3-2 of the AC (**Figure 3A**). This chart requires the following knowledge:

- The mean maximum daily temperature of the hottest month: August at 88.4° (F).
- The airport elevation: 1,320.7 feet above mean sea level (MSL).

By locating the appropriate temperature and airport elevation on the performance chart, the recommended runway length, without any adjustments, is 5,750 feet. The 90 percent useful load performance chart was also referenced and provides for an unadjusted runway length of 8,700 feet.

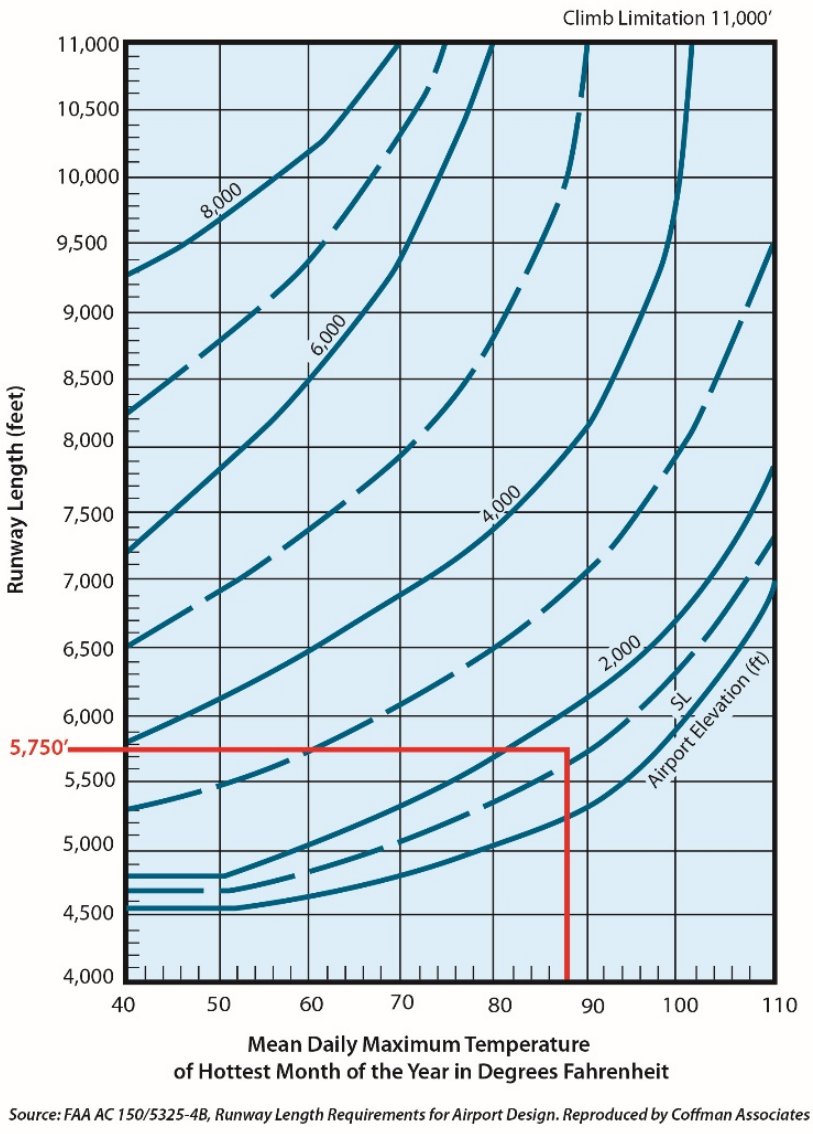


Figure 3A: Business Jet Runway Length Chart

Step 5: Apply any necessary adjustments to the obtained runway length.

The recommended runway length determined in Step #4 is based on zero effective gradient and dry runways. Step #5 applies adjustments to the raw runway length for these factors. The adjustments are not cumulative, since one adjustment applies to takeoffs and the other landings. Per the AC, the higher of the two adjustments is the recommended runway length.

With a 0.27 percent effective runway gradient (13 feet of elevation difference between the runway ends), the runway length obtained previously is increased at the rate of 10 feet per foot of elevation change. At LBO, this equates to an additional 130 feet of required runway length for a total length of

5,830 feet at a 60 percent useful load. Typically, any final runway length obtained is rounded up to the nearest hundred if above 30 feet, resulting in 5,900 total feet. The same process results in 8,900 feet for the 90 percent useful load category.

For business jet landing length, the runway length obtained in Step #4 is increased by 15 percent or up to 5,500 feet for the 60 percent useful load category, whichever is less, and up to 7,000 feet for the 90 percent useful load category. The calculated 15 percent increase results in a recommended runway length, rounded to the nearest hundred, of 6,600 feet. Therefore, the 5,500-foot length is maintained as the recommended length for this step, in accordance with the AC. For the 90 percent useful load, the calculated increase results in a runway length of 10,000 feet; the FAA allows for a maximum length of 7,000 feet for this category.

Table 3E summarizes the data inputs and the recommended runway lengths, including calculations for the 75 percent of the fleet category. It should be noted that, although the 90 percent useful load category was analyzed, if there is no specific justification to use the 90 percent useful load category, then the recommended runway length falls under the 60 percent useful load category. That justification does not exist today, therefore **the recommended runway length, following FAA guidance, is 5,900 feet for Floyd W. Jones Lebanon Regional Airport.**

TABLE 3E | Business Jet Runway Length Requirements

Airport Elevation	1,320 feet above mean sea level
Average High Monthly Temp	88.4 degrees F (August)
Runway Gradient	0.27 percent (13 feet)

Fleet Mix Category	Raw Runway Length	Runway Length with Gradient Adjustment	Wet Surface Landing Length for Jets (+15%)[1]	Final Runway Length[2]
75% of fleet at 60% useful load	4,800	4,930	5,500	5,500
75% of fleet at 90% useful load	6,650	6,780	7,000	7,000
100% of fleet at 60% useful load	**5,750**	**5,830**	**5,500**	**5,900**
100% of fleet at 90% useful load	8,700	8,830	7,000	8,900

Boldface indicates recommended runway length.
[1]A maximum of 5,500 feet and 7,000 feet is allowed for 60% and 90% useful loads, respectively.
[2]Final runway length is the larger of the two adjustments, rounded to nearest 100.
Note: All runway length values are in feet.

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Supplemental Runway Length Analysis for Specific Business Jets Operating at LBO

The official runway length methodology previously presented determined that the airport could have a need for a runway length of 5,900 feet based on existing activity levels by large business jets (those in the 100 percent fleet mix category). In some cases, this generalized methodology may not account for different conditions that may apply to specific aircraft models. The following discussion examines the runway length needs for specific aircraft that can operate at the airport by examining the flight planning manuals of a variety of aircraft.

The flight planning manuals of several business jet and turboprop models were analyzed for takeoff and landing length requirements under the local condition of a design temperature of 88.4 degrees F at a field elevation of 1,320.7 feet MSL. **Table 3F** provides detailed runway takeoff length analyses for the most common business jet and turboprop aircraft in the national fleet. This data was obtained from Ultranav software, which computes operational parameters for specific aircraft based on the flight planning manuals for each aircraft. The resulting runway length figures are shaded green or red, based on their relation to the current length of Runway 18-36 (5,000 feet), with red figures exceeding the current length.

TABLE 3F | Business Aircraft Takeoff Length Requirements

		TAKEOFF LENGTH REQUIREMENTS (feet)				
		Useful Load				
Aircraft Name	MTOW	60%	70%	80%	90%	100%
Pilatus PC-12	9,921	2,510	2,729	2,959	3,201	3,456
Citation CJ3	13,870	3,029	3,234	3,490	3,740	4,025
Citation II (550)	13,300	3,195	3,525	3,880	4,259	6,688
Citation Encore Plus	16,830	3,249	3,547	3,901	4,272	4,684
Citation (525A) CJ2	12,375	3,317	3,601	3,902	4,181	4,461
Citation 560 XLS	20,200	3,518	3,798	4,080	4,387	4,715
Citation Sovereign	30,300	3,552	3,625	3,778	4,056	4,348
Citation (525) CJ1	10,600	3,563	4,096	4,626	5,160	5,715
King Air 350	15,000	3,565	3,722	3,888	4,158	4,504
Citation Bravo	14,800	3,764	4,041	4,353	4,719	5,115
Premier 1A	12,500	4,005	4,433	4,950	5,510	6,072
Beechjet 400A	16,300	4,122	4,434	4,757	5,097	5,494
Lear 40	21,000	4,346	4,736	5,186	5,713	6,180
Falcon 900EX	49,200	4,350	4,900	5,530	6,200	6,800
Hawker 4000	39,500	4,387	4,767	5,173	5,623	6,180
Global 5000	92,500	4,461	4,962	5,486	6,035	6,607
Falcon 7X	70,000	4,536	5,067	5,630	6,243	6,949
Hawker 800XP	**28,000**	**4,578**	**4,950**	**5,427**	**5,927**	**Climb Limited**
Gulfstream 450	74,600	4,593	5,054	5,575	6,128	6,728
Challenger 300	38,850	4,607	5,047	5,502	5,977	6,475
Citation III	21,500	4,701	5,169	5,680	6,234	Climb Limited
Gulfstream 550	91,000	4,751	5,438	6,139	6,904	7,727
Citation X	35,700	4,841	5,263	5,776	6,331	6,926
Global XRS	98,000	4,877	5,463	6,080	6,726	7,629
Falcon 2000	35,800	4,886	5,456	5,959	6,515	7,334
Citation VII	23,000	4,905	5,264	5,658	6,086	6,560
Gulfstream 650	99,600	5,014	5,519	6,096	6,758	7,515
Lear 55	21,500	5,014	5,558	6,258	7,191	8,475
Challenger 604/605	48,200	5,069	5,598	6,196	6,832	7,479
Lear 60	23,500	5,297	5,854	6,452	7,025	7,752
Hawker 1000	31,000	5,470	6,120	6,760	Climb Limited	Climb Limited
Gulfstream 200	35,450	5,582	6,281	7,049	7,879	Climb Limited
Embraer 135	49,604	5,600	6,208	6,527	7,090	7,800
Average Takeoff Length		**4,341**	**4,771**	**5,233**	**5,692**	**6,220**

- Green figures are less than the length of Runway 18-36 at LBO; red figures are greater than the current runway length.
- **Boldface** indicates current based aircraft.
- MTOW: Maximum Takeoff Weight
- Climb Limited: The input data is outside the operating limits of the aircraft.
- Assumptions: 1,320.7 feet MSL field elevation; 88.4° F ambient temperature; 0.27% runway grade.

Source: Ultranav software

Takeoff Length Requirements

The runway takeoff length analysis calculates the length needed for a specific aircraft to safely perform a departure from an airport, given the airport's specific conditions (elevation, max temperature, and runway grade). It includes the maximum takeoff weight (MTOW) allowable and the useful load from 60 percent to 100 percent.

This analysis shows that during the hottest periods of the year, Runway 18-36 can accommodate all but seven aircraft at 60 percent useful load, including the Hawker 800XP that is based at LBO. At 70 percent useful load, nine more aircraft become weight-restricted, with the Hawker 800XP having only 50 feet of remaining runway allowed than what the current length provides. As shown, progressively fewer turbine aircraft can operate on the available runway as useful load increases. The average takeoff length needed for all turbine aircraft analyzed at 100 percent useful load is **6,220 feet.**

Landing Length Requirements

Table 3G presents the runway lengths required for landing under three operational categories: Title 14 Code of Federal Regulations (CFR) Part 25, Part 135, and Park 91k. Part 25 operations are those conducted by individuals or companies operating their own transport category aircraft. Part 91k includes operations in fractional ownership, which uses their own aircraft under direction of pilots specifically assigned to said aircraft. Part 135 applies to all for-hire charter operations, including most fractional ownership operations. 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 operator's program operations manual. The landing length analysis conducted accounts for both these scenarios.

As can be seen on **Table 3G**, the current runway length is adequate for all aircraft operating under Part 25. Under the 80 percent rule, only two aircraft become weight-restricted, and over half the analyzed aircraft are restricted under the 60 percent rule. When the runway is wet, the airport is less accessible to business aircraft. With an average landing length of 5,736 feet for aircraft operating under the 80 percent rule during wet runway conditions, the airport cannot accommodate most aircraft. The airport becomes unusable when wet to aircraft operating under the 60 percent rule, with an average landing length requirement of 7,648 feet. It should be noted that the landing length calculations consider the maximum landing weight. Most aircraft will have burned off fuel during flight and will be lighter.

TABLE 3G | Business Aircraft Landing Length Requirements

		LANDING LENGTH REQUIREMENTS (feet)					
		Dry Runway Condition			Wet Runway Condition		
Aircraft Name	MLW	Part 25	80% Rule	60% Rule	Part 25	80% Rule	60% Rule
Pilatus PC-12	9,921	2,369	2,961	3,948	N/A		
Citation II (550)	12,700	2,513	3,141	4,188	6,073	7,591	10,122
Challenger 300	33,750	2,675	3,344	4,458	5,127	6,409	8,545
Hawker 800XP	**23,350**	**2,730**	**3,413**	**4,550**	**4,195**	**5,244**	**6,992**
Global 5000	78,600	2,733	3,416	4,555	3,143	3,929	5,238
Global XRS	78,600	2,733	3,416	4,555	3,143	3,929	5,238
Embraer 135	40,785	2,762	3,453	4,603	3,167	3,959	5,278
Gulfstream 550	75,300	2,848	3,560	4,747	5,228	6,535	8,713
Challenger 604/605	38,000	2,877	3,596	4,795	4,446	5,558	7,410
Lear 40	19,200	2,911	3,639	4,852	3,713	4,641	6,188
King Air 350	15,000	2,922	3,653	4,870	3,360	4,200	5,600
Hawker 1000	25,000	2,971	3,714	4,952	4,076	5,095	6,793
Citation (525) CJ1	9,800	2,993	3,741	4,988	4,041	5,051	6,735
Falcon 7X	62,400	3,005	3,756	5,008	3,455	4,319	5,758
Citation Sovereign	27,100	3,022	3,778	5,037	3,884	4,855	6,473
Citation CJ3	12,750	3,187	3,984	5,312	4,332	5,415	7,220
Falcon 2000	33,000	3,210	4,013	5,350	3,691	4,614	6,152
Citation Encore Plus	15,200	3,212	4,015	5,353	4,863	6,079	8,105
Citation VII	20,000	3,256	4,070	5,427	4,412	5,515	7,353
Hawker 4000	33,500	3,343	4,179	5,572	3,845	4,806	6,408
Gulfstream 450	66,000	3,349	4,186	5,582	5,844	7,305	9,740
Citation (525A) CJ2	11,500	3,355	4,194	5,592	4,843	6,054	8,072
Lear 55	18,000	3,417	4,271	5,695	5,467	6,834	9,112
Premier 1A	11,600	3,466	4,333	5,777	4,474	5,593	7,457
Citation 560 XLS	18,700	3,589	4,486	5,982	5,678	7,098	9,463
Gulfstream 200	30,000	3,663	4,579	6,105	4,213	5,266	7,022
Lear 60	19,500	3,700	4,625	6,167	4,978	6,223	8,297
Falcon 900EX	44,500	3,770	4,713	6,283	4,335	5,419	7,225
Citation Bravo	13,500	3,792	4,740	6,320	5,962	7,453	9,937
Beechjet 400A	15,700	3,808	4,760	6,347	5,685	7,106	9,475
Gulfstream 650	83,500	3,985	4,981	6,642	5,231	6,539	8,718
Citation X	31,800	4,052	5,065	6,753	5,768	7,210	9,613
Citation III	19,000	4,233	5,291	7,055	6,166	7,708	10,277
Average Landing Length		**3,226**	**4,032**	**5,376**	**4,589**	**5,736**	**7,648**

- Green figures are less than the length of Runway 18-36 at LBO; red figures are greater than the current runway length.
- **Boldface** indicates current based aircraft.
- MLW: Maximum Landing Weight
- N/A: Aircraft landing length not adjusted for wet runway conditions.

Source: Ultranav software

Small Aircraft Runway Length

Many of the operations at LBO are conducted using smaller GA aircraft weighing less than 12,500 pounds, such as the Cessna 172 and Beechcraft Bonanza. Following guidance from AC 150/5325-4B, *Runway Length Requirements for Airport Design*, to accommodate 100 percent of these small aircraft, a runway length of 4,100 feet is recommended. For small aircraft with 10 or more passenger seats, 4,400 feet of runway length is recommended. **Table 3H** summarizes the runway length needs for small aircraft.

TABLE 3H | Small Aircraft Runway Length Requirements

Airport Elevation	1,320 feet above mean sea level
Average High Monthly Temp	88.4 degrees F (August)
Fleet Mix Category	**Runway Length (feet)**
95% of small airplanes	3,500
100% of small airplanes	4,100
Small airplanes with 10+ passenger seats	4,400

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Runway Length Summary

The analysis for determination of the recommended runway length for LBO followed FAA guidance provided in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. To accommodate 100 percent of the general aviation business jet fleet at 60 percent useful load, the runway should be 5,900 feet long. The analysis also indicated that a runway length of 8,900 could be justified if the 90 percent useful load category were used. Runway extension planning is restricted to the 60 percent useful load category unless specific documentation can be provided. Therefore, **future planning for LBO will consider a runway length of 5,900 feet.**

Additional analysis was conducted to determine the runway length needs of specific aircraft that may operate at LBO by examining the flight planning manuals for specific aircraft. Under certain operating conditions (hot days, wet runways, maximum weight), several aircraft will be weight restricted when operating on the current runway length of 5,000 feet. If activity by any of these specific aircraft can be documented to exceed the 500 annual operations threshold, then an extension to fully accommodate those aircraft would be justified.

Justification for any runway extension to meet the needs of business jets 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 existing length of Runway 18-36 does not fully provide for all jet activity, especially during hot weather conditions and when jet aircraft are carrying full useful loads. Analysis in the next chapter will examine the potential to extend the runway to 5,900 feet to better serve the needs of larger aircraft during the planning period and beyond.

RUNWAY WIDTH

Runway 18-36 is 75 feet wide, which meets FAA's design standards for ARC B-II runways, which is the current and future ARC designation. Therefore, LBO should maintain the current runway width in order to accommodate both the current and future design.

PAVEMENT STRENGTH

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. At LBO, the pavement for Runway 18-36 should be able to accommodate regular usage by the largest business jet aircraft using and planned to use the airport. The current strength rating of Runway 18-36 is 33,000 pounds single wheel loading (SWL) and 54,000 pounds dual wheel loading (DWL). The current strength rating is adequate for many of the business jet fleet, including the smaller Cessna Citation jets, Embraer Phenom 300, and Hawker 800XP, the last of which is based at LBO.

The future critical design aircraft grouping includes aircraft like the Citation Latitude, which weighs 30,800 pounds and has a dual wheel landing gear configuration. The runway is currently rated to meet such demands; therefore, the pavement strength should be maintained through the planning period.

TAXIWAYS

The design standards associated with taxiways are determined by both the taxiway design group (TDG) and the airplane design group (ADG) of the critical aircraft. As determined previously, the applicable ADG for Runway 18-36 is ADG "II" and the TDG "1B." **Table 3J** presents the taxiway design standards related to ADG II.

The table also shows those taxiway design standards related to TDG. The TDG standards are based on the main gear width (MGW) and the cockpit-to-main gear (CMG) distance of the critical design aircraft expected to use those taxiways. Different taxiway/taxilane pavements can – and should – be designed to the most appropriate TDG design standards.

The existing and ultimate critical TDG for LBO is 1B, which is based on the Hawker 800/850, which is based at and regularly uses the airport. This means that the taxiways associated with the runway should be at least 25 feet wide. All taxiways on the airfield are at least 25 feet wide. The primary parallel taxiway ranges from 29 to 35 feet wide, which exceeds the design standard.

TABLE 3J | Taxiway Dimensions and Standards

STANDARDS BASED ON ADG	ADG II
Taxiway Protection	
Taxiway Safety Area (TSA) Width	79
Taxiway Object Free Area (TOFA) Width	131
Taxilane Object Free Area Width	115
Taxiway Separation	
Taxiway Centerline to:	
Fixed or Movable Object	65.5
Parallel Taxiway/Taxilane	105
Taxilane Centerline to:	
Fixed or Movable Object	57.5
Parallel Taxilane	97
Wingtip Clearance	
Taxiway Wingtip Clearance	26
Taxilane Wingtip Clearance	18
STANDARDS BASED ON TDG	**TDG 1B**
Taxiway Width	25
Taxiway Edge Safety Margin	5
Taxiway Shoulder Width	10
Note: All dimensions are in feet.	

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

Taxiways are protected by a taxiway safety area (TSA) and a taxiways object free area (TOFA). The TSA must meet the following standards: (1) it must be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations; (2) it must be drained by grading or storm sewers to prevent water accumulation; (3) it must be capable of supporting firefighting equipment and the occasional passage of aircraft without causing structural damage to the aircraft; and (4) it must be free of objects except for those needed for navigational functions.

TOFA clearing standards prohibit service vehicle roads, parked aircraft, and other objects, except for those objects that need to be located in the TOFA for air navigation or aircraft ground maneuvering purposes. The ADG II TSA has a width of 79 feet, and the TOFA has a width of 131 feet, both centered on the taxiway centerline. There are no conflicts within either the TSA or the TOFA, and they should be maintained as such through the planning period.

TAXIWAY DESIGN CONSIDERATIONS

FAA AC 150/5300-13B, *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 LBO generally provides for the efficient movement of aircraft; however, AC 150/5300-13B, *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 oversteering," 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. Any additional options can increase pilot confusion and lead to runway incursions.
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 they are 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 two-fold, through simple reduction in the likelihood and 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 a runway 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 be no 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 deliberately make turns. Taxiways originating from aprons and forming straight line access to runways should be avoided.
   - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and make signage, marking, and lighting 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 deliberate 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 150/5300-13B, *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. LBO does not have any identified "hot spots." However, there are taxiways that provide direct access from the primary ramp and aircraft parking areas, which can lead to runway incursions. These conditions are shown on **Figure 3B**.

In the alternatives chapter (Chapter Four), solutions to these non-standard taxiway conditions will be presented. Analysis in the next chapter will also consider future taxiway design to minimize runway incursion risks, improve efficiency, and conform to FAA taxiway design standards.

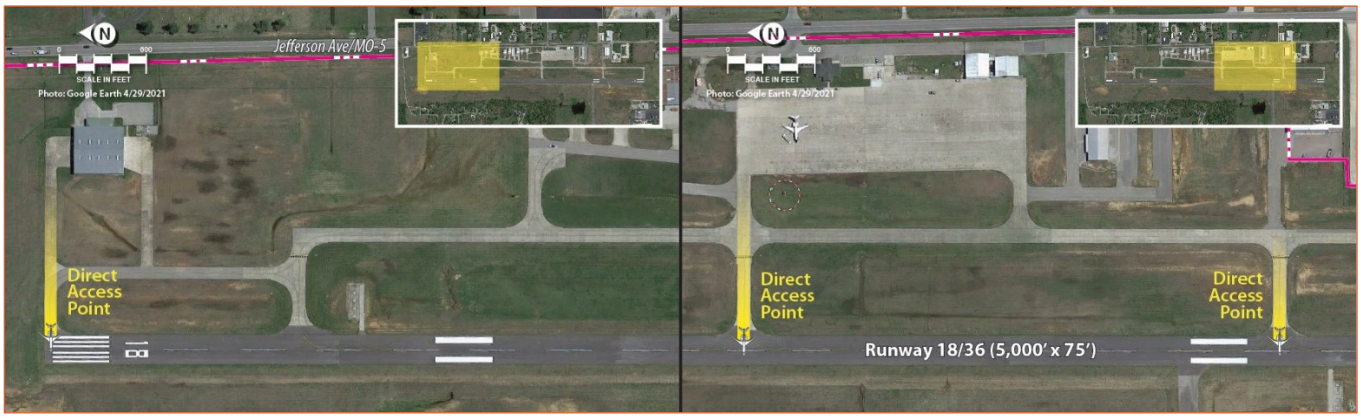


Figure 3B: Taxiway Direct Access Conditions

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 designed to varying design standards depending on the type of aircraft using, or expected to use, the taxilane. For example, a taxilane leading to a T-hangar area only needs to be designed to accommodate those aircraft accessing the T-hangar area.

The taxilane separating T-hangar buildings needs to only meet clearance standards for ADG I aircraft, which has a TOFA requirement of 79 feet. Therefore, any T-hangar should be at least 39.5 feet from the taxilane centerline. At LBO, there are no marked centerlines on taxilanes. It is recommended that, for safety reasons, centerlines should be marked on taxilanes that allow access to multiple hangar facilities in order to prevent aircraft wander.

SAFETY AREA DESIGN STANDARDS

The FAA has established several safety surfaces to protect aircraft operational areas and keep them free from obstructions that could affect their safe operation. These include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (OFZ), and runway protection zone (RPZ). **Table 3K** presents the applicable design standards for the RSA, ROFA, and OFZ. RPZs are discussed later.

TABLE 3K | Airfield Design Standards			
Runway Design Code	**B-II-5000 (existing)**	**B-II-4000 (ultimate)**	**Current Conditions/Notes**
RUNWAY DIMENSIONS			
Runway Width	75	75	Meets Existing and Ultimate Standards
Runway Shoulder Width	10	10	Meets Existing and Ultimate Standards
RUNWAY SAFETY AREA			
Width	150	150	Meets Existing and Ultimate Standards
Length Prior to Threshold	300	300	Meets Existing and Ultimate Standards
Length Beyond Runway End	300	300	Meets Existing and Ultimate Standards
RUNWAY OBJECT FREE AREA			
Width	500	500	Meets Existing and Ultimate Standards
Length Beyond Runway End	300	300	Meets Existing and Ultimate Standards
RUNWAY OBSTACLE FREE ZONE			
Width	400	400	Meets Existing and Ultimate Standards
Length Beyond Runway End	200	200	Meets Existing and Ultimate Standards
SEPARATION STANDARDS			
Runway Centerline to:			
Holding Position	200	200	Exceeds Existing and Ultimate Standards
Parallel Taxiway	240	240	680-foot Section of Taxiway does not meet Existing or Ultimate Standards
Aircraft Parking Area	250	250	Meets Existing and Ultimate Standards
Note: All dimensions are in feet.			

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

Dimensional standards for the various safety areas associated with the runway are a function of the type of aircraft (ARC) expected to use the runway, as well as the approved instrument approach visibility minimums. The entire RSA, ROFA, and OFZ should be under the direct control of the airport to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. **Exhibit 3B** depicts the existing safety areas at LBO, as well as any current non-standard conditions.

Runway Safety Area (RSA)

The RSA is defined in FAA AC 150/5300-13B, *Airport Design*, as a "surface surrounding the runway prepared for 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 with 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, as well as fire and rescue vehicles, and free of obstacles not fixed by navigational purposes, 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 Advisory Circular 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 ARC B-II design, the FAA calls for the RSA to be 150 feet wide and extend 300 feet beyond the runway ends. Analysis in the previous chapter indicated that Runway 18-36 should be planned to continue accommodating aircraft in ARC B-II in the future. The RSA meets the current design standards; therefore, the current RSA dimensions should be maintained through the planning period.

Runway Object Free Area (ROFA)

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 as the RSA does; instead, the primary requirement of 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 with the critical aircraft design category using the runway.

ARC B-II standards require a 500-foot wide ROFA that extends 300 feet beyond the ends of the runway. Currently there are no obstructions that cause conflict within the ROFA. The airport should continue to maintain this standard through the planning period.

Obstacle Free Zones (OFZ)

The OFZ is an imaginary surface which precludes object penetrations, including taxiing and parked aircraft. The only allowance for OFZ obstructions is navigational aids mounted on frangible bases which are fixed in their location by function, such as airfield lighting or signage. The OFZ is established to ensure the safety of aircraft operations. If the OFZ 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 OFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the runway ends. This standard applies to Runway 18-36 at LBO in both the existing and ultimate conditions. Currently there are no OFZ obstructions at the airport. Future planning should maintain the OFZ for the appropriate runway type.

Runway Protection Zones (RPZ)

The RPZ is a trapezoidal area centered on the extended runway centerline, typically 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 in order to enhance the protection of people and property on the ground. The RPZ is comprised of the central portion of the RPZ and the controlling 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 controlling activity area is any remaining portions of the RPZ. The dimensions of a RPZ vary according to the visibility minimums serving the runway and the type of aircraft (design aircraft) operating on the runway. It is not required that the RPZ be under airport ownership, but it is strongly recommended. An alternative to fee-simple ownership of the RPZ is the purchase of avigation easements (acquiring control of designated airspace within the RPZ) or have sufficient land use control measures in place which ensure the RPZ remains free of incompatible development. **Table 3L** provides the applicable RPZ dimensions for the runway at LBO.

Existing B-II-5000

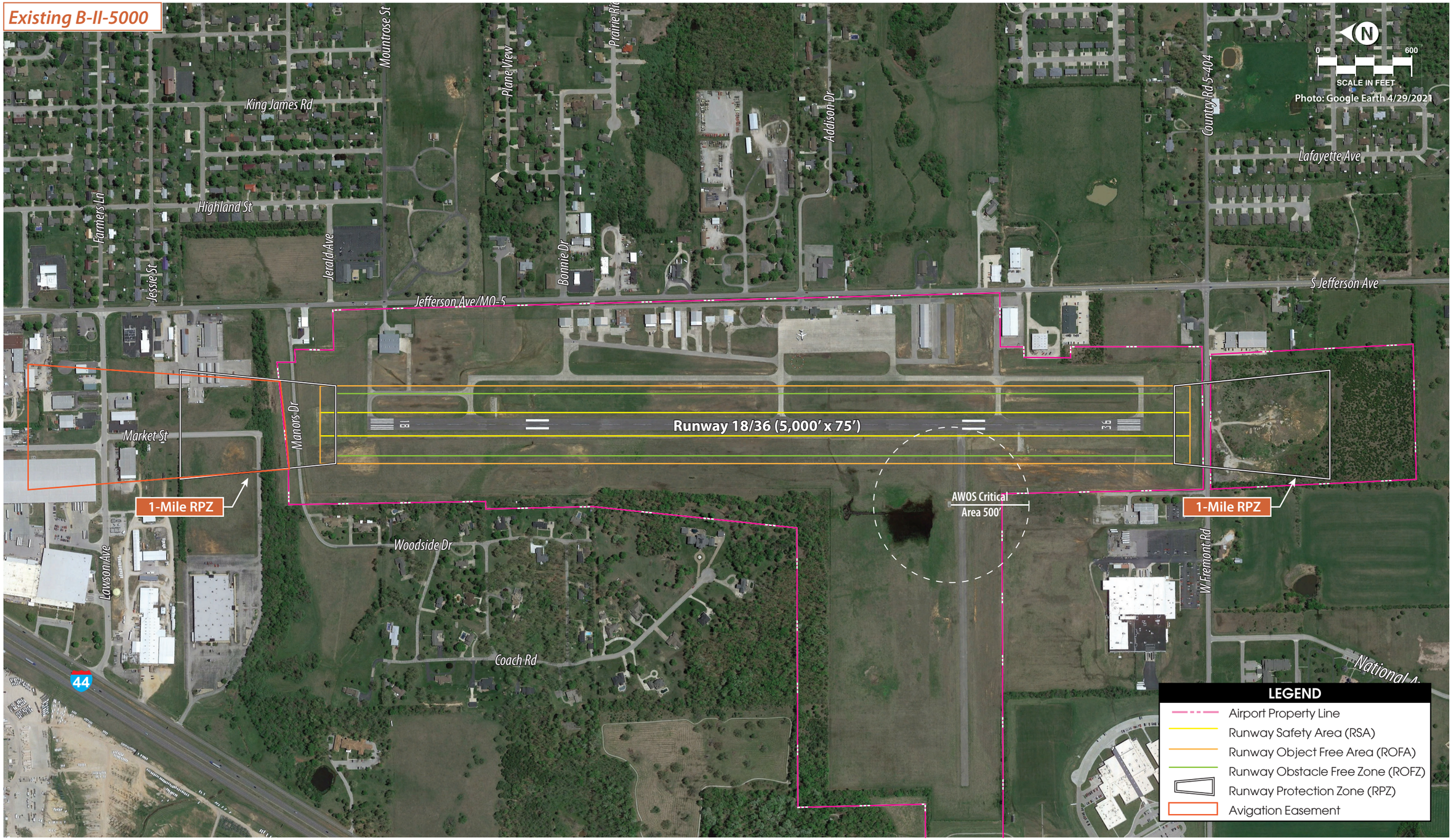


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TABLE 3L | Runway Protection Zones	RDC B-II-5000 (EXISTING)		RDC B-II-4000 (ULTIMATE)	
	Runway 18	Runway 36	Runway 18	Runway 36
APPROACH RUNWAY PROTECTION ZONES				
Approach Visibility Minimum	1-mile	1-mile	¾-mile	¾-mile
Inner Width (ft)	500	500	1,000	1,000
Outer Width (ft)	700	700	1,510	1,510
Length (ft)	1,000	1,000	1,700	1,700
DEPARTURE RUNWAY PROTECTION ZONES				
Inner Width (ft)	500	500	500	500
Outer Width (ft)	700	700	700	700
Length (ft)	1,000	1,000	1,000	1,000

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

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 150/5300-13B, 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;
- 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 those 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 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* (9.27.2012), 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 (e.g., residences, schools, churches, hospitals or other medical care facilities, commercial/industrial buildings, etc.);
- Recreational land use (e.g., golf courses, sports fields, amusement parks, other places of public assembly, etc.);
- Transportation facilities (e.g., rail facilities, public roads/highways, vehicle parking facilities, etc.);
- Fuel storage facilities (above and below ground);
- Hazardous material storage (above and below ground);
- Wastewater treatment facilities; and,
- Above-ground utility infrastructure (e.g., electrical substations), including any type of solar panel installations.

The *Interim Guidance on Land Uses within a Runway Protection Zone* states, "RPZ land use compatibility 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 (i.e., 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 essentially "grandfathered" under certain circumstances. While it is still necessary for the airport to take all reasonable actions to meet the RPZ design standards, 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 AAC and the approach visibility minimums associated with the approach runway end. The departure RPZ is a function of the AAC and the departure procedures associated with the runway. For a particular runway end, the more stringent RPZ requirements (usually the approach RPZ) will govern the property interests and clearing requirements that the airport sponsor should pursue.

As depicted on **Exhibit 3B**, the existing RPZ serving Runway 36 falls within the airport property, with the exception of the portion that extends over West Fremont Road. Fremont Road is not owned by the airport and separates the airport at the south end. The Runway 18 RPZ extends beyond airport property and over a section of Market Street and a commercial business for a total of approximately 9.4 acres. These are considered incompatible land uses within an RPZ. In the future condition the RPZs become larger based on lower visibility minimums. The effect of the enlarged RPZs on the surrounding area will be explored in the Alternatives chapter. It should be noted that, to lower the visibility minimums, the airport will have to develop a plan of action to mitigate the newly introduced incompatible land uses and work in consultation with MoDOT to determine if the additional incompatible land is acceptable.

Improved visibility minimums are a vital benefit to general aviation airports with existing and increasing amounts of business and corporate jet operations. Lower visibility minimums extend the usefulness of the airport during times of poor visibility conditions. This means that any business traveler flying to Lebanon can be reassured that even in poor weather conditions they will be able to complete their business in the community.

RUNWAY/TAXIWAY SEPARATION

The design standard for the required separation between a runway and a parallel taxiway is a function of the critical design aircraft and the instrument approach visibility minimum. The separation standard

for RDC B-II-5000 is 240 feet from the runway centerline to the parallel taxiway centerline. Most of the primary parallel taxiway is 300 feet from Runway 18-36 (centerline to centerline), with the northernmost 680 feet of the taxiway only 200 feet from the runway centerline. Therefore, the entirety of the taxiway does not meet FAA design specifications. Options to correct this non-standard condition will be evaluated in the next chapter.

BUILDING RESTRICTION LINE (BRL)

The BRL identifies suitable building area locations on the airport. The BRL encompasses the RPZs, the ROFA, navigational aid critical areas, areas required for terminal instrument procedures, and other areas necessary for meeting airport line-of-sight criteria.

Two primary factors contribute to the determination of the BRL: type of runway ("utility" or "other-than-utility") and the capability of the instrument approaches. Runway 18-36 is an "other-than-utility" runway since it serves aircraft weighing over 12,500 pounds. The BRL is the CFR Part 77 transitional surface clearance requirements. These requirements stipulate that no object can be located in the primary surface, defined as being 500 feet wide for "other-than-utility" runways with visibility minimums greater than ¾-mile. From the primary surface, the transitional surface extends outward at a slope of one vertical foot to every seven horizontal feet. A change in visibility minimums to ¾-mile and below would result in the primary surface increasing from 500 to 1,000 feet wide.

A common BRL identifies the 25-foot clearance line for the transitional surface. Currently, the 25-foot BRL is 425 feet from the runway centerline. Since the ultimate visibility minimums are planned to go as low as ¾-mile, the ultimate BRL will increase to 675 feet from the runway centerline. The BRL only indicates where structures should be below the designated height at that point. Buildings can be in front of the BRL if they remain lower than the transitional surface, otherwise consultation with the FAA and MoDOT would be required to reach a solution for those structures that penetrate the transitional surface. Changes to the existing BRL will be considered further in the Alternatives chapter.

HOLDING POSITION SEPARATION

Holding position markings are placed on taxiways leading to runways. When instructed, pilots should stop short of the holding position marking line. At non-towered airports like LBO, it is common practice for pilots to stop shot of the markings before moving onto the active runway. For Runway 18-36, holding position marking lines are situated 250 feet from the runway centerline, which exceeds ARC B-II design standards of 200 feet. There is no holding position marking on the taxiway at the Runway 18 threshold; a marking exists on the taxilane toward the private hangar, as well as on the parallel taxiway just before the pavement shifts closer to the runway. It is expected that aircraft intending to depart from the end of Runway 18 would use this hold position. However, with the planned relocation of that section of the taxiway, a new holding position marking will have to be added, at least 200 feet from the runway centerline. This will be explored further in the next chapter.

INSTRUMENT APPROACH CAPABILITY

Instrument approaches are categorized as either precision or non-precision. Precision instrument approaches provide an exact course alignment and vertical descent path for aircraft on final approach to a runway, while non-precision instrument approaches provide only course alignment information. In the past, most existing precision instrument approaches in the U.S. have been the ILS; however, with advances in the technology, global positioning system (GPS) can now be used to provide both vertical and lateral navigation for pilots under certain conditions.

LBO currently has straight-in instrument approach capabilities, consisting of an area navigation (RNAV) GPS approach to each runway end. Both of the RNAV/GPS approaches to Runway 18-36 provide for visibility minimum as low as 1-mile. Consideration will be given to reducing the approach visibility minimums for one or both runways to ¾-mile. This will permit additional operational capacity of the airport during inclement weather or poor visibility conditions.

The visibility minimums at an airport directly impact the economic development objective of the community. The lower the minimums, the more confidence that operators will have that they can arrive and depart, even in poor weather/visibility conditions. The impacts of reducing the visibility minimums will be considered in the Alternatives chapter of this master plan.

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 approaches to the runway, electronic visual approach aids are installed at airports. Currently, both runways are served by a four-box precision approach path indicator (PAPI-4) system. PAPI-4s are recommended for runways that are used by jet aircraft; the existing PAPI-4s should be maintained throughout the planning period.

Runway end identifier lights (REILs) are flashing lights located at the runway threshold 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 other lighting on the airport and in the approach areas. The FAA states that REILs should be considered for all runway ends where a more sophisticated approach lighting system (ALS) is not planned.

An ALS provides a visual lighted grid and alignment path for pilots at nighttime and during poor visibility conditions. Currently, neither end of the runway has an ALS. For visibility minimums lower than ¾-mile, a medium intensity approach lighting system with runway alignment indicator lights (MALSR) is required on the lead-in to the landing end of the runway. Runway 18-36 has REILs at both ends; because the lowest instrument approach proposed at LBO is a ¾-mile, a MALSR would not be necessary and is not planned for the airport.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

The location of the airport at night is universally indicated by a rotating beacon. For civil airports, the rotating beacon projects two beams of light, one white and one green, 180 degrees apart. The existing beacon at LBO, located adjacent to the terminal building, should be maintained through the planning period.

Runway and Taxiway Lighting

Runway lighting provides the pilot with positive identification of the runway and its alignment. Runway 18-36 is equipped with medium-intensity runway edge lighting (MIRL). This intensity is adequate for runways served by instrument approaches of ¾-mile or greater; therefore, the existing MIRL should be maintained through the planning period.

Blue reflectors provide pilots with a visual reference of taxiway edges that are not equipped with lighting systems. Medium-intensity taxiway lighting (MITL) is recommended to increase situational awareness at the airport, especially on the parallel taxiway. This is vital for safe and efficient ground movements of aircraft. Consideration should be given to adding edge lighting to all taxiway and taxilane surfaces, as well as all future taxiways that support the runway at LBO.

It should be noted that many airports are transitioning to light emitting diode (LED) pavement edge lighting technology. 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 overall. Consideration should be given to gradually replacing all pavement edge lighting with LED systems.

Pavement Markings

Runway markings are typically designed for the type of instrument approach available on the runway. FAA AC 150/5340-1M, *Standards for Airport Markings*, provides guidance necessary to design airport markings. Runway 18-36 has non-precision markings, which are adequate for a runway served by instrument approach procedures with visibility minimums down to ¾-mile. The existing runway markings are sufficient for the existing and any improved future instrument approach procedures.

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 taxiways at runway intersections. Consideration should be given to expanding the signage on the airport to include direction and additional taxiway location identifiers, as well as replacing the existing lighted signs with LED technology.

Additional consideration may be given to installing distance remaining signage. These lighted signs alert pilots to how much runway length remains in 1,000-foot increments.

WEATHER AND COMMUNICATION INFORMATION

LBO has a lighted wind cone and segmented circle adjacent to the northwest corner of the primary apron. The segmented circle consists of a system of visual indicators designed to provide traffic pattern information to pilots. The wind cone provides information to pilots regarding wind speed and direction. There are no supplemental wind cones at the airport. This condition may be maintained through the planning period.

The airport is equipped with an AWOS, which provides weather observations 24 hours a day. The system updates weather observations every minute, reporting significant weather changes as they occur. This information is transmitted on radio frequency 118.975 MHz. Additionally, pilots can call a published telephone number (417-533-3419) and receive the information via an automated voice recording. The AWOS is surrounded by an additional security fence to prevent people and wildlife from disrupting the equipment. This system should be maintained through the planning period.

Furthermore, an AWOS critical area with a radius of 500 feet is depicted on **Exhibit 3B**. Objects and buildings within this area are permissible so long as they do not obstruct the operation of the AWOS sensors. The airport should monitor any development within the AWOS critical area to ensure the weather equipment remains unobstructed.

AIRFIELD FACILITY REQUIREMENTS SUMMARY

A summary of the airside facilities previously discussed at LBO is presented on **Exhibit 3C**.

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 in order to identify future landside facility needs. At LBO, this includes components for general aviation needs, such as:

- General Aviation Terminal Facilities
- Vehicle Parking
- Aircraft Hangars
- Aircraft Parking Aprons
- Airport Support Facilities

GENERAL AVIATION TERMINAL FACILITIES

General aviation terminal facilities have several functions. Space may be provided for a pilots' lounge, flight planning, concessions, management offices, storage, restrooms, and various other needs. This space is not necessarily limited to a single, separate terminal building, but can include space offered by

	AVAILABLE	SHORT TERM	LONG TERM
RUNWAY 18-36			
	RDC B-II-5000	RDC B-II-5000	RDC B-II-4000
	5,000' X 75'	Maintain	5,900' x 75'
	33,000 LBS. SWL | 54,000 lbs. DWL	Maintain	Maintain
	Standard RSA; Standard ROFA; Standard ROFZ	Maintain	Maintain
	RPZs partially owned, extends over private property, public roads	Mitigate RPZ incompatibilities	Mitigate new RPZ incompatibilities with upgrading to RDC B-II-4000 standards
TAXIWAYS			
	TDG 1B	TDG 1B	TDG 1B
	35'Taxiway Width	Maintain	Widen northern section of Parallel taxiway to 35'
	Northern section of parallel taxiway is 200' from runway centerline	Relocate taxiway section to match existing parallel taxiway	Maintain corrected condition
	No holding position markings on taxiway leading to Runway 18	Add hold position marking at least 200' from runway centerline after taxilane has been shifted	Maintain corrected condition
	Main ramp and hangar aprons provide direct access to runway	Mitigate direct access points	Maintain corrected condition
NAVIGATIONAL AND APPROACH AIDS			
	RNAV (GPS) - Runways 18, 36 (both 1-mile)	Maintain	Reduce RNAV (GPS) Visibility Minimums to 3/4-mile
	AWOS	Maintain	Maintain
	Lighted Windcones	Maintain	Maintain
	PAPI-4 - Runways 18, 36	Maintain	Maintain
	REILs - Runways 18, 36	Maintain	Maintain
LIGHTING, MARKING, AND SIGNAGE			
	Rotating Beacon	Maintain	Maintain
	Non-Precision Markings - Runways 18, 36	Maintain	Maintain
	MIRL - Runway 18-36	Maintain / Consider gradual replacement with LED technology	
	Taxiways have blue colored reflectors	Add taxiway lighting to primary taxiway / Consider LED technology when installing	
	Runway Holding Position Markings - 250' from runway centerline	Maintain	Maintain
	Lighted airfield location signage	Consider gradual replacement with LED technology, addition of runway distance remaining signage	

KEY

AWOS: Automated Weather Observation System
DWL: Dual-Wheel Type Landing Gear Type
GPS - Global Positioning System
LED - Light-Emitting Diode
MIRL: Medium Intensity Runway Edge Lighting
MITL - Medium Intensity Taxiway Lighting
PAPI: Precision Approach Path Indicator
RDC: Runway Design Code
REIL: Runway End Identification Lighting
RNAV - Area Navigation (GPS variant)
ROFA: Runway Object Free Area
ROFZ: Runway Obstacle Free Zone
RPZ: Runway Protection Zone
RSA: Runway Safety Area
SWL: Single-Wheel Landing Gear Type
TDG: Taxiway Design Group

fixed-base operators (FBOs) for these functions and services. Currently, the terminal building provides these services; there are no external FBOs at the airport. The terminal building is approximately 2,660 square feet (sf) in size.

The methodology used in estimating general aviation terminal facility needs is based on the number of airport users expected to utilize general aviation facilities during the design hour. Space requirements for terminal facilities are based on providing 125 sf 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 multiplier indicates an expected increase in business and recreational operations throughout the planning period. These operations often support larger turboprop and jet aircraft, which accommodate an increasing passenger load factor.

Table 3M outlines the space requirements for general aviation terminal services at LBO through the planning period. As shown in the table, the existing terminal building is nearing its capacity in the long-term. The alternatives in the next chapter will consider expansion of the terminal in the event the terminal reaches its capacity sooner than the long-term.

TABLE 3M | General Aviation Service Facilities

	Existing	Short Term	Inter. Term	Long Term
Design Hour Operations	7	8	8	8
Design Hour Itinerant Operations	6	7	7	7
Multiplier	1.5	1.5	2.0	2.5
Total Design Hour Itinerant Passengers	9	11	14	18
GA Terminal Building Services (sf)	2,660	1,800	2,300	2,700

Source: Coffman Associates analysis

Vehicle Parking

General aviation vehicular parking demands have also been determined for LBO. Space determinations for itinerant passengers were based on an evaluation of existing airport use, as well as standards set forth to help calculate projected terminal facility needs.

The parking requirements of based aircraft owners should also be considered. Although some owners prefer to park their vehicles in their hangar, safety can be compromised when automobile and aircraft movements are mixed. For this reason, separate parking requirements, which consider one-half of the based aircraft at the airport, were applied to general aviation automobile parking space requirements. Using this methodology, parking requirements for general aviation activity call for approximately 35 spaces in the short-term, increasing to approximately 52 spaces in the long-term. The GA based parking space estimate is the recommendation and is not reflective of what is currently available. **Table 3N** presents the vehicle parking needs of the airport through the planning period. Future consideration in the master plan will be given to providing vehicle parking to support additional development potential.

TABLE 3N | General Aviation Vehicle Parking Requirements				
	Existing	Short Term	Inter. Term	Long Term
Design Hour Itinerant Passengers	9	11	14	18
VEHICLE PARKING SPACES				
GA Itinerant Spaces (Terminal)	15	20	27	34
GA Based Spaces (Near/In Hangars)	11[1]	15	16	18
Total Parking Spaces	**26**	**35**	**43**	**52**
[1]Existing based parking spaces is an estimation; no dedicated parking spots exist other than the terminal lot.				

Source: Coffman Associates analysis

AIRCRAFT HANGARS

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

The demand for aircraft storage hangars is dependent on the number and type of aircraft expected to be based at LBO in the future. For planning purposes, it is necessary to estimate hangar requirements based on forecasted operational activity. However, actual hangar construction should be based on actual demand trends and financial investment conditions.

It is important to note that the types of hangars detailed in this section are categorized based on the proposed size and layout of the facility and do not necessarily correspond with the locally designated hangar facility categories. For example, certain categories, such as T-hangars and linear box hangars, aircraft storage hangars, FBO, and specialized aviation service operator (SASO) hangars, all typically correspond to conventional style hangars detailed in this section.

There are a variety of aircraft storage options typically available at an airport, including T-hangars, linear box hangars, executive/box hangars, and conventional hangars. T-hangars are intended to accommodate one small single-engine piston aircraft or, in some cases, one multi-engine piston aircraft. T-hangars are so names because they are in the share of a "T," providing a space for the aircraft tail and wings, but no space for turning the aircraft within the hangar. Basically, the aircraft can be parked in only one position: backed ("pushed back") into the hangar. T-hangars are commonly "nested" with several individual storage units to maximize hangar space. In these cases, taxilane access is needed on both sides of the nested T-hangar facility. T-hangars are popular with aircraft owners with tighter budgets as they tend to be the least expensive enclosed hangar space to build and lease. There are currently 12 T-hangar units at LBO, totaling 14,690 sf of aircraft storage capacity. At the time of this writing, the airport had plans and materials for constructing a new 4-unit T-hangar facility, but it was not included in these calculations as concrete and construction efforts had yet to erect the building.

Conventional hangars are the large, clear span hangars typically located facing the main aircraft apron at airports. These hangars provide for bulk aircraft storage and are often used by airport businesses, such as an FBO and/or SASO (e.g., an aircraft maintenance business). Conventional hangars generally range in size from 4,000 sf to more than 20,000 sf. Often, a portion of a conventional hangar is used for

non-aircraft storage needs, such as maintenance or office space. Box hangars are smaller versions of conventional hangars and are treated as a sub-section of conventional hangars. They may be owned by the airport or by private companies with land leases on the airport who operate their business from the hangar. The conventional hangars at LBO encompass approximately 49,960 sf. The airport does also have two large private hangars, one at the north and the other at the south end of the landside hangar development. These are privately owned and maintained and, therefore, are not available for transient aircraft parking/storage.

Planning for future aircraft storage needs is based on typical owner preference and industry standard sizes for hangar space. For determining future aircraft storage needs, a planning standard of 1,400 sf per T-hangar and 3,000 sf per conventional hangar space is used. It should be noted that any projected estimate of required hangar space is an ideal and does not take into consideration the actual function of the hangar. For example, a large 10,000-square-foot hangar could house four or more aircraft, or the owner may house only one aircraft.

With the trend toward aircraft owners preferring enclosed aircraft storage space, no growth is projected for aircraft that utilize outside tiedowns. Providing a mix of aircraft storage options is preferred when planning hangars to meet the varied needs of aircraft owners. **Table 3P** provides a summary of the aircraft storage needs through the planning period.

TABLE 3P | Aircraft Hangar Requirements

	Existing	Short Term	Inter. Term	Long Term
Based Aircraft	**28**	**30**	**32**	**36**
HANGAR AREA REQUIREMENTS				
T-Hangar Area	14,690	25,000	27,000	29,000
Conventional Hangar Area	49,960	53,000	55,000	65,000
Total Storage Area (sf)	**64,650**	**78,000**	**82,000**	**94,000**
Area per aircraft parking space: T-hangar: 1,400 sf; conventional hangar: 3,000 sf Note: Box/corporate hangars included in conventional hangar calculations.				

Source: Coffman Associates analysis

The analysis shows that there is a potential need for an additional 15,000 square feet of new T-hangar storage capacity through 2041, as well as an additional 15,000 square feet in larger executive and conventional hangars. 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. The construction of conventional hangars will be better suited to accommodate larger turboprop and jet aircraft, while T-hangar storage space requirements will grow over time as new piston-powered aircraft choose to base at LBO.

It should be noted that hangar requirements are general in nature and based on the aviation demand forecasts. The actual need for hangar space will further depend on the actual usage within hangars. For example, some hangars may be used 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 use may differ from the calculated space necessary.

AIRCRAFT PARKING APRONS

FAA AC 150/5300-13B, *Airport Design*, suggests a methodology by which transient apron requirements can be determined from knowledge of busy-day operations. At LBO, the number of itinerant spaces required was determined to be approximately 89 percent of the busy-day itinerant general aviation operations. A planning criterion of 800 square yards (sy) per aircraft was applied to determine future transient apron requirements for turbine aircraft; because they are generally not as large as turbine aircraft, piston-powered aircraft have a planning criterion of 500 sy. For local airport needs, the 500 sy criterion was applied since most local operations are conducted by piston aircraft. Apron parking requirements are presented in **Table 3Q** and are separated by local and transient needs.

TABLE 3Q | Aircraft Parking Apron Requirements

	Existing	Short Term	Inter. Term	Long Term
Local Apron Area (sy)		6,000	6,000	6,000
Transient Apron Area (sy)		3,800	3,800	3,800
Total Apron Area (sy)	**19,300**	**9,800**	**9,800**	**9,800**

Note: Area measurements include taxilanes.

Source: Coffman Associates analysis

Currently, the existing GA and terminal aircraft parking apron encompasses approximately 19,300 sy of space at the airport. Available apron space is sufficient to meet long-term needs of GA activity at LBO and should be maintained through the planning period.

SUPPORT FACILITIES

Various facilities that do not logically fall within classifications of airside or landside facilities have also been identified. These other areas provide certain functions related to the overall operation of the airport.

Fuel Storage

The City of Lebanon operates the only FBO at the airport and is the airport's fuel service provider. There are two underground storage tanks, one for Jet A and one for AvGas/100LL, both with a 12,000-gallon capacity. These tanks are connected to a set of self-serve pumps, located on the east side of the ramp. Pilots can also have fuel delivered by fuel trucks. For the purposes of this study, however, only static fuel storage capacity will be considered.

Records of fuel sales were provided by airport management. Based on the fuel sales receipts from 2021, the airport pumped 63,976 gallons of Jet A and 27,590 gallons of AvGas. Operational data is extrapolated from the annual estimate of operations for the airport, with an estimated seven percent of all operations being conducted by turbine aircraft. The remaining 93 percent of operations are conducted by piston-powered aircraft. Dividing the total fuel flowage by the total number of operations provides a ratio of fuel flowage per operation. Last year, the airport pumped approximately 82.87 gallons of Jet A per turbine operation and 2.68 gallons of AvGas per piston operation. It is anticipated that the ratio of aircraft operations will shift toward higher turbine counts through the planning period.

Fuel storage forecasts were produced using the calculated rations above with the projected number of annual operations for each planning horizon. The forecasted fuel storage requirements are summarized in **Table 3R**. 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 fuel storage to meet the 14-day supply criteria for both Jet A and AvGas fuel to meet demand through the long-term.

TABLE 3R | Fuel Storage Requirements

	Current Capacity	Baseline[1]	Short Term	Inter. Term	Long Term
Jet A					
Daily Usage	12,000	175	199	231	269
14-Day Supply		2,450	2,786	3,234	3,766
Annual Usage		63,976	72,677	84,362	98,118
AvGas					
Daily Usage	12,000	76	86	86	88
14-Day Supply		1,064	1,204	1,204	1,232
Annual Usage		27,590	31,209	31,377	32,074

[1]Baseline data derived from 2021 fuel sales.
Note: All values are in gallons.

Sources: Airport records, Coffman Associates analysis

PERIMETER FENCING

The entire airfield is equipped with a perimeter fence. Secured access gates provide vehicular access to the apron, hangar facilities, fuel farm, and other locations around the airfield. The secured gates are accessible only to airport tenants and employees. The AWOS is surrounded by additional fencing. The perimeter fence also has a three-wire barbed wire top to increase the difficulty of accessing the airfield. The fencing system should be maintained through the planning period.

LANDSIDE FACILITY REQUIREMENTS SUMMARY

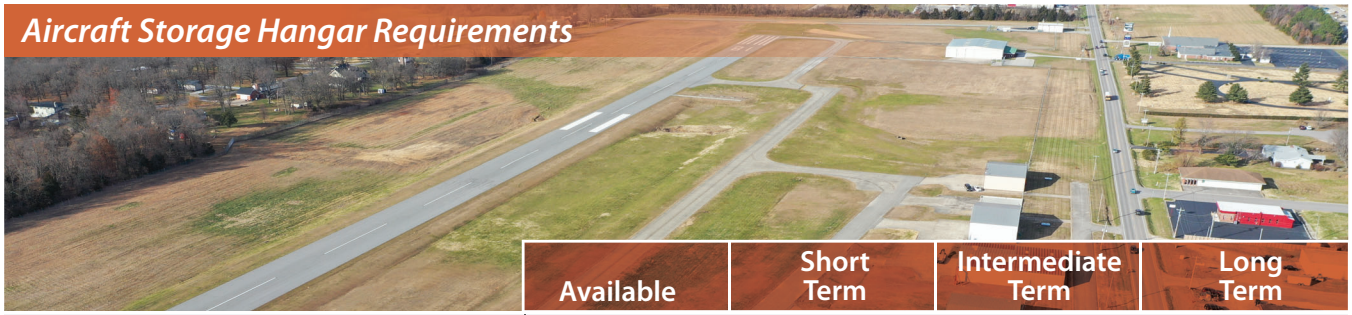
A summary of the landside facilities previously discussed for LBO is presented on **Exhibit 3D**.

SUMMARY

The intent of this chapter has been to outline the facilities required to meet potential aviation demands projected for LBO through the 20-year planning horizon. 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 five-year period, the intermediate term is approximately 10 years, and the long-term is 20 years. By using planning horizons, airport management can focus on demand indicators for initiating projects and grant requests rather than on specific dates in the future.

Runway 18-36 is designed to meet FAA design standards associated with RDC B-II-5000. This category includes most small- and medium-sized business jets, such as the Cessna Citation Sovereign, as well as most turboprop aircraft, including the Beechcraft King Air 300. The airport should be planned to meet RDC B-II-4000 design standards, allowing for the same group of aircraft to operate at the airport but with improved instrument visibility minimum approach capabilities.

Aircraft Storage Hangar Requirements



	Available	Short Term	Intermediate Term	Long Term
T-Hangar Area (sf)*	14,690	**25,000**	**27,000**	**29,000**
Conventional Hangar Area (sf)	49,960	**53,000**	**55,000**	**65,000**
Total Hangar Storage Area (sf)	64,650	**78,000**	**82,000**	**94,000**

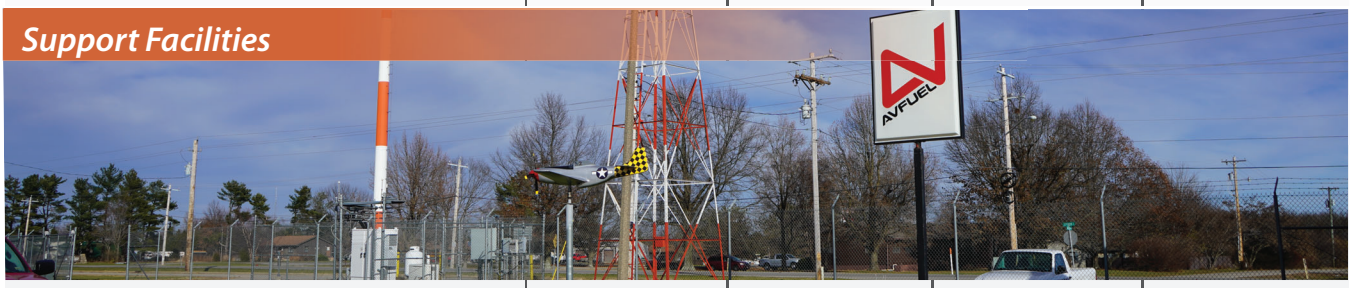
Aircraft Parking Apron

Local Apron Area (sy)		6,000	6,000	6,000
Transient Apron Area (sy)		3,800	3,800	3,800
Total Apron Area (sy)	19,300	9,800	9,800	9,800

General Aviation Terminal Facilities and Parking

Building Space (sf)	2,660	1,800	2,300	**2,700**
Total Parking Spaces (#)	26	**35**	**43**	**52**

Support Facilities



14-Day Fuel Storage, Jet A	12,000	2,786	3,234	3,766
14-Day Fuel Storage, AvGas (100LL)	12,000	1,204	1,204	1,232

*Includes FBO and Terminal spaces
Red numbers indicate a deficiency in meeting demand.

The existing runway has been adequately serving a wide range of aircraft fleet mix, including business jets. However, to accommodate larger and faster jets flying longer stage lengths, additional runway length is needed. Therefore, runway extension alternatives will be considered in the next chapter. Improvements to the runway strength will also be addressed. Taxiway geometry improvements will be considered to mitigate the potential for runway incursions to the greatest possible extent. The analysis in the next chapter will also address improvements to lighting and instrument approach capabilities at the airport.

On the landside, planning calculations show a need for expanding aircraft storage hangar capacity as more sophisticated aircraft (i.e., business jets, turboprops, and helicopters) base at the airport. Hangar space will largely depend on the needs of individual aircraft owners and developers and may not precisely follow the forecast. For example, if demand indicates a desire for additional T-hangars, then they should be the first priority. The availability of additional hangar space is a significant factor as to whether the airport will experience and can accommodate the forecast growth in based aircraft.

The next chapter will examine potential improvements to the airfield system and landside facilities. Several development alternatives will be presented that meet the needs outlined in this chapter. On the landside, several facility layouts that meet the forecast demands for the next 20 years will be presented. On the airside, several options for extending the runway and meeting more restrictive safety area design standards are presented.