Appendix C – Runway Justification Study

Ann Arbor Municipal Airport

Runway 6/24 Extension Justification Study

Prepared By:

Mead & Hunt

February 2021

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Table of Figures

Table of Tables

THIS PAGE INTENTIONALLY LEFT BLANK

1. Introduction

The Ann Arbor Municipal Airport (ARB or Airport) is considering an extension to its primary runway, Runway 6/24, to meet the takeoff and landing distance requirements of aircraft that currently operate at the Airport and have steadily increased operations in recent years. To determine the length of runway that is needed for existing and future aircraft, this justification study documents the types of aircraft that comprise this fleet and determines the length of runway that is needed for their operation. The intent of a runway length project is to provide sufficient runway length for the aircraft types regularly using the airport under prescribed conditions, including operating weight, takeoff on a hot day, and landing on a wet runway. With this determination, development options are evaluated to define the recommended plan to provide additional length on Runway 6/24. Several resources reviewed in the development of this study include:

- Federal Aviation Administration (FAA) Operations Network (OPSNET) database
- FAA Traffic Flow Management System Counts (TFMSC) database
- FAA Advisory Circular (AC) 150/5300-13A, *Airport Design*
- FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*
- Midwestern Regional Climate Center
- Aircraft manufacturer operating manuals
- Communication with ARB users
- Operational logs maintained by ARB staff

Identifying the fleet of aircraft types with similar characteristics that conduct at least 500 annual operations contributed to the determination of runway length needs presented in this study. This is a criterion necessary to seek federal funding eligibility towards a runway extension project. The following sections present information from the previously mentioned resources as it pertains to the calculation of runway infrastructure and the runway length requirements. Determinations made in this report require concurrence from the FAA for federal funding participation in implementing a runway extension project.

This runway extension justification study is organized by the following sections:

1. Introduction
2. Existing Conditions & Constraints
3. Operations and Users
4. Forecasts
5. Critical Aircraft Determination
6. Runway Length Determination
7. Alternatives
8. Summary / Recommendation

THIS PAGE INTENTIONALLY LEFT BLANK

2. Existing Conditions & Constraints

An understanding of the condition of existing infrastructure and surrounding constraints that limit development options is a part of the process to determine how to provide additional length on Runway 6/24. This section summarizes the existing conditions and constraints and is organized as follows:

2.1 Existing Infrastructure
2.2 Constraints Limiting Development

2.1 Existing Infrastructure

The airfield has an elevation of 839 feet above mean sea level (MSL). ARB's primary runway, Runway 6/24, is paved and has a length of 3,505 feet with a width of 75 feet. The surface of Runway 6/24 is grooved concrete and has a Pavement Condition Index (PCI) rating of 77. ARB also has a turf runway, Runway 12/30, that is 2,750 feet in length and 110 feet in width. This runway is used seasonally and is not utilized by jet aircraft. Taxiway A parallels Runway 6/24 and has connector taxiways A1, A2, and A3 to the north that provide access between the runway and the parallel taxiway. Connector taxiways B, C, and D provide access between the parallel taxiway and the main apron as well as numerous hangars located on the airfield. **Figure 2-1** presents the airfield configuration at ARB.

Figure 2-1: Existing Airfield Configuration

Source: Google Earth (2020)

The existing surface of Runway 6/24 has been well maintained with preventative maintenance. The Pavement Condition Index (PCI) of pavement surfaces is based on a 100-point scale with 100 assigned to pavements in excellent condition while pavements assigned a score of 10 or less are considered to be failed. The current PCI for Runway 6/24 is 75 as published by the Michigan Department of Transportation Office of Aeronautics (MDOT AERO) in 2017. Generally, it is recommended that primary runway pavement surfaces have a PCI of 70 or greater.

Runway 6/24 is equipped with Medium Intensity Runway Lighting (MIRL). The approach end of Runway 6 is equipped with a 4-light precision approach path indicator (PAPI), while the approach end of Runway 24 is equipped with a 2-box visual approach slope indicator (VASI). Both navigational aids are owned by ARB and assist aircraft with vertical guidance when landing. In addition to these navigational aids, Runway End Identifier Lights (REIL) at the approach end of Runway 6 and an Omnidirectional Approach Lighting System (ODALS) at the approach end of Runway 24, both owned by the FAA, are also at ARB. These navigational aids are the only two owned by the FAA. While the approach to Runway 24 is equipped with an ODAL, it is currently out of service and has been decommissioned awaiting removal. In addition to these navigational aids, both ends of the runway also have non-precision markings. ARB is also served by an airport traffic control tower (ATCT) that manages the landing and departure of aircraft.

2.2 Constraints Limiting Development

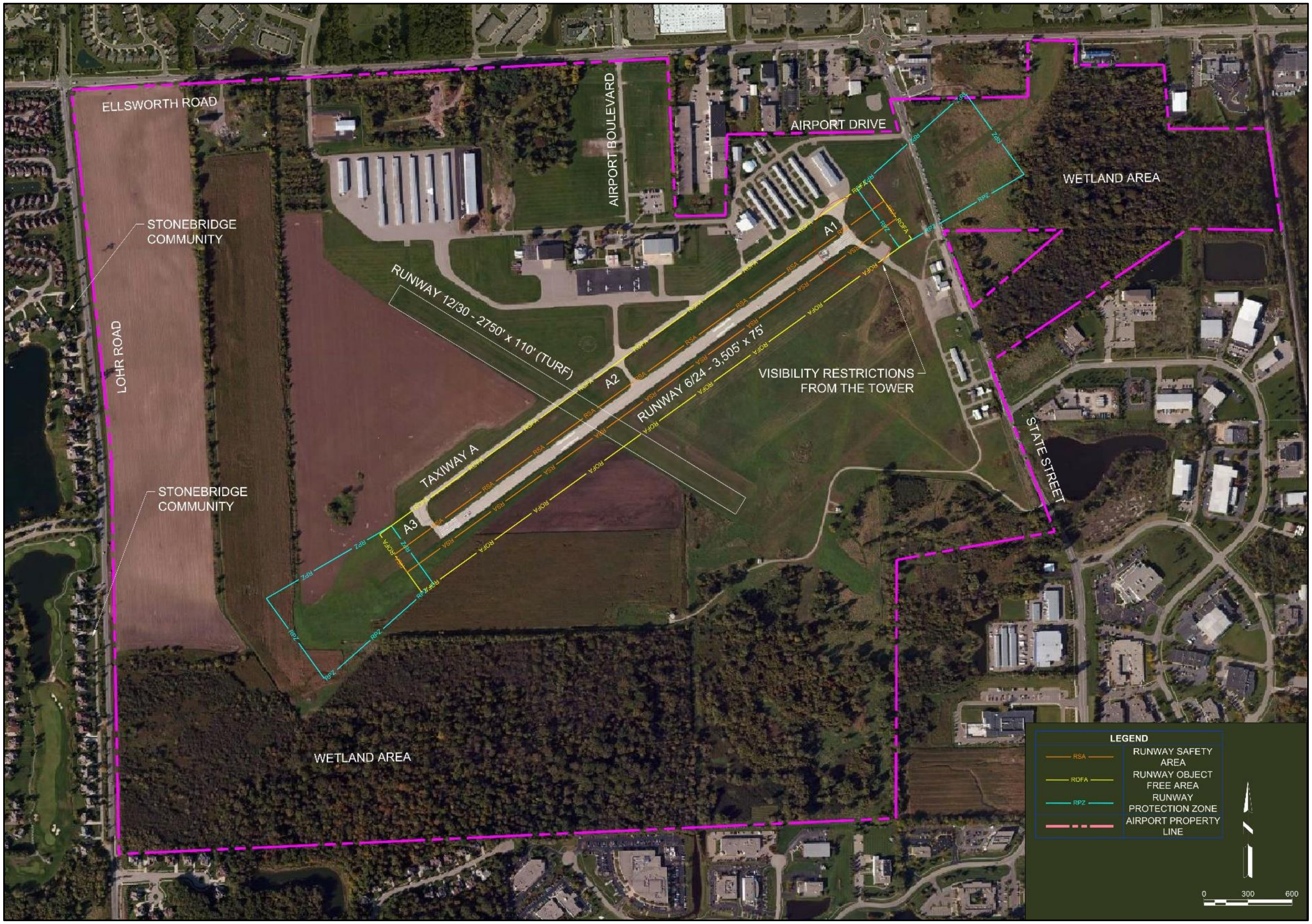
Constraints surrounding ARB limit options to provide additional runway length. These constraints not only limit the ability to extend the runway but also opportunities to change its orientation within the footprint of the existing property boundary to provide additional length. **Figure 2-2** illustrates the significant constraints surrounding ARB.

The location of State Street and its intersection with Airport Drive are limiting factors at the end of Runway 24. The proximity of W Ellsworth Road to the north and the location of businesses and the Pittsfield Township community center adjacent to this intersection create constraints. Options are limited to reroute State Street so that the runway could be extended in this direction. In addition, wetlands are also located off the end of Runway 24 east of State Street.

Hangars located north of Taxiway A limit the visibility from the ATCT adjacent to the main apron to the approach end of Runway 24 and its intersection with Taxiway A1 and Taxiway D. Any extension of the runway at the end of Runway 24 would increase the obstructed view from the ATCT. Any runway extension at the approach end of Runway 24 is not recommended due to these visibility concerns that could reduce safety.

While area is available at the end of Runway 6 for a runway extension, surrounding constraints limit how long of a length could be obtained. Primarily, Lohr Road to the west and the adjacent Stonebridge neighborhoods limit how far the runway can be extended due to runway design surfaces and approach slope height clearance requirements. Likewise, a wetland area located south of the approach end of Runway 6 limits options to change the orientation of the runway to provide additional length.

Figure 2-2: Constraints Limiting Development



Source: Mead & Hunt, Inc. (2020)

THIS PAGE INTENTIONALLY LEFT BLANK

3. Operations and Users

This section presents information on the level of aircraft activity, types of aviation users, and weather conditions that are experienced at ARB. This information is presented to establish a baseline in understanding if there is demand for additional runway length. Understanding that at least 500 annual operations must be conducted by aircraft types that require additional runway length, this section will guide the aviation forecasting efforts and runway length analysis determinations to focus on those aircraft types with demanding runway length needs.

3.1 Existing Airport Operations

Existing aircraft operations are evaluated at ARB using multiple data sources. No one data source captures all aircraft operations. To best understand the activity level at ARB, data from three data sources were reviewed and are summarized in the following sections:

- 3.1.1 Tower Operational Counts
- 3.1.2 Terminal Area Forecast
- 3.1.3 Traffic Flow Management System Counts
- 3.1.4 Summary

3.1.1 Tower Operational Counts – Information from the FAA's OPSNET database provides actual observations from the ATCT which includes both itinerant and local operations. Local operations are defined as operations by an aircraft that operates in the local traffic pattern or within sight of the airport as well as departing for, or arriving from, local practice areas located within a 20-mile radius of the airport. Itinerant operations are defined as all other aircraft operations and are comprised mostly of flights between two different airports. As noted previously, the OPSNET database only accounts for operations that occurred when the ATCT is open between 8 AM and 8 PM. **Table 3-1** presents the total number of airport operations categorized by itinerant and local flights between 2009 and 2019. OPSNET data indicates a fluctuation in traffic over the 10-year period with a low of 56,915 operations conducted in 2015 and a high of 76,430 annual operations in 2019. OPSNET does not differentiate by aircraft type but is useful to understand aggregate operational trends.

Table 3-1: 2019 Tower Operations Counts

Year	Itinerant	Local	TOTAL
2009	21,593	35,516	57,109
2010	21,363	42,636	63,999
2011	21,333	35,895	57,228
2012	23,815	39,740	63,555
2013	22,541	35,205	57,746
2014	22,316	35,054	57,370
2015	22,944	33,971	56,915
2016	24,404	33,982	58,386
2017	24,845	37,121	61,966
2018	24,808	38,295	63,103
2019	28,754	47,676	76,430

Source: FAA OPSNET database (2019)

3.1.2 Terminal Area Forecast – **Table 3-2** presents the operational information that was collected from the FAA's Terminal Area Forecast (TAF) database which is based on historical activity levels from ATCT records. As indicated in the table, an estimate of 72,738 annual operations occurred at ARB in federal fiscal year 2019.

Table 3-2: 2019 Operations – Terminal Area Forecast

Itinerant	Local	TOTAL
27,727	45,011	72,738

Source: FAA TAF (Federal Fiscal Year 2019)

3.1.3 Traffic Flow Management System Counts – The FAA's Traffic Flow Management System Counts (TFMSC) database records flights 24/7 that filed a flight plan and operated under Instrument Flight Rule (IFR) procedures, regardless of whether the ATCT is open or closed. Flights conducted under Visual Flight Rules (VFR) are not captured in this database. **Table 3-3** presents the total number of IFR operations that were recorded at ARB in the TFMSC database in 2019. A total of 4,649 IFR operations occurred at ARB in 2019. **Appendix A** presents a complete listing of operations from the TFMSC database by aircraft types which is summarized and discussed in greater detail as a part of the aviation activity forecasts presented later in this document.

Table 3-3: 2019 Instrument Flight Rules Operations

Departures	Arrivals	Total Operations
2,316	2,333	4,649

Sources: FAA TFMSC database (2019)

3.1.4 Summary – A single data source is not available that provides information on the total number of aircraft operations that occur over a 24-hour period at ARB; thus, resources such as ATCT operational counts, FAA TAF, and TFMSC operational data must be reviewed separately to gain a collective overview of aviation activity at ARB. The ATCT operational counts provide an indication of activity during the busiest part of the day when the ATCT is open between 8 AM and 8 PM, but it does not provide information on aircraft activity that occurs between 8 PM and 8 AM. Finally, the TFMSC database records activity that has occurred regardless of time of day when an aircraft operates under IFR; however, this information does not count activity that has occurred when aircraft are operating under VFR. Combined, these data sources indicate that ARB is an active airport with sufficient operational activity where further evaluation of operations by groupings of aircraft types is needed to determine runway length demands.

3.2 Aircraft Operators

To further analyze the operational data to determine runway length needs, an understanding is needed of the types of aircraft users operating at ARB. The following sections summarize the primary users of aircraft at ARB:

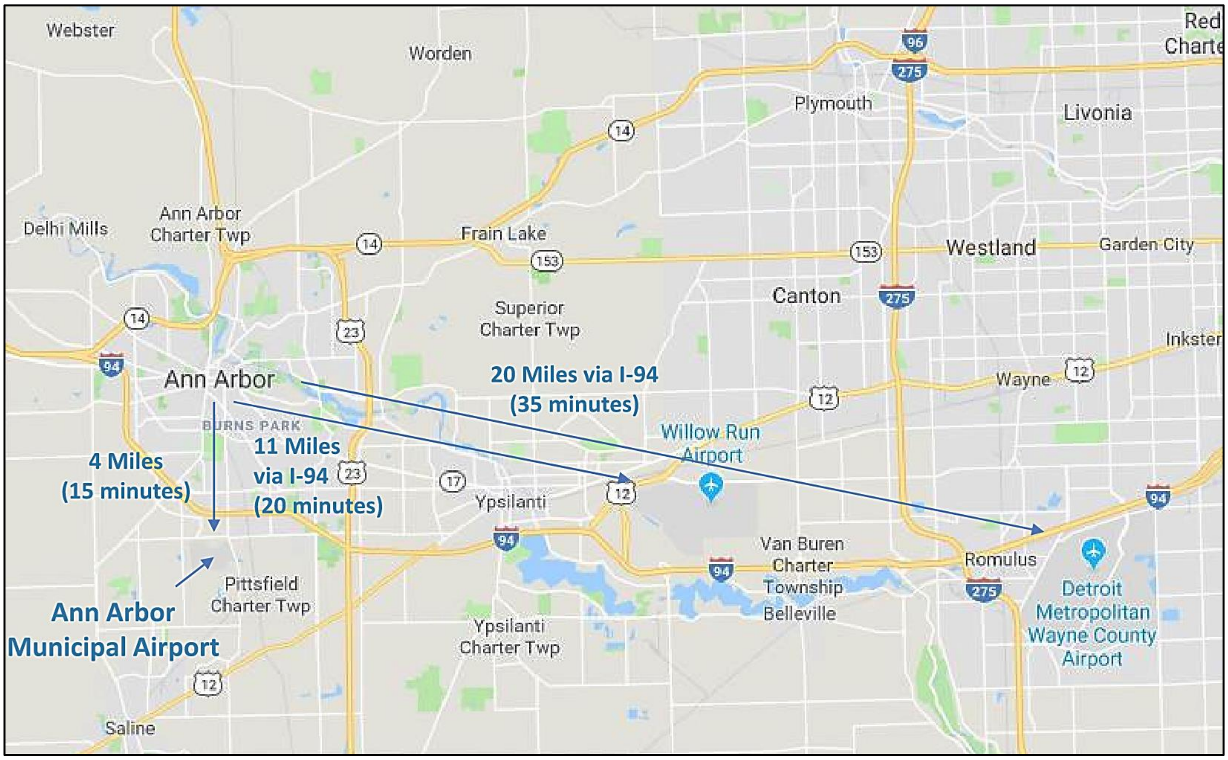
- 3.2.1 Geographic Considerations
- 3.2.2 Tenant Based Jet Operations
- 3.2.3 Special Event Weekends
- 3.2.4 Business Jet Activity Destined for Ann Arbor
- 3.2.5 Based Turboprop Operations
- 3.2.6 Recreational General Aviation Users
- 3.2.7 Summary of Additional User Considerations

3.2.1 Geographic Considerations – While design of the airfield, condition of infrastructure, and available support services are also important considerations, the following geographic considerations also influence why aircraft operators use ARB when visiting the Ann Arbor area.

Downtown Ann Arbor and the surrounding area is home to many prominent businesses and institutions with the University of Michigan being the area’s largest employer. Manufacturing, health care, automotive, information technology, and biomedical research companies account for major employers in the surrounding area. With these technological-driven industries, there is often a need for air transportation to bring workers, clients, suppliers, customers, and time sensitive parts/suppliers to and from the region. These businesses operate a combination of turboprop driven and business jet aircraft.

Currently, Willow Run Airport (YIP) or Detroit Metropolitan Wayne County Airport (DTW) are popular options for businesses in the region that demand use of aviation. This requires travel distances of approximately 11 miles (30 minutes) and 20 miles (40 minutes), respectively, via Interstate 94 (I-94) to reach these airports from downtown Ann Arbor (**Figure 3-1**). However, ARB is located only 4 miles (20 minutes) south of downtown Ann Arbor and can be quickly accessed by businesses in the community desiring efficient access to the air transportation system.

Figure 3-1: Airport Locations in Relation to Ann Arbor Area



Source: Google Earth (2019)

It is logical to assume that some aircraft used by businesses in the community that are based at other nearby airports due to the existing length of Runway 6/24, may shift to ARB if additional runway length were provided, helping to justify its demand. Given the approximate 4-mile distance from downtown Ann Arbor, businesses and visitors to the Ann Arbor community would likely consider operating out of ARB instead of traveling to YIP or DTW if able to do so. The 20- and 35- minute drive times it can take to reach YIP and DTW from downtown Ann Arbor increases when congested traffic conditions are present. As a result, it is reasonable to assume that operations at ARB will increase if Runway 6/24 were extended.

3.2.2 Tenant Based Jet Operations – AvFuel, a global supplier of aviation fuel and services headquartered in Ann Arbor, operates the only jet based at ARB, a Cessna Citation 560XL. This aircraft can seat up to 10 passengers and is used by AvFuel to conduct business between their Fixed Base Operator (FBO) facilities and fueling partners across North America and around the world. An outreach effort with AvFuel conducted as a part of this study confirmed existing and future use by this aircraft. AvFuel indicates, in a letter of support (**Appendix B**), that they plan to continue to conduct operations at Ann Arbor into the future.

AvFuel also operates a Falcon 2000 jet that is based at YIP. While there have not been any commitments by AvFuel to base this jet at ARB, this aircraft could conduct operations at ARB after the runway is extended. Operations by this aircraft are not anticipated to exceed 500 annually that would influence the critical design aircraft determination or recommended runway length; rather, the aircraft may occasionally operate at ARB when trip distance/payload and environmental conditions such as wind speed / direction, runway surface condition, and visibility / ceiling favor its use. Accordingly, occasional use of the Falcon 2000 is incorporated into the forecast. However, consistent use of this aircraft at ARB is unlikely because infrastructure at YIP such as longer runway length and adequately sized hangar facilities better supports the operational and user demands of this aircraft.

AvFuel also indicates in their letter of support that most flights departing ARB require concessions to fuel and/or passenger loads with a stop for fuel before reaching their intended destination due to runway length limitations at ARB. When Runway 6/24 is contaminated with snow and ice, AvFuel often needs to divert to another airport which delays or cancels flight plans until pavement surface conditions at ARB improve since braking distance is reduced when water, snow, or ice is present.

3.2.3 Special Event Weekends - University of Michigan (U of M) home football games generate a substantial amount of aircraft traffic to and from the Ann Arbor area. When U of M has a home football game, airports in the region experience a significant increase in operations. It is likely that some of these aircraft would shift operations to ARB on football weekends if the runway length were extended.

Likewise, Michigan International Speedway (MIS) located 27 miles southwest of ARB hosts two (2) National Association for Stock Car Auto Racing (NASCAR) events each year with each event attracting upwards of 56,000 spectators. As a result of the two events, airports in the Southeast Michigan region see an increase in aircraft activity associated with the transport of drivers, team crews, team owners, fans, and officials to and from the race. Jackson County Airport – Reynolds Field in Jackson (JXN), Lenawee County Airport in Adrian (ADG), and YIP are airports in the vicinity that also see an increase in activity. If the length of Runway 6/24 were extended, it is likely that ARB would also see an increase in activity on these weekends.

U of M football weekends and NASCAR races at MIS are two examples of increased aircraft activity that airports in the region experience due to special events. They suggest that should Runway 6/24 be extended additional aircraft activity could occur at ARB due to its proximity to special event venues surrounding the Ann Arbor area.

3.2.4 Business Aircraft Activity Destined for Ann Arbor – There is also a significant amount of aviation activity that occurs daily at other airports in the region for business activity destined for the Ann Arbor area. Since this study did not include user surveys, it is difficult to accurately determine the amount of traffic at ARB and other airports that is destined for Ann Arbor businesses. Businesses using aircraft to travel to the Ann Arbor area typically operate turboprop aircraft as well as small-, and medium-sized business jet aircraft. Additional information about existing and anticipated activity levels by these aircraft is presented in the next section as a part of the projections of aviation demand.

3.2.5 Based Turboprop Operators – ARB currently has operators of turboprop aircraft based on the airfield that consist of a variety of single- and twin-propeller driven types. These based operators use turboprop aircraft for both business reasons and recreational flying. Currently, the existing length of Runway 6/24 is adequate for some turboprop aircraft in ideal conditions (dry, cool days); however, when water, snow, and ice is present on the runway, increased braking distances associated with these conditions can cause the operators of these aircraft to delay or cancel their flights. Additional runway length would better accommodate the operational demands of these users so ARB can provide more efficient access to the air transportation system in all weather conditions.

3.2.6 Recreational General Aviation Users – Finally, the last classification of aircraft operators at ARB are recreational general aviation (GA) users that fly smaller aircraft types for leisure flying purposes. The aircraft used by this classification of operators are generally small single- to twin-engine propeller driven types that seat between 1 to 6 persons. These aircraft are not only used for recreational flying, but also for flight training that is available at ARB. ARB has 4 flight schools and has frequent flight training activity daily. While the runway length demands of these aircraft are the least demanding, additional runway length would be beneficial to increase the margin of safety for flight training activities. While the operational demands of aircraft used by this classification of flyers is not a focal point in determining the need for additional runway length, it is important to note their activity when understanding existing airport activity and projecting future demand.

3.2.7 Summary of Aircraft Operators – While the existing length of Runway 6/24 satisfies some of the operational demands of aircraft operating at ARB, other based and itinerant users that operate turboprop and business jet aircraft types generally have more demanding runway length needs particularly during hot days or when landing on a wet runway. These types of aircraft are already conducting operations at ARB and during certain conditions often require concessions to fuel and passenger loads to conduct operations within the parameters of the existing length of Runway 6/24. Should the length of Runway 6/24 be extended, turboprop, small-, and medium-sized jet aircraft would not be required to regularly make concessions to fuel and passenger loads to operate at ARB. Additional information about these aircraft types, the frequency of operations, and their runway length demands are discussed later in this report.

3.3 Weather

Local weather conditions can play a significant factor in the length of runway needed for an aircraft to depart and land. The direction and velocity of local winds can factor into landing and takeoff distances needed. The temperature can also play a factor in aircraft operation; as the temperature rises, the need for additional length of runway increases. The FAA considers specific weather impacts when determining runway length needed for federal funding eligibility purposes (i.e., takeoff distance on the mean max hot day, and landing distance on a wet runway). Not considered for infrastructure development purposes is the presence of water, snow, and ice on a runway surface affects braking action distances as well as, to a lesser degree, acceleration during takeoff. Inclusion of this information in the study is for informational purposes since it contributed to the understanding of the aircraft operational requirements, even if not included in the runway length calculations per AC 150/5325-4B. The following sections summarize weather conditions that can affect the demand for runway length at ARB. **Appendix C** presents the annual weather statistics summarized in this chapter.

3.3.1 Precipitation – When a runway surface has ice, snow, or rain on it, the runway is said to be contaminated, and concessions are often made by aircraft to operate on its surface to maintain safe operations, influencing braking and accelerating distances. Data from the Midwestern Regional Climate Center (MRCC) indicates ARB receives an average of 28.81 inches of precipitation each year that occurred over an average of 192 days of the year. This demonstrates that, on average, over half the days of each year there is some form of contamination on the runway affecting braking and accelerating distances.

3.3.2 Temperature – When temperatures are freezing (below 32 degrees Fahrenheit), present on average 147 days each year at ARB according to weather data from the MRCC, any contamination turns to snow and/or ice, which further increases braking and accelerating distances. With the frequency ARB experiences freezing temperatures, the need for additional runway length when aircraft brake during landing or accelerate during takeoff is useful for reliable aircraft operations.

Likewise, when temperatures are warm, increased runway length is needed for aircraft to takeoff due to the air being less dense. Between 2010 and 2018, the warmest month, July, averaged a high temperature of 84.6 degrees Fahrenheit at ARB according to weather data from the MRCC. On average, 81 days were experienced when the temperature was 80 degrees or greater. The frequency of these warmer temperatures indicates that planning for runway length needs should consider increased distances for aircraft to take off and land at ARB for warmer temperatures.

3.3.3 Weather Summary – The weather data indicates that aircraft frequently operate in inclement weather conditions at ARB. Often, pilots will adjust for takeoff and/or landing distances when water, snow, and ice are present. A typical method of doing this is reducing the takeoff weights of aircraft by decreasing fuel, passenger, and/or cargo loads. The pilot may also delay or cancel flights until weather conditions improve. Ultimately, aircraft operators can be impacted if adequate runway length is not available given local weather conditions. With an average of 81 days when warm conditions are present, and 147 days where below freezing temperatures are present, a total of 228 days each year on average, weather increases the runway length needed for aircraft types operating at ARB.

228 days of the year, weather factors into additional runway length needed for aircraft types operating at ARB.

THIS PAGE INTENTIONALLY LEFT BLANK

4. Forecasts

This section contains aviation activity forecasts for ARB over a 20-year planning horizon. Activity forecasts are based on 2019 operational data, as this was the most recent calendar year in which a full 12 months of historical data was available at the time the forecasts were prepared. Since the preparation of the forecasts, impacts due to the COVID-19 pandemic have caused significant disruptions to the economy and the aviation industry. The potential impacts of COVID-19 as it pertains to these forecasts are presented at the conclusion of this section.

Aviation demand forecasts are an important step in the planning process. Ultimately, they form the basis for future demand-driven improvements at ARB, provide data from which to estimate future off-airport impacts, such as noise, and are incorporated by reference into other studies and policy decisions. The forecast is based on the activity of the types of users that currently operate at ARB; included in the growth rate is incremental additional use of a possible extended runway, but no substantive inducement of additional traffic is expected. **Appendix D** presents the complete forecasts prepared for ARB including based aircraft, air taxi & itinerant/local general aviation operations, military operations, instrument operations, and fleet mix projections.

The projections of operations by fleet mix contributes to the determination of the critical aircraft for Runway 6/24. For this summary, it is assumed that all jet operations are conducted as instrument operations with an IFR flight plan. **Table 4-1** summarizes the number of instrument operations conducted in 2019 by physical class and weight class, as defined by the TFMSC database, and notes the most prevalent aircraft types that conduct operations within each classification.

The most prevalent aircraft types to operate at ARB are single- and twin-engine propeller driven turboprop aircraft types. These aircraft are not large enough to provide air carrier services but are a convenient option for businesses looking for a more efficient way to conduct air travel for business needs. Business jet aircraft are also operated by some of the users at ARB.

The following is a list of example aircraft from these categories that conduct operations at ARB:

Examples of turboprop business aircraft include:

- PC12 - Pilatus PC-12
- BE20/B350 - Beech King Air and Super King Air 350
- TBM8 - Socata TBM-850

Examples of business jets aircraft include:

- C550 - Cessna Citation II/Bravo
- C510 - Cessna Citation Mustang
- E55P - Embraer Phenom 300

- C56X - Cessna Citation Excel XLS
- C680 - Cessna Citation Sovereign
- C525 - Cessna Citation CJ1

Assuming this fleet mix for instrument operations remains relatively constant throughout the planning period, and utilizing the forecasted number of instrument operations, the projected number of operations by classification is presented in Table 4-1. As shown, total operations are forecasted to increase from 4,649 in 2019 to 5,972 in 2039. The projected number of operations is based on a socio-economic growth rate methodology using employment as the forecasting variable. This was selected as the preferred forecasting methodology because the projected compounded annual growth rate (CAGR) of 1.29 percent (1.29%) most closely matches the modest growth in air taxi and itinerant GA operations projected by the FAA over the next 20 years. Additional information about the forecasts and selection of the preferred methodology is presented in Appendix D.

Table 4-1: IFR Fleet Mix

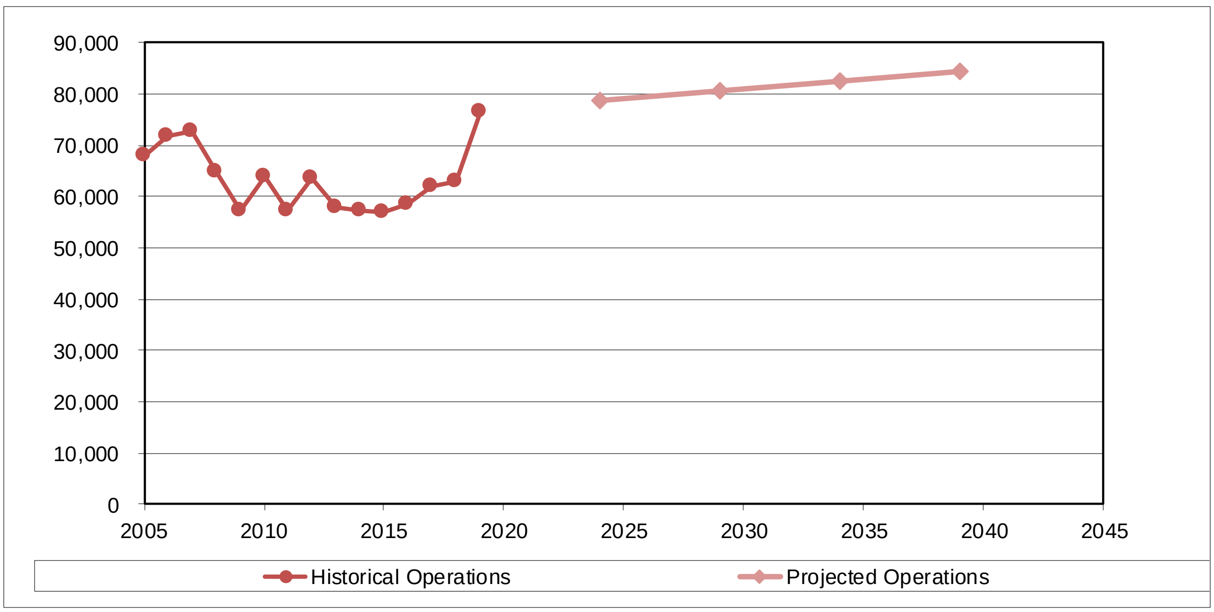
Physical Class	Representative Types	2019 Ops	%	Forecast Operations			
				2024	2029	2034	2039
Jet	C56X (Cessna Excel/XLS), C680 (Citation Sovereign), PC24 (Pilatus)	263	5.7%	283	302	321	338
Jet	E55P (Phenom 300), C25C (Cessna CJ4)	97	2.1%	104	112	118	125
	Subtotal Jets	**360**	**7.7%**	**387**	**414**	**439**	**462**
Turbine	TBM8 (TBM 850), TBM9 (TBM)	150	3.2%	161	172	183	193
Turbine	PC12 (Pilatus), B350 (Beech), P46T (Piper Meridian), C208 (Cessna Caravan)	966	20.8%	1,040	1,111	1,178	1,241
	Subtotal Turbine	**1,116**	**24.0%**	**1,201**	**1,283**	**1,361**	**1,434**
Piston	C172/182 (Cessna), PA32 (Piper Cherokee), SR22 (Cirrus)	3,049	65.6%	3,282	3,506	3,719	3,917
	Subtotal Piston	**3,049**	**65.6%**	**3,282**	**3,506**	**3,719**	**3,917**
Other	Helicopters, Unclassified	124	2.7%	133	143	151	159
	Subtotal Other	**124**	**2.7%**	**133**	**143**	**151**	**159**
	Total IFR Itinerant Ops	**4,649**		**5,004**	**5,346**	**5,671**	**5,972**

Source: 2019 Instrument Operations - FAA TFMSC, Mead & Hunt
Projections - Mead & Hunt, Inc.

A summary of the forecasts is presented in **Table 4-2**. These figures illustrate that there is anticipated growth in aircraft activity over the planning period with total operations expected to increase from the 2019 level of 76,428 to 84,336 in 2039.

Table 4-2: Projections Summary

Year	Itinerant Operations: Air Taxi	Itinerant Operations: General Aviation	Itinerant Operations: Military	Local Operations: General Aviation	Local Operations: Military	Total Operations	Based Aircraft
Historical							
2005	2,105	24,942	17	40,871	5	67,940	164
2006	2,082	26,530	263	42,910	0	71,785	148
2007	1,876	25,483	243	45,251	0	72,853	148
2008	1,198	22,677	42	40,991	2	64,910	136
2009	376	21,195	22	35,508	8	57,109	141
2010	208	21,102	33	42,629	7	63,979	129
2011	272	21,016	36	35,893	2	57,219	129
2012	474	23,285	51	39,737	3	63,550	168
2013	556	21,943	40	35,202	3	57,744	175
2014	524	21,728	57	35,051	3	57,363	176
2015	524	22,373	47	33,953	18	56,915	182
2016	568	23,761	72	33,933	49	58,383	188
2017	564	24,213	68	37,112	9	61,966	178
2018	570	24,196	41	38,264	31	63,102	164
2019	550	28,126	76	47,653	23	76,428	164
Projected							
2024	596	30,465	76	47,494	23	78,654	163
2029	636	32,547	76	47,264	23	80,546	163
2034	675	34,524	76	47,123	23	82,421	162
2039	711	36,357	76	47,168	23	84,336	162
CAGR (2019-2039)	*1.29%*	*1.29%*	*0.00%*	*-0.05%*	*0.00%*	*0.49%*	*-0.05%*



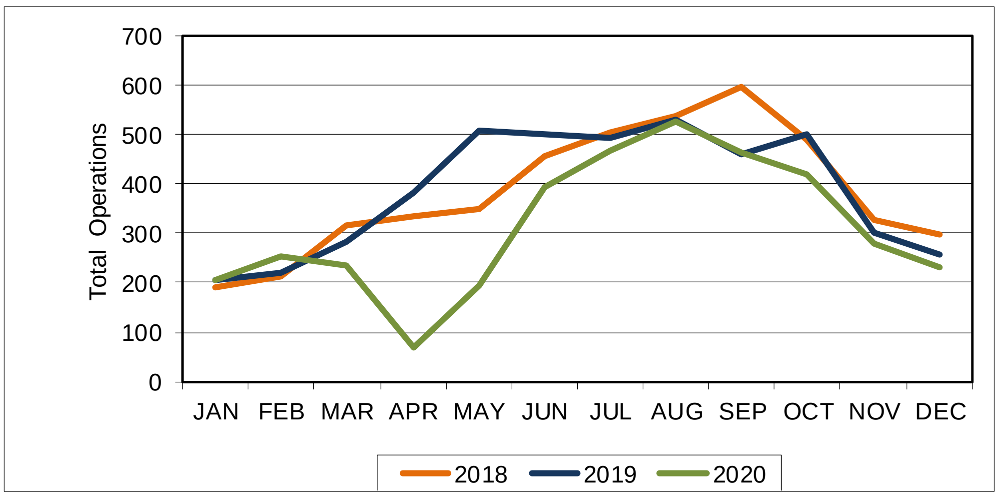
Source: Historical Operations - FAA OPSNET
Historical Based Aircraft - FAA TAF
Projections - Mead & Hunt, Inc.

4.1 Impacts of COVID-19 on Forecasts

The economy of the United States and the aviation industry had a near complete shutdown in April 2020 due to the COVID-19 pandemic. **Table 4-3** presents ARB's monthly number of IFR operations for 2018, 2019, and 2020. IFR operations were reviewed as they align with itinerant Turboprop and Jet activity which is the reason for this runway extension study. Total IFR operations at ARB fell to a low of 69 in April 2020. Since that time IFR aircraft operations at ARB have begun a quick recovery.

Table 4-3: Monthly IFR Operations 2018 - 2020

	Total IFR Operations		
Month	2018	2019	2020
JAN	190	207	204
FEB	211	219	252
MAR	315	283	236
APR	334	382	69
MAY	351	510	194
JUN	457	502	395
JUL	504	494	468
AUG	539	530	528
SEP	599	459	464
OCT	489	502	420
NOV	328	303	279
DEC	297	258	230



Source: Historical IFR Operations - FAA TFMSC

As shown in the table above, total monthly IFR operations at ARB have rebounded quickly and nearly matched the totals from 2018 and 2019. Therefore, it is anticipated that IFR operations will have fully recovered to pre-COVID levels at ARB in 2021. Review of this recovery data and various industry recovery scenarios, it is projected that forecasts presented in Table 4-2 may be delayed approximately 1-year (i.e., 2024 forecast year likely delayed to 2025, etc.).

5. Critical Aircraft Determination

FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, states that the critical aircraft for an airport may be a single type of aircraft or a grouping of types of aircraft with similar characteristics that conducts at least 500 annual operations at an airport. To determine the critical aircraft for ARB, aircraft types that have historically conducted operations at ARB as well as those projected to conduct operations in the future was reviewed. TFMSC data from **Appendix A**, summarized by groupings of aircraft types presented in **Table 5-1**, indicates that the Airport Reference Code (ARC) classification of B-II aircraft types are the most demanding grouping that currently conduct greater than 500 annual operations. Thus, this determines that the existing and future critical aircraft for the design of Runway 6/24 is B-II. This is relevant to the assessment of standards applicable to the design of Runway 6/24 for safe and efficient aircraft operations. Runway length calculations, however, have a distinct methodology that is based on aircraft performance using the design concepts in AC 150/5325-4B, as described in Section 6.3.

Table 5-1: 2019 Instrument Flight Rules Operations by Airport Reference Code Classification

ARC Classification	Annual Operations
A-I	3,178
A-II	315
B-I	340
B-II	679
Helicopter	106
Unknown	31
TOTAL	**4,649**

Source: FAA TFMSC database (2019)

Table 5-2 summarizes the fleet mix projections at ARB. These fleet mix projections are based on existing users of ARB. The projections of activity are separated by the physical groupings of aircraft types according to the TFMSC database, which is based on the type of engine. A representative aircraft type and representative ARC classification for each grouping of aircraft is also presented.

Table 5-2: Future Demand Projections by ARC Classification

TFMSC Physical Class	Representative Aircraft	Representative ARC	IFR Ops 2019	Forecast IFR Operations			
				2023	2028	2033	2038
Jet	C56X - Excel XLS	B-II	263	283	302	321	338
Jet	E55P - Phenom 300	B-II	97	104	112	118	125
		Subtotal Jets	**360**	**387**	**414**	**439**	**462**
Turbine	TBM8 - TBM-850	A-I	150	161	172	183	193
Turbine	BE20/B350 - King Air	B-II	966	1,040	1,111	1,178	1,241
		Subtotal Turbine	**1,116**	**1,201**	**1,283**	**1,361**	**1,434**
Piston	C172 - Cessna 172	A-I	2,876	3,016	3,225	3,427	3,613
		Subtotal Piston	**2,876**	**3,106**	**3,225**	**3,427**	**3,613**
Other	EC55 - EC-155	n/a	67	70	75	80	84
		Subtotal Other	**67**	**70**	**75**	**80**	**84**

Source: FAA TFMSC database (2019)
Projections: Mead & Hunt, Inc. (2020)

As shown in Table 5-2, the ARC grouping of B-II aircraft types comprises both jet and turboprop aircraft types. Jet and turboprop aircraft each have distinct and varying runway length needs due to the varying performance of these aircraft types. Jet aircraft typically have a greater demand for runway length than turboprop types; however, B-II turboprop aircraft types have more demanding runway length needs than compared to piston-powered airplanes.

Thus, it is logical to plan that the design of Runway 6/24 should meet B-II standards and provide a runway length that can accommodate, in whole or part, both turboprop and jet B-II aircraft are the critical aircraft for Runway 6/24. This approach has been presented to the FAA and deemed a viable methodology for analysis, as outlined in the next section.

6. Runway Length Determination

This section documents the rationale used to determine the length of Runway 6/24 for the similar characteristics grouping of turboprop and jet aircraft types at ARB. The runway length needed for an aircraft is based on the performance requirements of an aircraft's intended, regularly occurring operation. The length of runway needed varies even for the same type of aircraft based on the conditions occurring at the time of flight. Thus, a specific set of prescribed, demanding conditions were used according to FAA guidance to evaluate runway length needs at airports, including ARB. Specifically, the methods and criteria from FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, and FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design* were used for this analysis. Factors such as takeoff weight, airfield elevation, and the mean maximum daily temperature of the warmest month contribute to the length of runway needed for these aircraft types under the specific conditions prescribed in AC 150/5325-4B. Runway condition is assumed to be dry for takeoff and wet for landing. Clearance over obstacles were not considered in the takeoff evaluation since standard IFR takeoff minima are in use at ARB. Since turboprop and business jets have separate performance characteristics the runway length needs of each are calculated separately.

6.1 Runway Length Requirements for Turboprop Aircraft

First, FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, was referenced for determining the runway length needed for turboprop aircraft. This advisory circular directs use of Figure 2-2, within the AC, to determine the runway length needed for small turboprop aircraft. This was selected to determine the recommended length of Runway 6/24 because it best represents the runway length needs of the classification of small turboprop aircraft.

The following provides in greater detail the rationale for use of Figure 2-2 from FAA AC 150/5325-4B, to determine the runway length needs of the critical aircraft type for Runway 6/24.

- **Intended Use of Figure 2-2 from AC 150/5325-4B** – Figure 2-2 from AC 150/5325-4B is used to determine the runway length needs of small turboprop aircraft types. Small, in this context, refers to aircraft with a MTOW of 12,500 pounds or less. These aircraft are often business types used by operators certified under 14 Code of Federal Regulations (CFR) Part 135 to transport passengers and cargo.

  FAA AC 150/5325-4B indicates in paragraph 202, Design Approach, under Chapter 2, that Figure 2-2 specifically includes runway length need performance for small *turboprop* aircraft. Turboprop aircraft comprised most of the ARC grouping of B-II aircraft that were found to regularly conduct operations at ARB. Turboprop aircraft types are also listed as "Representative Airplanes" as presented in Figure 2-2 of FAA AC 150/5325-4B. Thus, this was also a factor in the use of Figure 2-2 from FAA AC 150/5325-4B to determine runway length needs.

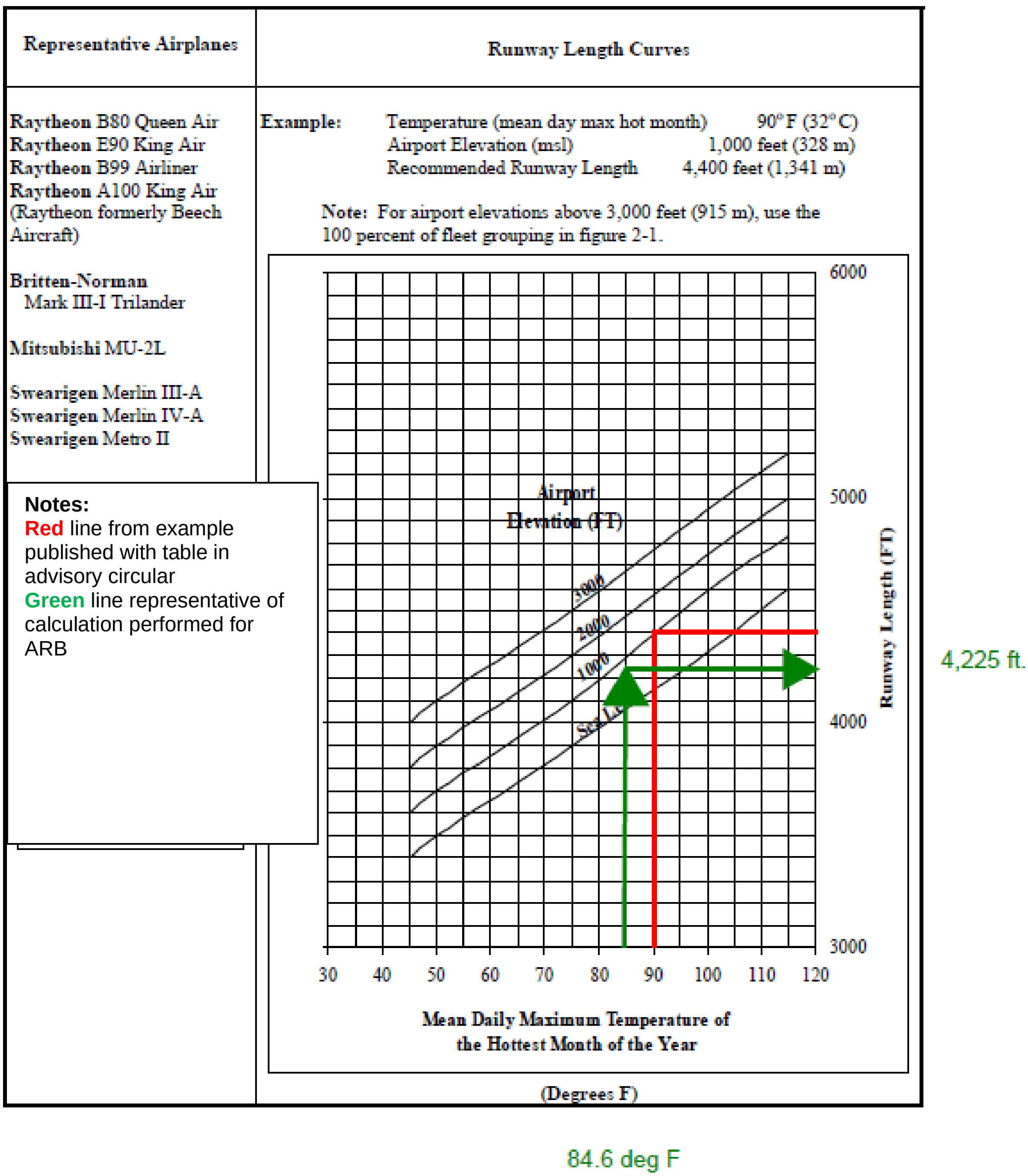
  In addition, 14 CFR Part 135 requires that aircraft operating under this regulation to factor in an accelerate-stop distance on takeoff. Paragraph 206 of AC 150/5325-4B identifies that the runway length curves presented in Figure 2-2 includes the accelerate-stop distance parameter in determining the runway length needs of small turboprop powered aircraft. . The need to calculate accelerate-stop distance as a part of a takeoff distance calculation (as solved with a balanced field length) is a requirement for Part 135 operators with 10 or more seats under paragraph §135.169.

Figure 6-1 replicates Figure 2-2 from AC 150/5325-4B, which for the reasons identified above is the appropriate technical reference to use for calculating runway length needs for small turboprop aircraft. At a temperature of 84.6 degrees Fahrenheit, which is the mean maximum daily temperature of the warmest month (July) at ARB according to the 2010-2018 MRCC records, **4,225 feet of runway length is recommended length for small turboprop aircraft operating at ARB.**

Figure 6-1: Runway Length Determination for Small Aircraft with 10 or More Passenger Seats

AC 150/5325-4B 7/1/2005

Figure 2-2. Small Airplanes Having 10 or More Passenger Seats
(Excludes Pilot and Co-pilot)



Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design* (Figure 2-2).

6.2 Runway Length Requirements for Business Jet Aircraft

Jet aircraft types operating at ARB have a MTOW of more than 12,500 pounds, but not greater than 60,000 pounds. For this scenario, FAA AC 150/5325-4B provides a performance curve in Chapter 3 of the AC to determine the length of runway needed. The performance curve presented in the AC is based on FAA-approved airplane flight manuals in accordance with the provisions of 14 Code of Federal Regulations (CFR) Part 25, *Airworthiness Standards: Transport Category Airplanes*, and Part 91, *General Operating and Flight Rules*.

Two series of performance curves are provided to determine the runway length needed, each focused on separate groupings of aircraft sizes and anticipated takeoff weight (as a function of useful load). **Table 6-1** presents the grouping of aircraft types that comprise 75 percent of the business jet fleet with a MTOW under 60,000 pounds; that is, the business jets that require less than 5,000 feet of runway length during standard day conditions at sea level. Moreover, several of the aircraft that were recorded as conducting operations at ARB are represented in groups or highlighted in green. Thus, it is logical to apply this performance chart to determine the runway length needs for jet aircraft types operating at ARB.

Table 6-1: Airplanes That Make Up 75 Percent of the 12,500 lbs. to 60,000 lbs. MTOW Fleet

Manufacturer	Model	Manufacturer	Model
Aerospatiale	SN-601 Corvette	Dassault	Falcon 10
Bae	125-700	Dassault	Falcon 20
Beechjet	400A	Dassault	Falcon 50/50 EX
Beechjet	Premier I	Dassault	Falcon 900/900B
Beechjet	2000 Starship	IAI	Jet Commander 1121
Bombardier	Challenger 300	IAI	Westwind 1123/1124
Cessna	500 Citation/501 Citation SP	Learjet	20 Series
Cessna	Citation I/II/III	Learjet	31/31A/31A ER
Cessna	525A Citation II (CJ-2)	Learjet	35/35A/36/36A
Cessna	550 Citation Bravo	Learjet	40/45
Cessna	550 Citation II	Mitsubishi	MU-300 Diamond
Cessna	551 Citation II/Special	Raytheon	390 Premier
Cessna	552 Citation	Raytheon Hawker	400/400 XP
Cessna	560 Citation Encore	Raytheon Hawker	600
Cessna	560/560 XL Citation Excel	Sabreliner	40/60
Cessna	560 Citation V Ultra	Sabreliner	75A
Cessna	650 Citation VII	Sabreliner	80
Cessna	680 Citation Sovereign	Sabreliner	T-39

Note: Green highlight indicates aircraft that conducted operations at ARB in 2019

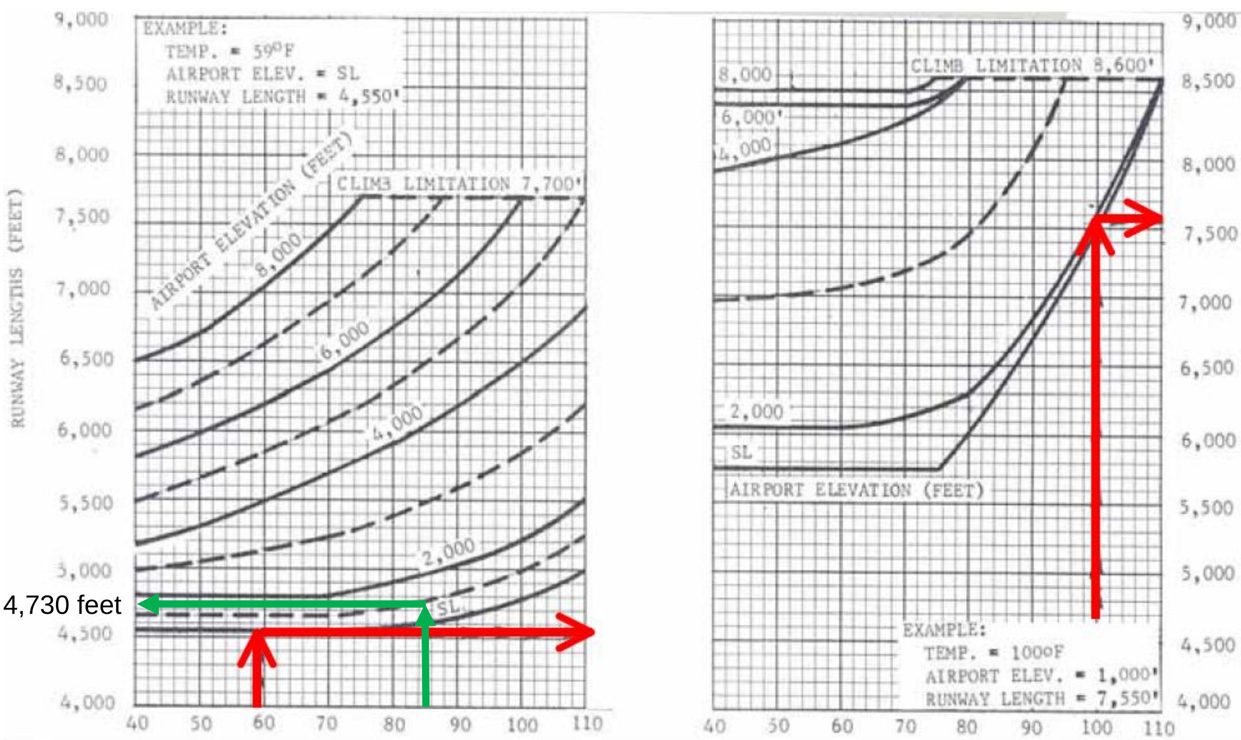
Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design, Table 3-1*

AC 150/5325-4B divides the performance curves for aircraft comprising 75 percent of the fleet into two weight groupings: departure at 60 percent useful load and 90 percent useful load. Use of the 60 percent or 90 percent useful payload charts is based on trip distance with regular use with 60 percent being the default value. Use of the 90 percent useful load chart is when at least 250 departures are going on longer trips that require a need for a higher fuel load for a 90 percent payload. Since the existing 3,505-foot length of Runway

6/24 is already limited in serving the runway length needs of jet aircraft types, use of the performance curve for aircraft departure at 60 percent useful load is appropriate to use for this study.

Figure 6-2 replicates Figure 3-1 from AC 150/5325-4B, which for the reasons identified above is the appropriate technical reference to use for calculating runway length needs for jet aircraft operating at ARB. In combination with the elevation of ARB (839 feet MSL) when the temperature is equal to the mean daily maximum temperature during the warmest month (84.6 degrees Fahrenheit), the runway length needed for these aircraft types is 4,730 feet.

Figure 6-2: Runway Length Requirements – Aircraft More Than 12,500 Pounds Up To 60,000 Pounds



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

75 percent of feet at 60 percent useful load **75 percent of feet at 90 percent useful load**

Notes:

Red arrows represent example calculation published with chart in advisory circular

Green arrows representative of runway length calculation performed for ARB Runway 6/24 Extension Justification Study

Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design, Figure 3-1*

6.3 Recommended Runway Length

In summary, use of FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design* indicates that small turboprop aircraft operating at ARB are recommended to have 4,225 feet of runway length for operations, while a runway length of 4,730 feet is recommended for business jets at ARB. FAA guidance, summarized in two parts below, identifies the criteria necessary to assimilate these two runway lengths.

First, the critical aircraft, whether an individual aircraft or a similar characteristic grouping of aircraft, must conduct at least 500 annual operations to meet FAA (i.e., AIP) funding requirements for any infrastructure improvement project intended to support the use of such aircraft. The forecast found that small turboprop and business jet aircraft with similar characteristic grouping are projected to continue to conduct at least 500 operations annually at ARB. Thus, the FAA's criterion is met for regular use of aircraft that need additional runway length at ARB.

Second, FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination,* directs in Chapter 3 that the runway length needs of a grouping of aircraft with similar characteristics can be used to determine a runway's needed length, in reference to the applicable design concepts in AC 150/5325-4B. When the runway length needed varies between individual types of aircraft within the critical aircraft grouping, Example 6 in Appendix B of the AC directs that the lowest common length which accounts for all or a portion of the distance needed for at least 500 annual operations is eligible for federal funding. Since both small turboprops and business jets need 4,225 feet of runway length to takeoff, this length is found to meet FAA criteria for the justified runway length at ARB.

Since FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design,* calculates that jets warrant more than 4,225 feet of runway, a separate analysis was conducted to evaluate the extent to which a runway of this length could support jet operations at ARB. For this evaluation, runway length performance information made available through pilot operating handbooks, airport planning manuals, and other information sources, were researched to determine the runway length needed to meet the demands of jet operators at ARB for specific aircraft types. **Table 6-2** presents the takeoff and landing distances for jet aircraft types that have the most demanding runway length needs that conducted operations at ARB in 2019. In addition to the landing length needed when the pavement is dry, landing distances for wet and compacted snow pavement conditions have also been included. The inclusion of the contaminated runway length distances cannot be used to justify runway length under FAA funding requirements; rather, these runway length needs are included to demonstrate the benefit additional runway length would provide when contaminates are present on its surface. Calculations in Table 6-2 are meant to supplement the runway length assessment, but are not used directly in the runway length calculation since they do not conform to the criteria used in AC 150/5325-4B (i.e., the AC permits use of the landing distances needed when pavement surfaces are contaminated with non-frozen water only, and MTOW is not assumed). **Appendix E** presents the runway length charts from the manufacturer operating manuals and other information sources used in calculating the runway lengths needed in the table.

Table 6-2: Manufacturers Performance Manuals for Jet Aircraft Types Operating at ARB

Aircraft Type	MTOW (lbs.)	Takeoff Distance[1] (MTOW, Warm Day)	Landing Distance		
			Dry Pavement	Wet Pavement (15% Safety Margin)	Compacted Snow (20% Safety Margin)
C25A – Cessna Citation CJ2	12,500 lbs.	4,050 ft.[2]	3,180 ft.[2]	3,657 ft.	3,816 ft.
C25M – Cessna Citation M2	10,700 lbs.	3,250 ft[3]	2,590 ft.[3]	2,979 ft.	3,108 ft.
C510 – Cessna Citation Mustang	8,645 lbs.	3,810 ft.[2]	2,300 ft.[3]	2,624 ft.	2,760 ft.
C525 – Cessna CitationJet/CJ1	10,700 lbs.	4,390 ft.[2]	2,780 ft.[2]	3,197 ft.	3,336 ft.
C550 – Cessna Citation II/Bravo	13,300 lbs.	4,130 ft.[2]	2,350 ft.[2]	2,703 ft.	2,820 ft.
C56X – Cessna Excel/XLS	20,200 lbs.	4,230 ft.[2]	3,400 ft.[2]	3,910 ft.	4,080 ft.
C680 – Cessna Citation Sovereign	30,775 lbs.	3,990 ft.[2]	2,810 ft.[2]	3,232 ft.	3,372 ft.
E55P – Embraer Phenom 300	17,968 lbs.	3,105 ft.[2]	2,743 ft.[2]	3,155 ft.	3,292 ft.
EA50 – Eclipse 500	6,000 lbs.	2,394 ft.[3]	2,342 ft.[3]	2,693 ft.	2,811 ft.
PC24 – Pilatus PC-24	18,298 lbs.	2,930 ft.[3]	2,375 ft.[3]	2,732 ft.	2,850 ft.
SF50 – Cirrus Vision SF50	6,000 lbs.	2,036 ft.[3]	1,628 ft.[3]	1,872 ft.	1,954 ft.

Notes:
Calculations in this table are meant to supplement the runway length assessment and are not used directly in the runway length calculation since they do not conform to the criteria used in AC 150/5325-4B.
[1] Takeoff length requirements based upon 839 feet MSL airport elevation, 84.6 deg Fahrenheit temperature unless otherwise noted
[2] Field elevation 1,000 ft. MSL, 86 degrees Fahrenheit
[3] Field elevation sea level, 59 degrees Fahrenheit
MTOW = Maximum Takeoff Weight
Source: Aircraft Manufacturer Performance Manuals (see Appendix E)

The most demanding runway length needed is the Cessna Citation CJ1 requiring 4,390 feet of runway under the identified conditions. Likewise, the Cessna Excel XLS which is based at ARB requires 4,230 feet of runway length under the identified conditions. This information suggests that a runway length of 4,225 feet would meet the normal demand of most jet aircraft types and be able to accommodate most of the runway takeoff distance requirements of others. Thus, this further confirms that a length of 4,225 feet is appropriate to accommodate the combined fleet of small turboprop and jet aircraft types operating at ARB.

Additionally, this length meets the runway length goals for ARB as outlined in the 2017 Michigan Aviation System Plan (2017 MASP). The MASP notes that ARB is an important component of the state aviation system and as a Tier 1 airport for tourism and regional capacity, it should meet a B-II MASP infrastructure goal. In this instance, the primary element that ARB does not meet is the length of its runway. Implementing a runway length of 4,225 feet would help achieve its recommended development level per the 2017 MASP.

THIS PAGE INTENTIONALLY LEFT BLANK

7. Alternatives

The next step is to evaluate alternatives of feasible development options to evaluate how Runway 6/24 could be extended to meet the runway length needs of the similar characteristics grouping of turboprop and jet aircraft types. Each alternative presented in this section is conceptual in nature and was prepared with minimal engineering evaluation. These alternatives were developed to evaluate options that are available to extend Runway 6/24 considering factors such as surrounding constraints, the location of other infrastructure, land use impacts, and known environmental features.

The presentation of each alternative includes advantages and disadvantages that should be considered when comparing the alternative with other development options. A summary of the advantages and disadvantages to consider with all alternatives is presented at the conclusion of the section. Alternatives presented in this section are organized as follows:

- 7.1 No Build (Do Nothing) – Maintain Existing 3,505 Feet of Runway Length
- 7.2 Alternative 1 – Extend 720 Feet at the Approach End of Runway 24
- 7.3 Alternative 2 – Extend 720 Feet at the Approach End of Runway 6
- 7.4 Alternative 3 – Extend 360 Feet at both ends of Runway 6/24
- 7.5 Recommended Alternative

7.1 No Build (Do Nothing) – Maintain Existing 3,505 Feet of Runway Length

This alternative is not a feasible option and is being documented to evaluate what would happen if no changes occurred to the existing length of Runway 6/24 to meet the demand of the similar characteristics grouping of turboprop and jet aircraft types. With a No Build (Do Nothing) Alternative, Runway 6/24 would remain at a length of 3,505 feet and no changes would occur to existing airside or landside infrastructure.

Obviously, retaining the existing length of Runway 6/24 at 3,505 feet does not provide 4,225 feet of runway length that is needed for the similar characteristics grouping of turboprop and jet aircraft types operating at ARB. Retention of the existing airfield configuration also does not allow ARB to address a taxiway design issue at the approach end of Runway 24. FAA AC 150/5300-13A, *Airport Design*, directs that taxiways should intersect runways at right angles to provide the best visibility for pilots when entering the surface. Currently, Taxiway D does not intersect Runway 6/24 to the south at a right angle. Retention of the airfield in its existing configuration would not address this design standard.

The intersection of Taxiway A1 and Taxiway D with Runway 6/24 is also a visibility concern on the airfield. In conversation with ARB officials, this intersection is not entirely visible from the ATCT. This is due to the location of hangars directly to the east of the ATCT which obstruct a clear view of this area of the airfield for air traffic controllers. Maintaining the existing configuration of the airfield would not improve this issue.

Should the existing configuration of the airfield be maintained, no impacts to wetlands or changes to land uses within the Runway Protection Zones (RPZs) would occur. Likewise, no off-airport impacts to roadways or on-airfield aircraft navigational instrumentation would be needed. While these are advantages, this development option does not address the need to provide 4,225 feet of runway length at ARB. Thus, this alternative is not recommended.

Considerations of the No Build (Do Nothing) development option are presented in **Table 7-1**.

Table 7-1: No Build (Do Nothing) – Summary of Considerations

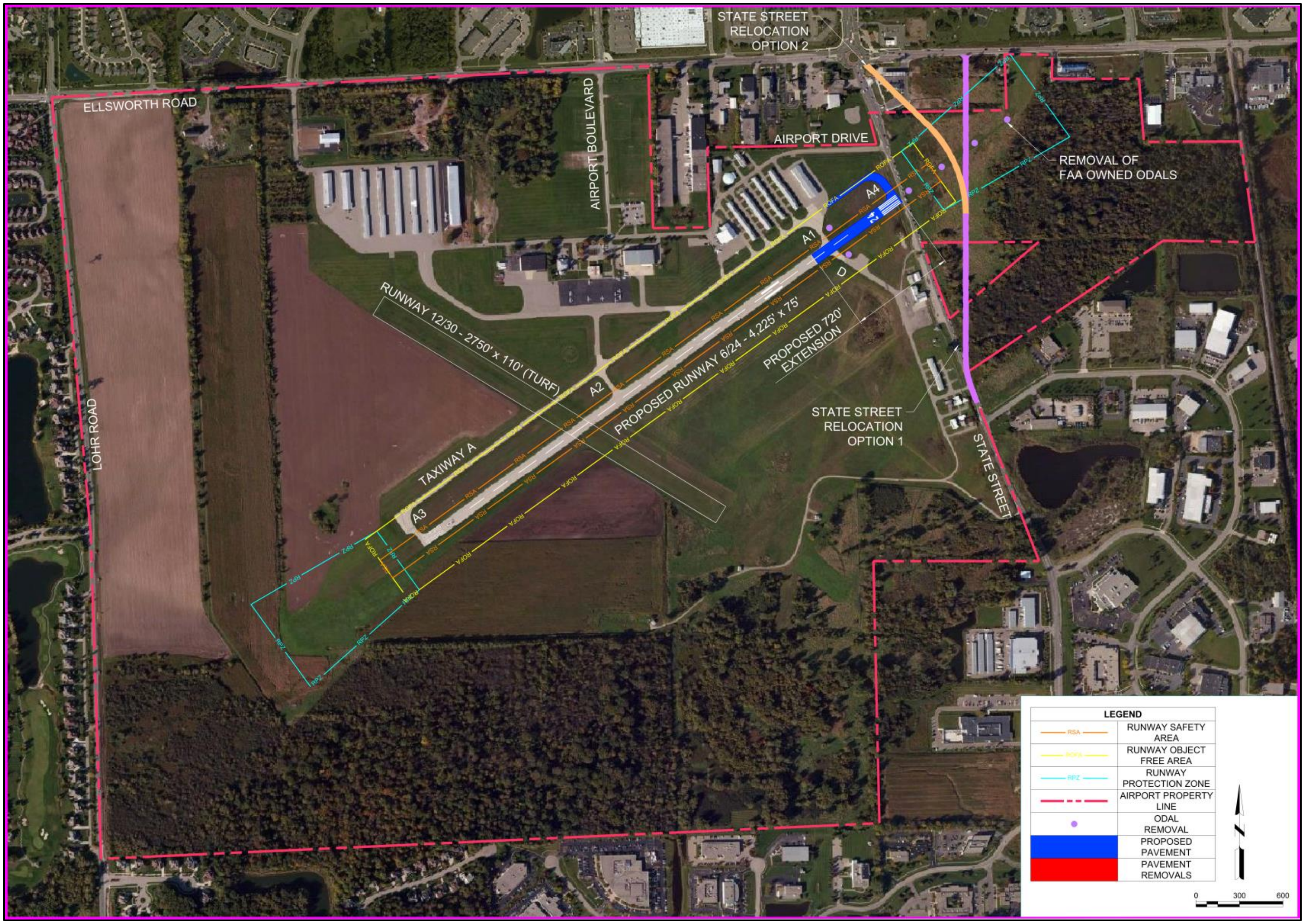
Advantages	Disadvantages
• No impacts to wetlands • No changes to land use with RPZs • No on- or off-airport infrastructure changes needed.	• Does not provide needed runway length. • Does not correct, as an integrated project, the geometry at Taxiway D & Runway 6/24 needed to meet design standards. • Does not address ATCT line-of-sight issue with intersection of Taxiway A1 and Taxiway D at Runway 6/24.

7.2 Alternative 1 – Extend 720 Feet at the Approach End of Runway 24

Alternative 1, presented in **Figure 7-1**, proposes that Runway 6/24 be extended 720 feet to the northeast at the approach end of Runway 24 to provide 4,225 feet of runway length. Taxiway A would be extended and a new connector taxiway, Taxiway A4, would be constructed to align the parallel taxiway system with the relocated threshold of Runway 24. Removal of a decommissioned FAA ODAL at the approach end of Runway 24 would also occur with this alternative. No other changes to existing airfield infrastructure would occur. With this proposed development action, State Street would need to be relocated around the Runway Safety Area (RSA) and Runway Object Free Area (ROFA), requiring that the existing roadbed of State Street, through these areas, be closed and removed. Control of land uses either through acquisition of property or an avigation easement would be needed for a portion of land not within the existing property boundary within the relocated RPZ at the approach end of Runway 6/24.

Alternative 1 offers the advantage of providing 4,225 feet of runway length to meet the needs of turboprop and jet aircraft as well as the removal of the decommissioned FAA ODAL system at the approach end of Runway 24. The primary disadvantage with Alternative 1 is that relocation of State Street will be necessary to change the alignment of this road around the approach end of Runway 24 and its associated RSA & ROFA surfaces. With the extension of the runway to the northeast, the ATCT will continue to have a line-of-sight issue when aircraft and ground vehicles cross the intersection of Taxiway A1 and Taxiway D with Runway 6/24. Alternative 1 also does not propose an improvement to the alignment of Taxiway D at this intersection so that it is aligned at a right angle. Potential wetland impacts and the need to control land uses through an acquisition or easement within the portion of the relocated RPZ are also disadvantages to consider. Finally, aircraft taxiing to and from the Southeast T-Hangar area would need to cross and access Runway 6/24 near the aiming point of the approach to Runway 24. The FAA desires that aircraft and ground vehicles cross a runway at either the departure or arrival end to give pilots more time to abort a landing or takeoff should a runway incursion occur. Aircraft crossing and accessing the runway at the aiming point would give pilots on approach to Runway 24 limited time to maneuver away from a potential runway incursion which is not desired.

Figure 7-1: Alternative 1 – Extend 720 Feet at the Approach End of Runway 24



Source: Mead & Hunt (2020)

Table 7-2 presents a summary of the considerations with the proposed implementation of Alternative 1.

Table 7-2: Alternative 1 – Extend 720 Feet at the Approach End of Runway 24

Advantages	Disadvantages
• Provides needed runway length • Removes decommissioned FAA ODAL system	• Does not correct geometry of Taxiway D & Runway 6/24 to meet design standards • Does not address ATCT line-of-sight issue with intersection of Taxiway A1 and Taxiway D at Runway 6/24. • Potential impacts to wetlands at approach end of Runway 24 • Control of land required within relocated RPZ at approach end Runway 24 • Relocation of State Street needed • Taxiing S.W. T-Hangar area aircraft cross / access runway near Runway 24 aiming point

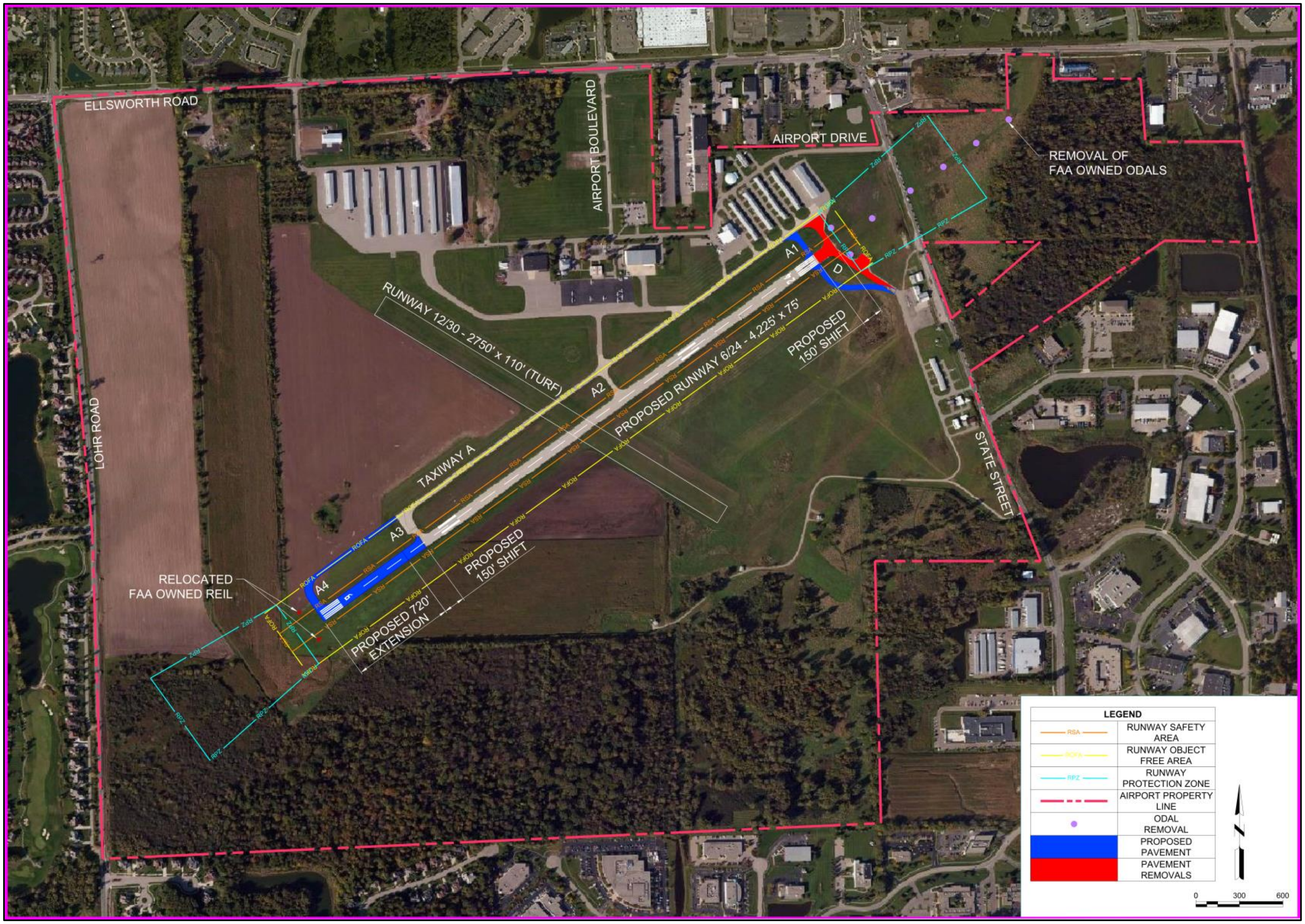
7.3 Alternative 2 – Extend 720 Feet at the Approach End of Runway 6

Alternative 2 (**Figure 7-2**) proposes to extend Runway 6/24 720 feet at the approach end of Runway 6 to provide 4,225 feet of runway length. An additional 150 feet of runway would also be constructed to shift Runway 6/24 to the southwest, allowing for clear ATCT visibility at the approach end of Runway 24. Taxiway D would also be relocated 150 feet to the southwest and its routing to the south changed so that the taxiway can intersect Runway 6/24 at a right angle. Pavement of the existing routing of Taxiway A1 and 150 feet of existing runway pavement at the approach end of Runway 24 would be removed. Removal of the decommissioned FAA ODAL system at the approach end of Runway 24 would also occur. Finally, the existing FAA REIL at the approach end of Runway 6 would be relocated to the new runway threshold.

Alternative 2 offers many advantages. First, it provides 4,225 feet of needed runway length for turboprop and jet aircraft that currently operate at ARB without significantly changing existing on- and off-airport infrastructure. Alternative 2 also provides additional runway length entirely within the existing property boundary without requiring the relocation of State Street. Additionally, Alternative 2 corrects the geometry of the intersection of Taxiway A1 and Taxiway D with Runway 6/24 so that pilot visibility is maximized, increasing safety. Shifting the runway 150 feet to the southeast also eliminates the obstructed view from the ATCT so that air traffic controllers can view of the entire surface of Runway 6/24.

This shift in the runway and extension to the southwest to provide the needed runway length of 4,225 also keeps the RPZ at the approach end of Runway 24 entirely within the existing property boundary, eliminating the need for land acquisition or easements to further control land uses within this area. Removal of the decommissioned FAA ODAL is an additional benefit with Alternative 2. While Alternative 2 mostly has advantageous considerations, mitigation of potential wetlands within the shifted RPZ at the approach end of Runway 6 may be needed. One other minor disadvantage is the need to relocate the FAA owned REILs at the approach end of Runway 6. **Table 7-3** summarizes the advantages and disadvantages with Alternative 2.

Figure 7-2: Alternative 2 – Extend 720 Feet at the Approach End of Runway 6



Source: Mead & Hunt (2020)

Table 7-3: Alternative 2 – Extend 720 Feet at the Approach End of Runway 6

Advantages	Disadvantages
• Provides needed runway length • Corrects geometry of Taxiway D & Runway 6/24 to meet design standards • Addresses ATCT line-of-sight issue with intersection of Taxiway A1 and Taxiway D with Runway 6/24. • Does not require control of land outside of existing property boundary • Does not require relocation of State Street • Removes decommissioned FAA ODAL system	• Potential impacts to wetlands at approach end of Runway 6 and Runway 24 • Relocation of FAA-owned REILs at approach end of Runway 6 needed

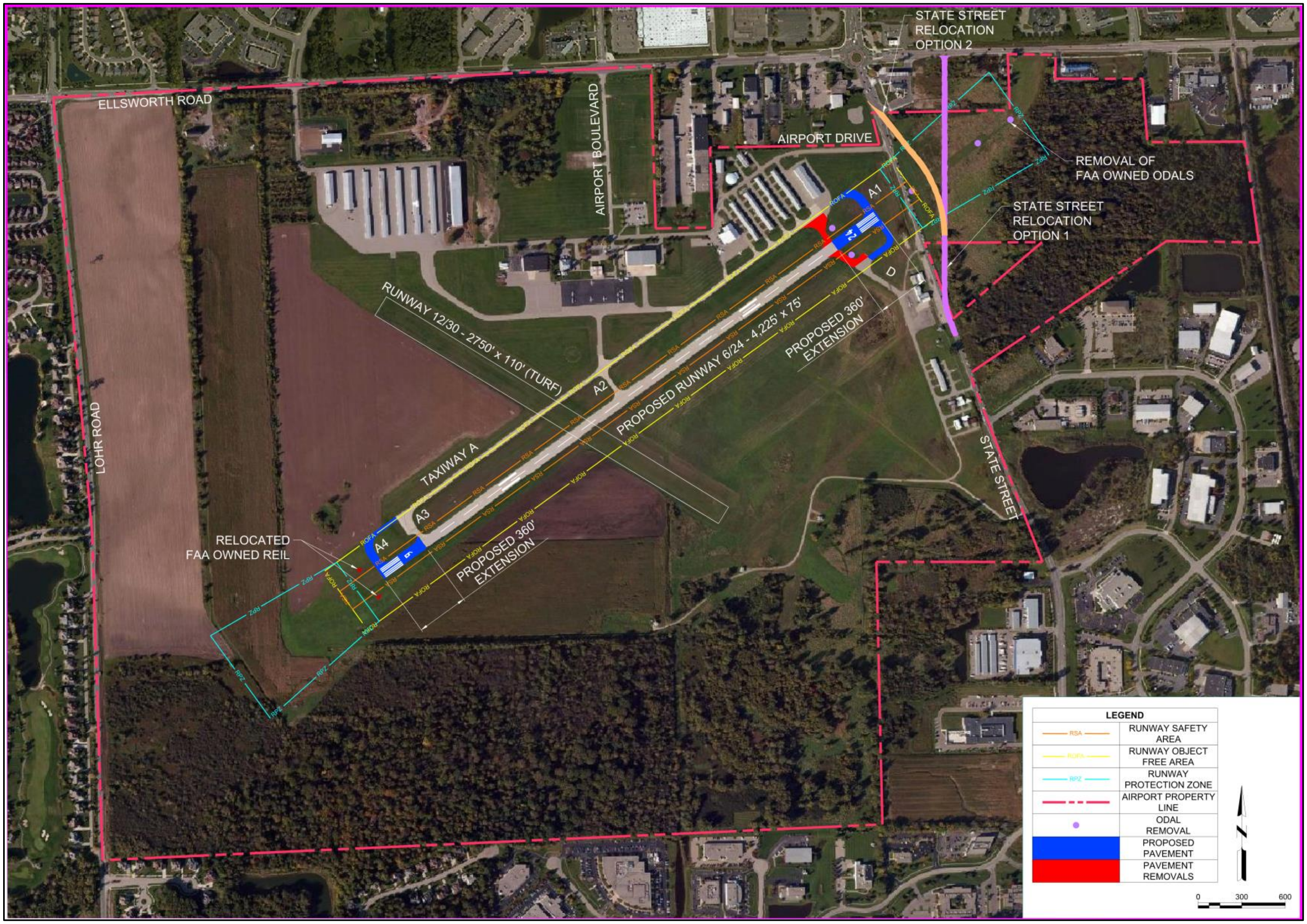
7.4 Alternative 3 – Extend 360 Feet at both ends of Runway 6/24

Alternative 3 (**Figure 7-3**) proposes to achieve a length of 4,225 feet with the construction of a 360-foot extension on each end of Runway 6/24. At the approach end of Runway 6 to the southwest, this would require a 360-foot extension of Taxiway A as well as the construction of a new connector taxiway (Taxiway A4) to align with the new threshold at this end of the runway. Likewise, at the approach end of Runway 24, a 360-foot extension of Taxiway A to the northeast would occur to match the 360-foot extension of the runway at this end as well as a relocation of Taxiway A1. The routing of Taxiway D to the south of Runway 6/24 would also change to align this portion of taxiway to intersect Runway 6/24 at a right angle. Portions of the existing alignment of Taxiway A1 and Taxiway D, where they currently intersect Runway 6/24, would be removed for this new taxiway configuration.

As a result of this proposed airfield configuration, the FAA-owned REIL at the approach end of Runway 6 would be relocated and the decommissioned FAA ODAL at the approach end of Runway 24 would be removed. With the runway extending to the northeast, State Street would also need to be relocated so its routing is located around the end of the approach end of Runway 24 and its associated RSA and ROFA surfaces. Acquisition of land or an easement within the relocated RPZ at the approach end of Runway 24 for portions outside of the existing airport property boundary is also needed with Alternative 3.

Alternative 3 offers the primary advantage of providing 4,225 feet of runway length to meet the needs of turboprop and jet aircraft users; however, Alternative 3 has many disadvantages. First, and most significantly, State Street would need to be relocated around the shifted runway. The acquisition of land or an easement within a portion of the relocated RPZ at the approach end of Runway 24 is another disadvantage to consider. Although the alignment of the intersection of Taxiway A1 and Taxiway D with Runway 6/24 is improved so that it intersects at right angles, the relocation of the intersection to the northeast does not allow air traffic controllers in the ATCT to view this area clearly, further complicating the current line-of-sight issue. Impacts to potential wetlands at both ends of Runway 6/24 may occur with this alternative as well. Finally, although Alternative 3 proposes removal of the decommissioned FAA ODAL system, the FAA owned REILs at the approach end of Runway 6 would need to be relocated. **Table 7-4** summarizes the advantages and disadvantages to consider with Alternative 3.

Figure 7-3: Alternative 3 – Extend 360 Feet at both ends of Runway 6/24



Source: Mead & Hunt (2020)

Table 7-4: Alternative 3 – Alternative 3 – Extend 360 Feet at both ends of Runway 6/24

Advantages	Disadvantages
• Provides needed runway length • Corrects geometry of Taxiway D & Runway 6/24 to meet design standards • Removes decommissioned FAA ODAL system	• Does not address ATCT line-of-sight issue within area of existing Taxiway A1 and Taxiway D with Runway 6/24 intersection • Potential impacts to wetlands at approach end of Runway 6 and Runway 24 • Requires control of land outside of existing property boundary at approach end of Runway 24 • Requires relocation of State Street • Relocation of FAA-owned REILs at approach end of Runway 6 needed

7.5 Recommended Alternative

In review of the proposed development options, Alternative 2 which extends the length of Runway 6/24 by 720 feet, all toward the southwest, to provide a total of 4,225 feet of runway length, is the recommended action to provide the runway length that is needed for turboprop and jet aircraft operating at ARB. In comparison with the other alternatives, Alternative 2 offers a method to provide this runway length and correct other airfield infrastructure needs with the least impacts to on- and off-airport infrastructure. With Alternative 2, there is no need to relocate State Street. Likewise, Alternative 2 does not require the Airport to seek the acquisition of land or an easement to further protect incompatible land uses within RPZs.

Alternative 2 offers the additional benefits of allowing Taxiway D to intersect Runway 6/24 at a right angle, meeting design standards identified in FAA AC 150/5300-13A, *Airport Design*. Alternative 2 also improves the safety of the airfield by shifting Runway 6/24 150 feet to the southwest so that the entire length of the runway can be viewed unobstructed by air traffic controllers in the ATCT. Although some wetland impacts may occur with the relocation of the RPZ at the approach end of Runway 6, these are anticipated to be minimal and can be managed through mitigation. Removal of the decommissioned FAA ODAL approach lighting system is an additional benefit with the infrastructure changes proposed by Alternative 2. Thus, to provide 4,225 feet of runway length at ARB to meet the needs of the similar characteristics grouping of turboprop and jet aircraft types, implementation of Alternative 2 to extend Runway 6/24 an additional 720 feet at the approach end of Runway 6 to the southwest is the recommended development action.

8. Summary / Recommendation

ARB's existing 3,505-foot length of Runway 6/24 is intended to serve primarily small piston driven aircraft; however, the airport receives regular use by small turboprop and business jet aircraft operations. This justification study found that this similar characteristics grouping of aircraft has runway length requirements that exceed the current length of Runway 6/24. For these users to conduct operations at ARB on the existing runway length, undue concessions to fuel and passenger loads are needed as well as diversions to other airports when runway surfaces are contaminated, or temperatures are too high.

Operators of small turboprop and jet aircraft types value the convenience that ARB provides with its proximity to the Ann Arbor area. With events such as U of M football games and NASCAR races at MIS that attract visitors to the Ann Arbor area, increases in small turboprop and jet activity are projected to occur each year. It can be assumed that additional operations by these aircraft types would occur at ARB if additional runway length were made available. This is supported by the MASP finding that ARB is a Tier 1 airport to support tourism.

The forecasts prepared for this study indicate the similar characteristics grouping of small turboprop and jet aircraft operations will increase at ARB, regardless of improvements made to the length of the runway. Understanding that demand is present for additional runway length, it is prudent to plan to extend Runway 6/24 at ARB. Of the four alternatives prepared to address the demands of this similar characteristics grouping of small turboprop and business jet aircraft, **Alternative 2, which recommends Runway 6/24 be extended 720 feet for a total of 4,225 feet of runway length, appears to be the best option to meet current and future demands.**

Implementation of Alternative 2 provides a runway extension that can meet the demands of the similar characteristics grouping of small turboprop and business jets that conduct operations at ARB while minimizing impacts to environmental resources, as well as avoiding impacts to State Street and the Stonebridge neighborhoods to the west. It also offers an option to improve safety at the approach end of Runway 24 by allowing a 150-foot shift of the runway.

Implementation of Alternative 2 also aligns with the plans of the 2017 MASP and is also supported by MDOT AERO. The 2017 MASP identified ARB as a Tier 1 airport that meets all development goals set forth for the facility except for available runway length. Tier 1 airports in the MASP are targeted to provide a runway length that is appropriate to their size, activity, and type of instrument approach. For airports with an ARC of B-II, the 2017 MASP sets a development goal of 4,300 feet of runway length. Though an extension of Runway 6/24 at a length of 4,225 feet is less than 4,300 feet, it allows ARB to better meet this goal by providing as much runway as possible.

This runway extension justification study finds that Runway 6/24, meeting B-II design standards, should be extended to the length of 4,225 feet. This would best accommodate not only the demands of existing ARB users, including those operators of the similar characteristics grouping of small turboprop and jet aircraft types currently visiting the Ann Arbor area. This would provide a runway length that offers a safer and better operating facility for these users.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix Summary

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A: 2019 Traffic Flow Management System Counts Data

TFMSC Report (ARB)

From 01/2019 To 12/2019 | Airport=ARB

Aircraft	AAC	ADG	Dep	Arr	Total Ops
-1 - unknown	n/a	n/a	4	26	30
A109 - Agusta SAAF-109	Helo	Helo	1	1	2
AA5 - American AA-5 Traveler	A	I	16	17	33
AC11 - North American Commander 112	A	I	10	11	21
AC95 - Gulfstream Jetprop Commander 1000	B	II	2	2	4
AEST - Piper Aero Star	B	I	1	2	3
AS65 - Aérospatiale AS-366	Helo	Helo	1	1	2
B06 - Agusta AB-206 LongRanger	Helo	Helo	1	0	1
B212 - Bell UH-1	Helo	Helo	1	0	1
B350 - Beech Super King Air 350	B	II	62	61	123
B58T - Beechcraft Baron Turbo	A	I	2	4	6
BE10 - Beech King Air 100 A/B	B	I	5	6	11
BE20 - Beech 200 Super King	B	II	67	74	141
BE30 - Raytheon 300 Super King Air	B	II	2	0	2
BE33 - Beech Bonanza 33	A	I	31	32	63
BE35 - Beech Bonanza 35	A	I	67	63	130
BE36 - Beech Bonanza 36	A	I	50	47	97
BE55 - Beech Baron 55	A	I	43	44	87
BE58 - Beech 58	B	I	25	21	46
BE65 - Beech 65 Queen Air	A	I	2	2	4
BE9L - Beech King Air 90	B	I	22	22	44
BE9T - Beech F90 King Air	B	II	1	1	2
C150 - Cessna 150	A	I	0	1	1
C152 - Cessna 152	A	I	7	7	14
C172 - Cessna Skyhawk 172/Cutlass	A	I	355	354	709
C177 - Cessna 177 Cardinal	A	I	5	5	10
C180 - Cessna 180	A	I	0	1	1
C182 - Cessna Skylane 182	A	I	105	120	225
C185 - Cessna Skywagon 185	A	I	0	2	2
C206 - Cessna 206 Stationair	B	I	25	23	48
C208 - Cessna 208 Caravan	B	II	51	49	100
C210 - Cessna 210 Centurion	A	I	15	12	27
C240 - Cessna TTx Model T240	A	I	1	2	3
C25A - Cessna Citation CJ2	B	I	1	1	2
C25C - Cessna Citation CJ4	B	II	5	5	10
C25M - Cessna Citation M2	B	I	2	2	4
C310 - Cessna 310	A	I	17	18	35
C320 - Cessna Skyknight	B	I	1	1	2
C340 - Cessna 340	B	I	16	13	29
C402 - Cessna 401/402	B	I	6	4	10
C414 - Cessna Chancellor 414	B	I	26	18	44

Aircraft	AAC	ADG	Dep	Arr	Total Ops
C421 - Cessna Golden Eagle 421	B	I	22	23	45
C425 - Cessna 425 Corsair	B	I	3	3	6
C441 - Cessna Conquest	B	II	1	1	2
C510 - Cessna Citation Mustang	B	I	7	7	14
C525 - Cessna CitationJet/CJ1	B	I	10	10	20
C550 - Cessna Citation II/Bravo	B	II	4	4	8
C56X - Cessna Excel/XLS	B	II	80	81	161
C680 - Cessna Citation Sovereign	B	II	14	14	28
C72R - Cessna Cutlass RG	A	I	0	1	1
C77R - Cessna Cardinal RG	A	I	0	1	1
C82S - Cessna 182 Skylane	A	I	1	1	2
C82T - Skyland RG,Turbo	A	I	1	1	2
COL3 - Lancair LC-40 Columbia 400	A	I	8	5	13
COL4 - Lancair LC-41 Columbia 400	A	I	16	15	31
DA40 - Diamond Star DA40	A	I	26	23	49
DA42 - Diamond Twin Star	A	I	1	1	2
E155 - unknown	Helo	Helo	1	0	1
E55P - Embraer Phenom 300	B	II	39	38	77
EA50 - Eclipse 500	A	I	5	6	11
EC15 - unknown	Helo	Helo	0	1	1
EC35 - Eurocopter EC-135	Helo	Helo	3	1	4
EC45 - Eurocopter EC-145	Helo	Helo	2	0	2
EC55 - Eurocopter EC-155	Helo	Helo	37	45	82
EPIC - Dynasty	A	I	13	13	26
EVOT - Lancair Evolution Turbine	A	I	5	6	11
FBA2 - Found FBA-2	A	I	1	0	1
GA7 - Grumman American Cougar	A	I	1	1	2
H60 - Sikorsky SH-60 Seahawk	Helo	Helo	1	0	1
HELO - Helicopter	Helo	Helo	0	1	1
LGEZ - Rutan 61 Long-EZ	A	I	0	1	1
LNC4 - Lancair 4	A	I	12	11	23
LNP4 - Lancair Propjet four-seat	A	I	3	3	6
M20P - Mooney M-20C Ranger	A	I	45	40	85
M20T - Turbo Mooney M20K	A	I	3	6	9
M600 - Piper PA-46 M600	A	I	2	2	4
P06T - Tecnam P2006T	A	I	10	9	19
P210 - Riley Super P210	A	I	1	1	2
P28A - Piper Cherokee	A	I	120	121	241
P28B - Piper Turbo Dakota	A	I	6	5	11
P28R - Cherokee Arrow/Turbo	A	I	26	27	53
P32R - Piper 32	A	I	36	30	66
P32T - Embraer Lance 2	A	I	0	1	1
P46T - Piper Malibu Meridian	A	I	86	85	171
P68 - Partenavia P68 Victor	A	I	1	1	2
PA24 - Piper PA-24	A	I	11	13	24
PA27 - Piper Aztec	A	I	5	6	11
PA28 - Piper Cherokee	A	I	1	4	5

Aircraft	AAC	ADG	Dep	Arr	Total Ops
PA31 - Piper Navajo PA-31	A	I	7	6	13
PA32 - Piper Cherokee Six	A	I	45	42	87
PA34 - Piper PA-34 Seneca	A	I	32	34	66
PA46 - Piper Malibu	A	I	9	10	19
PAY1 - Piper Cheyenne 1	B	I	3	3	6
PAY2 - Piper Cheyenne 2	B	I	3	3	6
PC12 - Pilatus PC-12	A	II	158	157	315
PC24 - Pilatus PC-24	B	II	10	11	21
RV10 - Experimental	A	I	5	5	10
RV7 - Experimental RV-7	A	I	3	3	6
S22T - Cirrus SR-22 Turbo	A	I	8	8	16
S76 - Sikorsky S-76	Helo	Helo	3	5	8
SF50 - Cirrus Vision SF50	A	I	2	2	4
SR20 - Cirrus SR-20	A	I	16	19	35
SR22 - Cirrus SR 22	A	I	213	208	421
T206 - Cessna T-206	A	I	2	0	2
T28 - HamiltonT-28 Nomair	A	I	1	0	1
TBM7 - Socata TBM-7	A	I	3	3	6
TBM8 - Socata TBM-850	A	I	44	46	90
TBM9 - Socata TBM	A	I	24	24	48
TBMB - unknown	n/a	n/a	1	0	1
Total:			**2,316**	**2,333**	**4,649**

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix B: AvFuel Letter of Support

Zachary Puchacz

From:	Kosin, Christopher A. <ckosin@avfuel.com>
Sent:	Tuesday, April 16, 2019 8:52 AM
To:	Zachary Puchacz
Cc:	Kulhanek, Matthew; William Ballard; Stephanie Ward
Subject:	Re: ARB Rwy Justification Study - AvFuel Excel 560 Operations
Attachments:	2019 04-09 AvFuel Letter of Support Template (Christopher Kosin) (1).docx

Good morning Zachary,

Please see the attached letter.

My apologies for this delay, thank you for the reminder.

Sincerely,

Chris Kosin
Chief Pilot
Avfuel Flight Department
734-502-1019

April 16th, 2019

Mr. Matthew Kulhanek
Airport Manager
Ann Arbor Airport
801 Airport Dr.
Ann Arbor, MI 48108

Subject: Use of Aircraft at Ann Arbor Airport

Dear Mr. Kulhanek:

I am writing this letter concerning the use of our aircraft at the Ann Arbor Airport (ARB). As you are aware, Avfuel Corporation is a global supplier of aviation fuel and services headquartered in Ann Arbor. As a result, we use aviation to conduct business between our Fixed Base Operator (FBO) facilities and fueling partners across North America and around the world.

Avfuel bases a Cessna Citation 560 XL at ARB and conducts 140 - 160 annual operations from Ann Arbor. Typically, we conduct flights with our Cessna Citation 560 XL to any of the 2500+ commercial and general aviation airports in the US and Canada. Ideally, flights to many of these destinations with a travel distance greater than 800NM would occur with a full fuel and passenger load. Given the elevation of the airfield (839 feet above mean sea level), 4300 feet of runway length would be needed for departure with a full load on an 84-degree Fahrenheit day. However, this runway length exceeds the available 3,505-foot length of Runway 6/24. Thus, we often need to make concessions to fuel and passenger loads requiring us to make a fuel stop before reaching our intended destination.

The existing 3,505-foot length of Runway 6/24 also limits our capability to use ARB when the runway is contaminated with standing water and snow as these conditions increase required landing distances and reduces braking action. With 4000+ feet of runway needed for landing when water, snow, or ice are present, we often need to divert to another airport when these conditions are present or delay/cancel our flight until conditions at ARB improves. This effects our business capabilities as it decreases our operational efficiency, increases overall travel time and requires us to reposition our aircraft to ARB from another airport which adds unnecessary flight cycles and increased maintenance expenses.

Our business is growing and as a result our demand for aviation has increased. We project conducting approximately 80+ operations in 2019 with this number increasing to 100+ annual operations by 2021. An extension in the length of Runway 6/24 would reduce our need to make concessions to fuel and passenger loads which would allow us to use our aircraft more efficiently. It would also reduce the factor that the presence of water, snow, and ice on the runway has in our decision to conduct landings when these environmental conditions are present as additional runway length would be available to accommodate the increased braking action distances. This would reduce our need to divert to another airport or cancel / delay flights.

In summary, I am writing this letter in support of increasing the length of Runway 6/24. Thank you in advance for your consideration of our aircraft operational needs and let me know if I can be of further assistance in your evaluation of runway length needs at the Ann Arbor Airport.

Christopher Kosin
Chief Pilot, Avfuel Corporation

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix C: Weather Information

Airfield Wind Coverage – All Weather Conditions

<table>
<tr><th>Crosswind (in knots)</th><th>Runway 6</th><th>Runway 24</th><th>Runway 12</th><th>Runway 30</th></tr>
<tr><td rowspan="3">10.5</td><td>62.43%</td><td>77.06%</td><td>65.49%</td><td>78.20%</td></tr>
<tr><td colspan="2">93.61%</td><td colspan="2">92.28%</td></tr>
<tr><td colspan="4">98.73%</td></tr>
<tr><td rowspan="3">13</td><td>63.80%</td><td>79.48%</td><td>67.04%</td><td>81.13%</td></tr>
<tr><td colspan="2">96.79%</td><td colspan="2">95.85%</td></tr>
<tr><td colspan="4">99.75%</td></tr>
<tr><td rowspan="3">16</td><td>65.10%</td><td>81.40%</td><td>68.68%</td><td>83.70%</td></tr>
<tr><td colspan="2">99.26%</td><td colspan="2">99.00%</td></tr>
<tr><td colspan="4">99.96%</td></tr>
<tr><td rowspan="3">20</td><td>65.44%</td><td>81.87%</td><td>69.02%</td><td>84.42%</td></tr>
<tr><td colspan="2">99.88%</td><td colspan="2">99.80%</td></tr>
<tr><td colspan="4">100.00%</td></tr>
</table>

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Ann Arbor, Michigan
Period of Record: 2009-2018 based on 127,698 observations

Airfield Wind Coverage – Visual Flight Rules Conditions

<table>
<tr><th>Crosswind (in knots)</th><th>Runway 6</th><th>Runway 24</th><th>Runway 12</th><th>Runway 30</th></tr>
<tr><td rowspan="3">10.5</td><td>57.40%</td><td>76.91%</td><td>60.21%</td><td>77.51%</td></tr>
<tr><td colspan="2">92.99%</td><td colspan="2">91.38%</td></tr>
<tr><td colspan="4">98.68%</td></tr>
<tr><td rowspan="3">13</td><td>58.81%</td><td>79.72%</td><td>61.86%</td><td>80.83%</td></tr>
<tr><td colspan="2">96.53%</td><td colspan="2">95.36%</td></tr>
<tr><td colspan="4">99.76%</td></tr>
<tr><td rowspan="3">16</td><td>60.17%</td><td>81.90%</td><td>63.66%</td><td>83.71%</td></tr>
<tr><td colspan="2">99.28%</td><td colspan="2">98.86%</td></tr>
<tr><td colspan="4">99.96%</td></tr>
<tr><td rowspan="3">20</td><td>60.48%</td><td>82.40%</td><td>64.05%</td><td>84.53%</td></tr>
<tr><td colspan="2">99.89%</td><td colspan="2">99.77%</td></tr>
<tr><td colspan="4">100.00%</td></tr>
</table>

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Ann Arbor, Michigan
Period of Record: 2009-2018 based on 94,765 observations
VFR = Ceiling greater than or equal to 1,000 feet and visibility greater than or equal to 3 statute miles

Airfield Wind Coverage – Instrument Flight Rules Conditions

Crosswind (in knots)	Runway 6	Runway 24	Runway 12	Runway 30
10.5	76.45%	77.00%	79.94%	79.90%
	95.35%		94.63%	
	98.86%			
13	77.75%	78.35%	81.26%	81.79%
	97.52%		97.17%	
	99.73%			
16	78.89%	79.52%	82.56%	83.53%
	99.24%		99.42%	
	99.94%			
20	79.32%	79.91%	82.77%	83.95%
	99.84%		99.89%	
	99.99%			

Note: Single runway end coverages calculated with a 3-knot tailwind
Source: National Climatic Data Center, FAA AGIS wind analysis tool
Station: Ann Arbor, Michigan
Period of Record: 2009-2018 based on 33,668 observations
IFR = Ceiling less than 1,000 feet but greater than or equal to 200 feet; and/or visibility less than 3 statute miles but greater than or equal to 1/2 statute mile

2010-2018 Average Annual Precipitation (in inches)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Inches Per Year
Inches	29.63	42.86	19.70	33.57	21.57	25.36	28.51	30.42	27.72	28.81

Source: MRCC records, 2010-2018; Station: Ann Arbor Municipal Airport (2019)

2010-2018 Average Days of Precipitation

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Days Per Year
Days	183	207	169	209	205	195	178	187	198	192

Source: MRCC records (2010-2018) Station: Ann Arbor Municipal Airport (2019)

2010-2018 Average Annual Snowfall

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Inches Per Year
Inches	51.0	67.5	37.0	64.4	80.5	54.1	59.4	54.3	64.3	59.2

Source: MRCC records (2010-2018) Station: Ann Arbor SE

2010-2018 Average Days of Snowfall

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Days Per Year
Days	76	71	61	99	91	68	83	77	89	79

Source: MRCC records (2010-2018); Station: Ann Arbor SE

2010-2018 Average High Temperature (Degrees Fahrenheit)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31.3	33.8	45.7	58.7	72.4	79.6	84.6	82.2	74.8	62.5	48.4	36.8

Source: MRCC records (2010-2018), Station: Ann Arbor Municipal Airport

2010-2018 Days of Temperature 80 degrees Fahrenheit or Greater

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Days Per Year
Days	88	80	96	75	59	70	95	81	88	81

Source: MRCC records, 2010-2018; Station: Ann Arbor Municipal Airport (2019)

2010-2018 Days of Temperature 32 Degrees Fahrenheit or Less

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg. Days Per Year
Days	153	144	131	157	154	141	149	129	165	147

Source: MRCC records, 2010-2018; Station: Ann Arbor Municipal Airport (2019)

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D: Projections of Aviation Demand

The FAA projects future aviation activity through the TAF which was used to compare projections prepared in determining the critical aircraft for Runway 6/24. Forecasts that are developed for airport studies and/or federal grants must be approved by the FAA. It is the FAA's policy, listed in AC 150/5070-6B, *Airport Master Plans*, that FAA approval of forecasts should be consistent with the TAF. Forecasts for GA and reliever airports are consistent with the TAF if they meet the following criteria:

- Where the 5- or 10-year forecasts exceed 100,000 total annual operations or 100 based aircraft:
    - Forecasts differ by less than 10 percent (10%) in the 5-year forecast and 15 percent in the 10-year period, or
    - Forecasts do not affect the timing or scale of an airport project, or
    - Forecasts do not affect the role of the airport as defined in the current version of FAA Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*.

- When the 5- or 10-year forecast is for less than 100,000 total annual operations or 100 based aircraft, the forecast does not need to be reviewed at FAA Headquarters, but the data should be provided to the FAA for the annual update of the TAF.

If the forecast is not consistent with the TAF, differences must be resolved prior to using the forecast in FAA decision-making. This may involve revisions to the airport sponsor's submitted forecasts, adjustments to the TAF, or both. FAA decision-making includes key environmental issues (e.g., purpose and need, air quality, noise, land use), noise compatibility planning (14 CFR Part 150), approval of development on an airport layout plan and initial financial decisions.

This chapter examines data that pertains to aviation activities and describes the projections of aviation demand at ARB. It should be noted that projections of aviation demand are based on data through the year 2019, as this was the most recent calendar year for which a full 12 months of historical data was available at the time these forecasts were developed in August 2020.

D.1 Forecasting Approach

Forecasting techniques can range from subjective judgment to sophisticated mathematical modeling. These forecasts incorporate local and national industry trends in assessing current and future demand. Socio-economic factors such as local population, retail sales, and employment have also been analyzed for the effect they may have had on historical and may have on future levels of activity. The comparison of the relationships among these various indicators provided the initial step in the development of realistic forecasts for future aviation demand.

The following sections provide an assessment of historical trends of aviation activity data at the local and national level. Aviation activity statistics on such items as based aircraft and aircraft operations were collected, reviewed, and analyzed. Since many variables affect a facility plan, it is important that each one be considered in the context of its use in the plan.

In statistical analysis, correlation (often measured as a correlation coefficient) indicates the strength of a linear relationship between two independent variables. In this analysis, the Pearson product-moment correlation coefficient is calculated for some methodologies. The closer the correlation coefficient is to 1.0, the stronger the correlation between the variables. Methodologies used to develop forecasts described in this section include:

- Time-series methodologies
- Market share methodologies
- Socio-economic methodologies

D.1.1 Time-Series Methodologies

Historical trend lines and linear extrapolation are widely used methods of forecasting. These techniques utilize time-series types of data and are most useful for a pattern of demand that demonstrates a historical relationship with time. Trend line analyses are linearly extrapolated using the least squares method to known historical data. Growth rate analyses used in this chapter examined the historical CAGR and extrapolated future data values by assuming a similar CAGR for the future.

D.1.2 Market Share Methodologies

Market share, ratio, or top-down methodologies compare local levels of activity with a larger entity. Such methodologies imply that the proportion of activity that can be assigned to the local level is a regular and predictable quantity. This method has been used extensively in the aviation industry to develop forecasts at the local level. Historical data is commonly used to determine the share of total national traffic activity that will be captured by a region or airport. The FAA develops national forecasts annually in its FAA Aerospace Forecasts document, the latest edition of which is the FAA Aerospace Forecasts Fiscal Year (FY) 2020-2040.

D.1.3 Socio-Economic Methodologies

Socio-economic or correlation analyses examine the direct relationship between two or more sets of historical data. Local market conditions examined in this chapter include population, total employment, total retail sales, and per capita income for Washtenaw County. Historical and forecasted socio-economic statistics for this service area were obtained from the economic forecasting firm Woods & Poole Economics, Inc. Based upon the observed and projected correlation between historical aviation activity and the socio-economic data sets, future aviation activity projections were developed. **Table D-1** presents forecasts of socio-economic indicators that are utilized in various locations of this chapter.

Table D-1: Historical and Projected Socio-Economic Indicators

Year	Population (persons)	Employment (persons)	Total Retail Sales (mil, 2009$)	Per Capita Personal Income (2009$)
Historical:				
2000	324,372	244,539	5,288.11	43,379
2001	328,749	244,891	5,257.85	43,613
2002	332,763	245,250	5,238.91	44,405
2003	336,154	243,414	5,069.61	44,645
2004	339,422	245,300	4,975.88	44,622
2005	342,234	247,807	4,835.73	44,084
2006	344,018	247,696	4,627.41	44,806
2007	345,310	247,813	4,323.96	45,053
2008	341,595	243,145	4,190.88	44,915
2009	343,520	238,962	4,001.32	40,956
2010	345,568	242,579	4,251.71	43,976
2011	349,071	246,151	4,573.45	42,752
2012	351,299	247,774	4,827.07	44,328
2013	354,573	251,734	4,941.62	44,044
2014	358,980	253,938	5,096.26	44,712
2015	360,847	259,594	5,195.90	46,951
2016	364,709	264,064	5,314.08	47,671
2017	367,325	269,689	5,435.38	48,977
2018	370,216	274,308	5,514.52	49,765
2019	372,945	276,064	5,527.38	50,146
CAGR (2000-2019)	*0.74%*	*0.64%*	*0.23%*	*0.77%*
Projected:				
2024	387,740	299,024	5,932.02	53,753
2029	402,192	319,455	6,239.48	56,907
2034	415,555	338,861	6,515.53	59,590
2039	427,114	356,858	6,777.76	62,102
CAGR (2019-2039)	*0.68%*	*1.29%*	*1.02%*	*1.07%*

Note: Washtenaw County, CAGR = Compound Annual Growth Rate
Source: Woods & Poole Economic Inc.

D.2 Based Aircraft

The FAA defines a based aircraft at an airport as an aircraft that is “operational & airworthy”, and which is typically based (stored) at the airport for most of the year. The FAA TAF notes the following based aircraft at ARB for 2019:

- 142 single-engine aircraft
- 12 multi-engine
- 1 jet
- 8 helicopters
- 1 other
- Total: 164

There are several factors that affect the number of based aircraft at an airport. Recently, increasing costs to own and operate aircraft has been a primary factor that has contributed to a decline in the overall national generation aviation fleet since 2007. ARB, however, has experienced an increase in the number of based aircraft following a low in 2010 and 2011. Several methodologies were evaluated to develop based aircraft projections. The FAA TAF, a time series methodology (growth rate analysis), and a market share methodology are presented in **Table D-2**.

Table D-2: Based Aircraft Forecasts – Terminal Area Forecast, Growth Rate, and Market Share Methodologies

	FAA TAF Summary	Growth Rate Methodology	Market Share Methodology		
Year	Based Aircraft	Based Aircraft	Based Aircraft	Total U.S. Active GA Aircraft	Market Share
Historical:					
2010	129	129	129	223,370	0.058%
2011	129	129	129	220,453	0.059%
2012	168	168	168	209,034	0.080%
2013	175	175	175	199,927	0.088%
2014	176	176	176	204,408	0.086%
2015	182	182	182	210,031	0.087%
2016	188	188	188	211,794	0.089%
2017	178	178	178	211,757	0.084%
2018	164	164	164	211,749	0.077%
2019	164	164	164	212,335	0.077%
CAGR (2010-2019)	*2.70%*	*2.70%*	*CAGR (2010-2019)*	*-0.56%*	
Projected					
2024	168	187	163	211,625	0.077%
2029	168	214	163	210,600	0.077%
2034	168	245	162	209,975	0.077%
2039	168	280	162	210,175	0.077%
CAGR (2019-2039)	*0.12%*	*2.70%*	*-0.05%*	*-0.05%*	

Sources: Historical Based Aircraft - FAA TAF
Projected Based Aircraft - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA TAF
Total U.S. Active Aircraft (GA & Air Taxi) - FAA Aerospace Forecasts FY2020-2040

The market share methodology compares local based aircraft at ARB to the total number of GA aircraft reported by the FAA. ARB's market share has increased since 2010 and in 2019 the number of based aircraft represented 0.077 percent of total active GA aircraft in the United States. The FAA Aerospace Forecasts project a slight decline in total active GA aircraft over the next 20 years, exhibiting a CAGR of negative 0.05 percent (-0.05%). Assuming ARB's 0.077 percent (0.077%) market share of active GA aircraft remains constant for the forecast period, based aircraft will fall slightly over the next 20 years from 163 to 162.

Socio-economic forecasting methodologies examine the direct relationship between two or more sets of historical data. Data examined in developing based aircraft forecasts using this methodology included both population and total employment. Total employment was used as an indicator of economic activity occurring within the community with the assumption being that changes in economic activity will impact the number of based aircraft. Population and total employment for Washtenaw County was examined while historical and forecasted socio-economic statistics for this service area were obtained from the economic forecasting firm Woods & Poole Economics, Inc. The observed and projected correlation between historical aviation activity and socio-economic data offers a method to project based aircraft. The forecasts that were prepared utilizing these methodologies are presented in **Table D-3**. As illustrated in the table, based aircraft at ARB are projected to increase from 164 aircraft in 2019 to 188 aircraft in 2039 using the population variable socio-economic methodology. Utilizing the same methodology but using the number of based aircraft per jobs in the county, based aircraft at ARB are projected to increase from 164 aircraft in 2019 to 212 aircraft in 2039.

Table D-3: Based Aircraft Forecasts – Socio-economic Methodologies

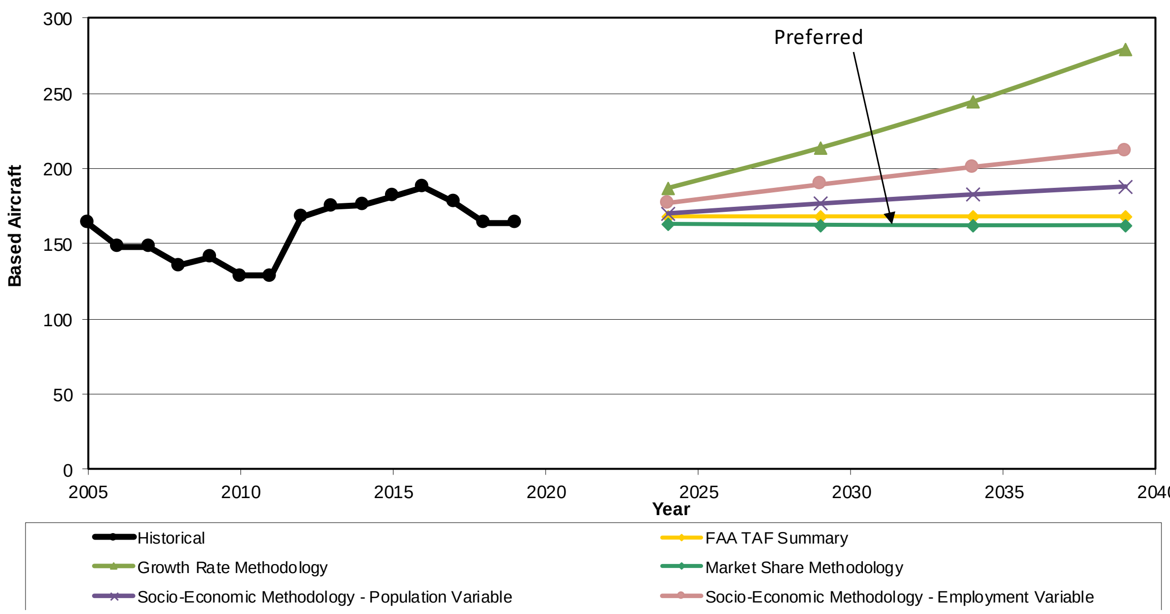
	Socio-Economic Methodology - Population Variable			Socio-Economic Methodology - Total Employment Variable		
Year	Based Aircraft	Washtenaw Co Population	Based Aircraft Per 1,000 Capita	Based Aircraft	Washtenaw Co Employment	Based Aircraft Per 1,000 Job
Historical:						
2010	129	345,568	0.373	129	242,579	0.532
2011	129	349,071	0.370	129	246,151	0.524
2012	168	351,299	0.478	168	247,774	0.678
2013	175	354,573	0.494	175	251,734	0.695
2014	176	358,980	0.490	176	253,938	0.693
2015	182	360,847	0.504	182	259,594	0.701
2016	188	364,709	0.515	188	264,064	0.712
2017	178	367,325	0.485	178	269,689	0.660
2018	164	370,216	0.443	164	274,308	0.598
2019	164	372,945	0.440	164	276,064	0.594
CAGR (2010-2019)	*2.70%*	*0.85%*		*2.70%*	*1.45%*	
Projected						
2024	171	387,740	0.440	178	299,024	0.594
2029	177	402,192	0.440	190	319,455	0.594
2034	183	415,555	0.440	201	338,861	0.594
2039	188	427,114	0.440	212	356,858	0.594
CAGR (2019-2039)	*0.68%*	*0.68%*		*1.29%*	*1.29%*	

Sources: Historical Based Aircraft - FAA TAF
Population & Employment - Woods & Poole

A comparison of projected based aircraft at ARB using the methodologies described in this section is presented in **Table D-4**. The methodologies range from a slight decrease in growth at a negative 0.05 percent (-0.05%) compound annual rate to growth of 2.70 percent (2.70%) using a CAGR. The FAA projects that active aircraft in the United States will decrease marginally over the next 20 years; therefore, for the purposes of these projections, the market share methodology serves as the preferred projection of based aircraft for the next 20 years. This methodology projects that based aircraft will fall from 164 in 2019 to 162 in 2039, representing a CAGR of negative 0.05 percent (-0.05%). This assumes no extension to the runway and that aircraft needing more runway length will continue to make operational concessions to use ARB.

Table D-4: Based Aircraft Forecasts Comparison

Year	Historical	FAA TAF Summary	Growth Rate Methodology	*Preferred* Market Share Methodology	Socio-Economic Methodology - Population Variable	Socio-Economic Methodology - Employment Variable
Historical:						
2005	164					
2006	148					
2007	148					
2008	136					
2009	141					
2010	129					
2011	129					
2012	168					
2013	175					
2014	176					
2015	182					
2016	188					
2017	178					
2018	164					
2019	164					
CAGR (2010-2019)	*2.70%*					
Projected:						
2024		168	187	163	171	178
2029		168	214	163	177	190
2034		168	245	162	183	201
2039		168	280	162	188	212
CAGR (2019-2039)		*0.12%*	*2.70%*	*-0.05%*	*0.68%*	*1.29%*



Sources: Historical Based Aircraft - FAA TAF
Projections - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA Terminal Area Forecast

D.3 Based Aircraft Fleet Mix

Historical based aircraft by type and the projected fleet mix at ARB is presented in **Table D-5**. In 2019, 87 percent (87%) of the local fleet was comprised of single-engine aircraft, 7 percent (7%) were multi-engine aircraft, 1 percent (1%) were jet aircraft, 5 percent (5%) were helicopters, and 1 percent (1%) were categorized as other.

The FAA Aerospace Forecast FY 2020-2040 projects the following growth rates in active aircraft within the United States from 2020 to 2040:

- Single Engine Piston -1.0%
- Multi-Engine Piston -0.5%
- Jet +2.2%
- Helicopters +1.6%
- Other 0.1%

Table D-5: Based Aircraft Fleet Mix Forecast

	Single Engine		Multi-Engine		Jet		Helicopter		Other		
Year	#	%	#	%	#	%	#	%	#	%	Total
Historical:											
2014	153	87%	14	8%	2	1%	6	3%	1	1%	176
2015	161	88%	13	7%	1	1%	7	4%	0	0%	182
2016	166	88%	13	7%	1	1%	7	4%	1	1%	188
2017	156	88%	12	7%	1	1%	8	4%	1	1%	178
2018	142	87%	12	7%	1	1%	8	5%	1	1%	164
2019	142	87%	12	7%	1	1%	8	5%	1	1%	164
Projected:											
2024	139	85%	11	7%	2	1%	10	6%	2	1%	163
2029	138	85%	11	7%	2	1%	10	6%	2	1%	163
2034	136	84%	11	7%	3	2%	10	6%	2	1%	162
2039	136	84%	11	7%	3	2%	10	6%	2	1%	162
CAGR (2019-2039)	*-0.20%*		*-0.27%*		*6.06%*		*0.99%*		*2.45%*		*-0.05%*

Notes: Numbers may not add due to rounding
Sources: Historical Based Aircraft FAA TAF
Projections - Mead & Hunt, Inc.

D.4 Air Taxi & Itinerant General Aviation Operations

As defined by the FAA, itinerant operations are operations performed by an aircraft, either IFR, special visual flight rule (SVFR), or VFR that lands at an airport arriving from outside the airport area or departs an airport and then leaves the airport area. Air taxi operations are operations with aircraft under 60 seats that are conducted for hire. At ARB, air taxi and itinerant GA operations are similar in the fact that they are conducted on demand of the aircraft owner or customer. Therefore, these operations have been projected together. FAA TAF and market share methodology projections are presented in **Table D-6**.

Table D-6: Air Taxi & Itinerant GA Operations Forecasts – Terminal Area Forecast and Market Share Methodology

		FAA TAF Summary	Market Share Methodology		
Year	Historical	AT & Itin GA Ops	AT & Itin GA Ops	Total U.S. AT & Itin GA Ops	Market Share
Historical:					
2010	21,310	21,007	21,310	24,274,237	0.088%
2011	21,288	21,118	21,288	23,806,445	0.089%
2012	23,759	24,175	23,759	23,516,027	0.101%
2013	22,499	22,779	22,499	22,920,772	0.098%
2014	22,252	22,214	22,252	22,418,704	0.099%
2015	22,897	22,881	22,897	21,782,681	0.105%
2016	24,329	23,792	24,329	21,485,323	0.113%
2017	24,777	24,907	24,777	21,018,802	0.118%
2018	24,766	24,871	24,766	21,256,051	0.117%
2019	28,676	27,652	28,676	21,479,026	0.134%
CAGR (2010-2019)	*3.35%*	*3.10%*	*3.35%*	*-1.35%*	
Projected:					
2024		28,406	26,782	20,060,743	0.134%
2029		29,024	27,400	20,523,530	0.134%
2034		29,658	28,054	21,013,191	0.134%
2039		30,304	28,736	21,523,791	0.134%
CAGR (2019-2039)		*0.46%*	*0.01%*	*0.01%*	

Sources: Historical Operations - FAA OPSNET
Total U.S. GA Operations - FAA Aerospace Forecasts FY 2020-2040
Projections - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA Terminal Area Forecast

The market share methodology compares the number of air taxi and itinerant GA Operations at ARB to the total number of air taxi and GA itinerant operations reported by the FAA nationally. ARB's market share of these types of operations has increased since 2010, and in 2019 the number operations at ARB represented 0.134 percent (0.134%) of total operations in the United States. FAA Aerospace Forecasts project these types of operations to grow slightly over the next 20 years, exhibiting a CAGR of only 0.01 percent (0.01%). Assuming ARB's national 0.134 percent (0.134%) market share remains constant through the forecast period, air taxi and itinerant GA operations at ARB will increase slightly over the next 20 years, from 28,676 in 2019 to 28,736 in 2039.

Based upon the observed and projected correlation between historical aviation activity and socio-economic data, air taxi and itinerant aircraft forecasts were developed. The forecasts that were prepared utilizing these methodologies are presented in **Table D-7**.

Table D-7: Air Taxi & Itinerant GA Operations Forecasts - Socio-Economic Methodologies

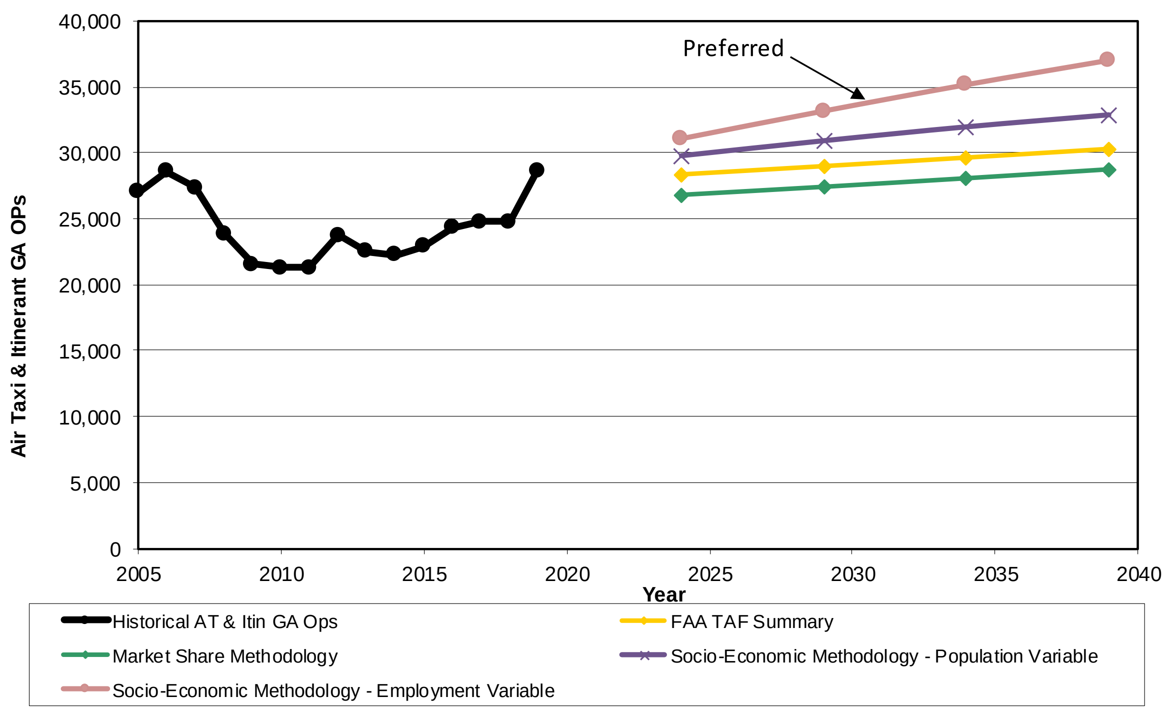
	Socio-Economic Methodology - Population Variable			Socio-Economic Methodology - Total Employment Variable		
Year	AT & Itin GA Ops	Washtenaw Co Population	Ops Per Capita	AT & Itin GA Ops	Washtenaw Co Employment	Ops Per Job
Historical:						
2010	21,310	345,568	0.062	21,310	242,579	0.088
2011	21,288	349,071	0.061	21,288	246,151	0.086
2012	23,759	351,299	0.068	23,759	247,774	0.096
2013	22,499	354,573	0.063	22,499	251,734	0.089
2014	22,252	358,980	0.062	22,252	253,938	0.088
2015	22,897	360,847	0.063	22,897	259,594	0.088
2016	24,329	364,709	0.067	24,329	264,064	0.092
2017	24,777	367,325	0.067	24,777	269,689	0.092
2018	24,766	370,216	0.067	24,766	274,308	0.090
2019	28,676	372,945	0.077	28,676	276,064	0.104
CAGR (2010-2019)	*3.35%*	*0.85%*		*3.35%*	*1.45%*	
Projected:						
2024	29,814	387,740	0.077	31,061	299,024	0.104
2029	30,925	402,192	0.077	33,183	319,455	0.104
2034	31,952	415,555	0.077	35,199	338,861	0.104
2039	32,841	427,114	0.077	37,068	356,858	0.104
	0.68%	*0.68%*		*1.29%*	*1.29%*	

Sources: Historical Operations - FAA OPSNET
Population & Employment - Woods & Poole
Projections - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA Terminal Area Forecast

A comparison of projected air taxi and itinerant GA operations at ARB using the methodologies described in this section is presented in **Table D-8**. The methodologies range from growth in operations at 0.01 percent (0.01%) CAGR as forecasted by the market share methodology to the socio-economic methodology – employment variable growth rate projection with a CAGR of 1.29 percent (1.29%). Since the FAA projects modest growth in air taxi and itinerant GA operations in the United States, the socio-economic methodology – employment variable projections are the preferred projection of air taxi and itinerant operations for the next 20 years. This methodology projects that air taxi and itinerant operations will grow from 28,676 annual operations in in 2019 to 37,068 annual operations in 2039, at a CAGR of 1.29 percent (1.29%).

Table D-8: Air Taxi & Itinerant General Aviation Operations Forecasts Comparison

Year	Historical AT & Itin GA Ops	FAA TAF Summary	Market Share Methodology	Socio-Economic Methodology - Population Variable	*Preferred* Socio-Economic Methodology - Employment Variable
Historical:					
2005	27,047				
2006	28,612				
2007	27,359				
2008	23,875				
2009	21,571				
2010	21,310				
2011	21,288				
2012	23,759				
2013	22,499				
2014	22,252				
2015	22,897				
2016	24,329				
2017	24,777				
2018	24,766				
2019	28,676				
CAGR (2005-2019)	*0.42%*				
Projected:					
2024		28,406	26,782	29,814	31,061
2029		29,024	27,400	30,925	33,183
2034		29,658	28,054	31,952	35,199
2039		30,304	28,736	32,841	37,068
CAGR (2019-2039)		*0.28%*	*0.01%*	*0.68%*	*1.29%*



Sources: Historical Operations - FAA OPSNET
Projections - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA Terminal Area Forecast

D.5 Local General Aviation Operations

As defined by the FAA, local operations are performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at an airport, or fly to/from the airport and a designated practice area within a 20−mile radius. **Table D-9** presents the local GA operations forecasts.

The operations per based aircraft methodology examines the number of local GA operations that occurred in 2019 per based aircraft. In 2019, the number of local GA operations per based aircraft was 291. Using the projected number of based aircraft for ARB and assuming this level of operations per based aircraft remains constant throughout the forecasting period, local GA operations will fall modestly from 47,653 in 2019 to 47,168 in 2039.

The market share methodology compares local activity with a larger entity. In 2019, ARB's 47,653 local GA operations represented 0.3635 percent (0.3635%) of the total national GA operations. Using the FAA's forecasts of total national local GA operations, and assuming the 2019 market share of 0.3635 percent (0.3635%) remains constant throughout the forecasting period, the market share methodology projects GA operations will increase from 47,653 in 2019 to 52,669 in 2039.

GA activity can be affected by many variables including the costs to own and operate an aircraft, available hangar space for lease, and the status of local, state, national and world economies. It is anticipated that ARB's number of local GA operations will remain consistent with the number of based aircraft; thus, the Operations per Based Aircraft Methodology is the preferred projection, representing a CAGR of negative 0.05 percent (-0.05%).

Table D-9: Local General Aviation Operations Forecasts

		FAA TAF Summary	*Preferred* Operations Per Based Aircraft Methodology			Market Share Methodology		
Year	Historical	Local GA Ops	Based Acft	Ops per Based Acft	Local GA Ops	Local GA Ops	Total U.S. Local GA Ops	Market Share
Historical:								
2010	42,629	41,096	129	330	42,629	42,629	11,716,274	0.3638%
2011	35,893	37,509	129	278	35,893	35,893	11,437,028	0.3138%
2012	39,737	39,488	168	237	39,737	39,737	11,608,306	0.3423%
2013	35,202	35,411	175	201	35,202	35,202	11,688,355	0.3012%
2014	35,051	35,599	176	199	35,051	35,051	11,675,040	0.3002%
2015	33,953	34,829	182	187	33,953	33,953	11,691,338	0.2904%
2016	33,933	33,064	188	180	33,933	33,933	11,632,612	0.2917%
2017	37,112	37,175	178	208	37,112	37,112	11,732,324	0.3163%
2018	38,264	38,181	164	233	38,264	38,264	12,354,014	0.3097%
2019	47,653	44,974	164	291	47,653	47,653	13,109,215	0.3635%
	1.25%	*1.01%*	*Average*	*234*	*1.25%*	*1.25%*	*1.26%*	
Projected:								
2024		46,120	163	291	47,494	50,088	13,779,091	0.3635%
2029		46,561	163	291	47,264	50,922	14,008,496	0.3635%
2034		47,006	162	291	47,123	51,782	14,245,082	0.3635%
2039		47,459	162	291	47,168	52,669	14,489,123	0.3635%
	CAGR (2019-2039)	*0.27%*	*-0.05%*		*-0.05%*	*0.50%*	*0.50%*	

Sources: Historical Operations - FAA OPSNET
Total U.S. GA Operations - FAA Aerospace Forecasts FY 2020-2040
Projections - Mead & Hunt, Inc., except FAA TAF Summary which are from the FAA Terminal Area Forecast

D.6 Total Air Taxi & General Aviation Operations Summary

Utilizing the preferred method noted in each section, the air taxi & itinerant GA operations forecasts and the local GA operations forecast are summarized in **Table D-10**.

Table D-10: Air Taxi & General Aviation Operations Forecast

	Total AT & GA	AT & Itin GA		Air Taxi		Itinerant GA		Local GA	
Year	Operations	Ops	%	Ops	%	Ops	%	Ops	%
Historical:									
2010	63,939	21,310	33%	208	0.3%	21,102	33%	42,629	67%
2011	57,181	21,288	37%	272	0.5%	21,016	37%	35,893	63%
2012	63,496	23,759	37%	474	0.7%	23,285	37%	39,737	63%
2013	57,701	22,499	39%	556	1.0%	21,943	38%	35,202	61%
2014	57,303	22,252	39%	524	0.9%	21,728	38%	35,051	61%
2015	56,850	22,897	40%	524	0.9%	22,373	39%	33,953	60%
2016	58,262	24,329	42%	568	1.0%	23,761	41%	33,933	58%
2017	61,889	24,777	40%	564	0.9%	24,213	39%	37,112	60%
2018	63,030	24,766	39%	570	0.9%	24,196	38%	38,264	61%
2019	76,329	28,676	38%	550	0.7%	28,126	37%	47,653	62%
CAGR (2010-2019)	*1.99%*	*3.35%*		*11.41%*		*3.24%*		*1.25%*	
Projected:									
2024	78,555	31,061	40%	596	0.8%	30,465	39%	47,494	60%
2029	80,447	33,183	41%	636	0.8%	32,547	40%	47,264	59%
2034	82,322	35,199	43%	675	0.8%	34,524	42%	47,123	57%
2039	84,237	37,068	44%	711	0.8%	36,357	43%	47,168	56%
CAGR (2019-2039)	*0.49%*	*1.29%*		*1.29%*		*1.29%*		*-0.05%*	

Sources: Historical Operations - FAA OPSNET
Projections - Mead & Hunt, Inc.

D.7 Military Operations

In 2019, the number of annual military operations conducted at ARB was 99. Military operations are driven more by national security policy decisions than by economic factors; therefore, it is logical to project military operations will remain constant as the number conducted in 2019. **Table D-11** presents the military operations projections.

Table D-11: Military Operations Forecast

	Itinerant		Local		Total
Year	Ops	%	Ops	%	Military Ops
Historical:					
2010	33	83%	7	18%	40
2011	36	95%	2	5%	38
2012	51	94%	3	6%	54
2013	40	93%	3	7%	43
2014	57	95%	3	5%	60
2015	47	72%	18	28%	65
2016	72	60%	49	40%	121
2017	68	88%	9	12%	77
2018	41	57%	31	43%	72
2019	76	77%	23	23%	99
Projected:					
2024	76	77%	23	23%	99
2029	76	77%	23	23%	99
2034	76	77%	23	23%	99
2039	76	77%	23	23%	99
CAGR (2019-2039)	*0.00%*		*0.00%*		

Sources: Historical Military Operations - FAA OPSNET
Projections - Mead & Hunt, Inc.

D.8 Instrument Operations

Instrument operations are those conducted by properly equipped aircraft that can utilize radio and global positioning system (GPS) signals emitted by navigational equipment for a pilot to conduct a landing with limited visual cues. Most instrument operations are conducted by itinerant aircraft. **Table D-12** presents a breakdown of historical itinerant aircraft operations recorded by the ATCT per FAA OPSNET records in IFR and visual conditions. Assuming this percentage remains constant throughout the forecasting period, instrument operations are projected to increase from 4,723 in 2019 to 5,972 in 2039.

Table D-12: Instrument Operations Forecast

	Itinerant	Instrument Operations		Visual Operations	
Year	Operations	Operations	%	Operations	%
Historical:					
2010	21,363	3,803	18%	17,560	82%
2011	21,333	4,021	19%	17,312	81%
2012	23,815	3,748	16%	20,067	84%
2013	22,541	3,831	17%	18,710	83%
2014	22,316	3,821	17%	18,495	83%
2015	22,944	3,564	16%	19,380	84%
2016	24,404	4,040	17%	20,364	83%
2017	24,845	3,859	16%	20,986	84%
2018	24,808	4,318	17%	20,490	83%
2019	28,754	4,723	16%	24,031	84%
Projected:					
2024	30,465	5,004	16%	25,461	84%
2029	32,547	5,346	16%	27,201	84%
2034	34,524	5,671	16%	28,853	84%
2039	36,357	5,972	16%	30,386	84%
CAGR (2019-2039)	*1.18%*	*1.18%*		*1.18%*	

Sources: Historical Operations - FAA OPSNET
Projections - Mead & Hunt, Inc.

D.9 Operations Fleet Mix

The projections of operations by fleet mix factors into the determination of the critical aircraft for Runway 6/24, particularly in the review of future jet operations. For this summary, it is assumed that all jet operations are conducted as instrument operations with an IFR flight plan. **Table D-13** summarizes the number of instrument operations conducted in 2019 by physical class and weight class, as defined by the TFMSC database, and notes the most prevalent aircraft types that conduct operations within each classification.

Assuming this fleet mix for instrument operations remains relatively constant throughout the planning period, and utilizing the forecasted number of instrument operations, the projected number of operations by classification is presented in the table. As shown, total operations are forecasted to increase from 4,649 in 2019 to 5,972 in 2039.

Table D-13: IFR Fleet Mix

Physical Class	Representative Types	2019 Ops	%	Forecast Operations 2024	2029	2034	2039
Jet	Cessna Excel/XLS, Citation Sovereign, Pilatus PC-24	263	5.7%	283	302	321	338
Jet	Phenom 300, CJ4	97	2.1%	104	112	118	125
	Subtotal Jets	**360**	**7.7%**	**387**	**414**	**439**	**462**
Turbine	TBM 850, TBM	150	3.2%	161	172	183	193
Turbine	Pilatus PC-12, Super King Air, Meridian, Caravan	966	20.8%	1,040	1,111	1,178	1,241
	Subtotal Turbine	**1,116**	**24.0%**	**1,201**	**1,283**	**1,361**	**1,434**
Piston	Cessna 172, 182, Piper Cherokee, Cirrus SR22	3,049	65.6%	3,282	3,506	3,719	3,917
	Subtotal Piston	**3,049**	**65.6%**	**3,282**	**3,506**	**3,719**	**3,917**
Other	Helicopter, Unclassified	124	2.7%	133	143	151	159
	Subtotal Other	**124**	**2.7%**	**133**	**143**	**151**	**159**
	Total IFR Itinerant Ops	**4,649**		**5,004**	**5,346**	**5,671**	**5,972**

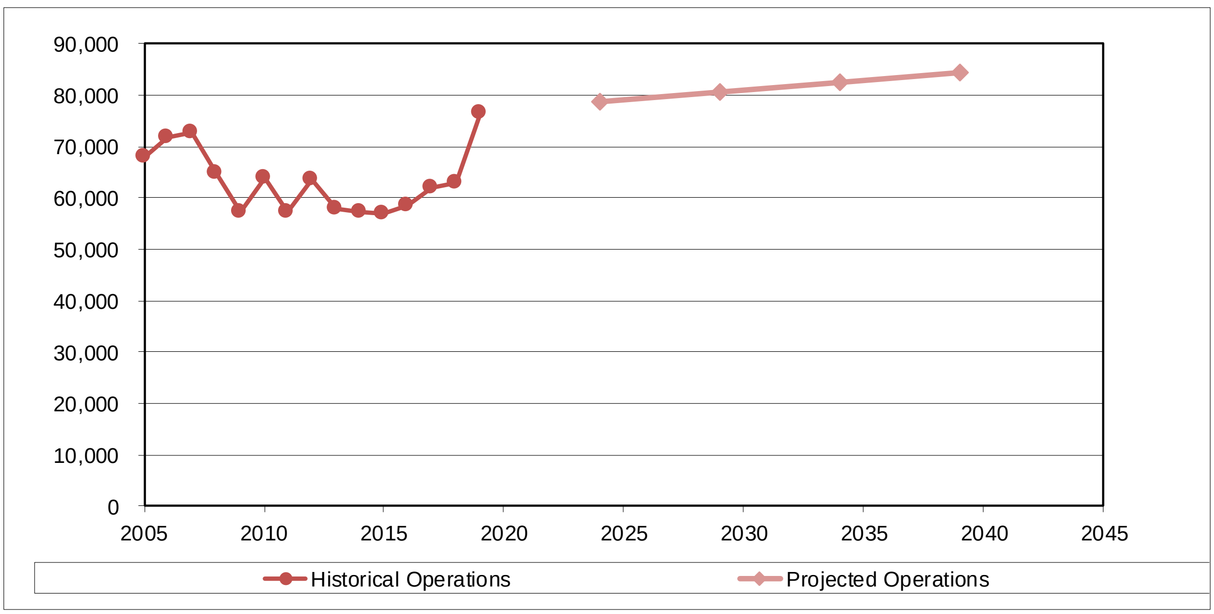
Source: 2019 IFR Operations - FAA TFMSC, Mead & Hunt
Projections - Mead & Hunt, Inc.

D.10 Forecasts Summary

A summary of the forecasts is presented in **Table D-14**.

Table D-14: Projections Summary

	Itinerant Operations			Local Operations			
Year	Air Taxi	General Aviation	Military	General Aviation	Military	Total Operations	Based Aircraft
Historical							
2005	2,105	24,942	17	40,871	5	67,940	164
2006	2,082	26,530	263	42,910	0	71,785	148
2007	1,876	25,483	243	45,251	0	72,853	148
2008	1,198	22,677	42	40,991	2	64,910	136
2009	376	21,195	22	35,508	8	57,109	141
2010	208	21,102	33	42,629	7	63,979	129
2011	272	21,016	36	35,893	2	57,219	129
2012	474	23,285	51	39,737	3	63,550	168
2013	556	21,943	40	35,202	3	57,744	175
2014	524	21,728	57	35,051	3	57,363	176
2015	524	22,373	47	33,953	18	56,915	182
2016	568	23,761	72	33,933	49	58,383	188
2017	564	24,213	68	37,112	9	61,966	178
2018	570	24,196	41	38,264	31	63,102	164
2019	550	28,126	76	47,653	23	76,428	164
Projected							
2024	596	30,465	76	47,494	23	78,654	163
2029	636	32,547	76	47,264	23	80,546	163
2034	675	34,524	76	47,123	23	82,421	162
2039	711	36,357	76	47,168	23	84,336	162
CAGR (2019-2039)	*1.29%*	*1.29%*	*0.00%*	*-0.05%*	*0.00%*	*0.49%*	*-0.05%*



Source: Historical Operations - FAA OPSNET
Historical Based Aircraft - FAA TAF
Projections - Mead & Hunt, Inc.

Appendix E: Aircraft Manufacturer Runway Performance Charts

CITATION CJ2+

TAKEOFF PERFORMANCE

TAKEOFF FIELD LENGTH – FLAPS 15°

(Over 35 Foot Screen Height)
Dry Runway, Zero Wind, Anti-Ice Off, Cabin Bleed Air On

Elevation = Sea Level

Ambient Temp °C / °F	Takeoff Weight (lb)							
	12,500	12,100	11,500	11,000	10,500	10,000	9,500	9,000
0 / 32	3,200	3,020	2,770	2,570	2,380	2,250	2,120	2,080
10 / 50	3,310	3,120	2,870	2,660	2,460	2,320	2,190	2,130
15 / 59	3,360	3,180	2,920	2,700	2,500	2,360	2,230	2,160
20 / 68	3,420	3,230	2,960	2,750	2,540	2,390	2,260	2,180
25 / 77	3,590	3,390	3,110	2,880	2,660	2,460	2,320	2,180
30 / 86	3,810	3,590	3,280	3,040	2,810	2,590	2,390	2,240
35 / 95	4,090	3,830	3,480	3,220	2,970	2,730	2,510	2,310
40 / 104	4,420	4,130	3,730	3,420	3,150	2,890	2,650	2,420
45 / 113	—	4,520	4,070	3,720	3,390	3,090	2,830	2,580
50 / 122	—	—	4,470	4,070	3,710	3,360	3,040	2,750
Climb Wght Temp Limits °C/°F	43/109	46/115	50/122	54/129	54/129	54/129	54/129	54/129
Field Length at Temp Limits (ft)	4,680	4,610	4,470	4,420	4,000	3,620	3,270	2,940

Elevation = 1,000 Feet

Ambient Temp °C / °F	Takeoff Weight (lb)							
	12,500	12,100	11,500	11,000	10,500	10,000	9,500	9,000
0 / 32	3,300	3,120	2,860	2,650	2,460	2,320	2,190	2,140
10 / 50	3,410	3,220	2,960	2,740	2,540	2,390	2,260	2,190
15 / 59	3,470	3,280	3,010	2,790	2,580	2,430	2,300	2,220
20 / 68	3,570	3,370	3,090	2,860	2,650	2,480	2,340	2,220
25 / 77	3,790	3,570	3,270	3,030	2,800	2,580	2,410	2,260
30 / 86	4,050	3,800	3,470	3,210	2,970	2,730	2,500	2,330
35 / 95	4,390	4,110	3,720	3,420	3,150	2,900	2,660	2,420
40 / 104	—	4,480	4,040	3,700	3,370	3,090	2,830	2,580
45 / 113	—	—	4,420	4,040	3,680	3,340	3,020	2,750
50 / 122	—	—	—	4,450	4,030	3,650	3,300	2,960
Climb Wght Temp Limits °C/°F	39/102	42/108	48/118	51/124	52/126	52/126	52/126	52/126
Field Length at Temp Limits (ft)	4,720	4,660	4,690	4,540	4,200	3,800	3,430	3,080

CITATION CJ2+

LANDING PERFORMANCE

LANDING DISTANCE – ACTUAL

(Distance from 50 Feet Above the Runway)
Flaps Land, Dry Runway, Zero Wind, Anti-Ice On or Off

Elevation = Sea Level								
Ambient Temp	Landing Weight (lb)							
°C / °F	11,525	11,100	10,500	10,000	9,500	9,000	8,500	8,000
0 / 32	2,870	2,800	2,700	2,620	2,530	2,450	2,360	2,250
10 / 50	2,940	2,870	2,770	2,690	2,600	2,510	2,420	2,310
15 / 59	2,980	2,910	2,810	2,720	2,640	2,550	2,450	2,340
20 / 68	3,020	2,950	2,850	2,760	2,670	2,580	2,480	2,370
25 / 77	3,060	2,990	2,880	2,790	2,700	2,610	2,510	2,400
30 / 86	3,100	3,020	2,920	2,830	2,740	2,640	2,550	2,430
35 / 95	3,140	3,060	2,950	2,860	2,770	2,670	2,580	2,460
40 / 104	3,180	3,100	2,990	2,900	2,800	2,710	2,610	2,490
45 / 113	3,210	3,140	3,020	2,930	2,840	2,740	2,640	2,520
50 / 122	3,250	3,170	3,060	2,960	2,870	2,770	2,670	2,550
Lndg Wght Temp Limits °C/°F	54/129	54/129	54/129	54/129	54/129	54/129	54/129	54/129
V_{REF} (KIAS)	111	109	106	104	101	99	96	93

Elevation = 1,000 Feet								
Ambient Temp	Landing Weight (lb)							
°C / °F	11,525	11,100	10,500	10,000	9,500	9,000	8,500	8,000
0 / 32	2,940	2,870	2,770	2,680	2,600	2,510	2,420	2,310
10 / 50	3,020	2,950	2,850	2,760	2,670	2,580	2,480	2,370
15 / 59	3,060	2,990	2,880	2,790	2,700	2,610	2,510	2,400
20 / 68	3,100	3,030	2,920	2,830	2,740	2,640	2,550	2,430
25 / 77	3,140	3,070	2,960	2,870	2,770	2,680	2,580	2,460
30 / 86	3,180	3,100	2,990	2,900	2,810	2,710	2,610	2,490
35 / 95	3,220	3,140	3,030	2,940	2,840	2,740	2,640	2,520
40 / 104	3,260	3,180	3,070	2,970	2,880	2,780	2,670	2,550
45 / 113	3,300	3,220	3,100	3,010	2,910	2,810	2,700	2,580
50 / 122	3,340	3,260	3,140	3,040	2,940	2,840	2,740	2,610
Lndg Wght Temp Limits °C/°F	50/122	52/126	52/126	52/126	52/126	52/126	52/126	52/126
V_{REF} (KIAS)	111	109	106	104	101	99	96	93

CITATION CJ3

TAKEOFF PERFORMANCE

TAKEOFF FIELD LENGTH - 15° FLAPS

(Over 35 Foot Screen Height)
Dry Runway, Zero Wind, Anti-Ice Off, Cabin Bleed Air On

Elevation = Sea Level								
Ambient Temp	Takeoff Weight (lb)							
°C / °F	13,870	13,400	13,000	12,500	12,000	11,500	11,000	10,000
10 / 50	3,130	2,940	2,820	2,700	2,580	2,570	2,580	2,640
15 / 59	3,180	2,990	2,870	2,740	2,620	2,600	2,610	2,670
20 / 68	3,230	3,040	2,910	2,780	2,660	2,630	2,650	2,710
25 / 77	3,290	3,090	2,960	2,820	2,700	2,660	2,680	2,740
30 / 86	3,440	3,230	3,070	2,900	2,770	2,640	2,630	2,680
35 / 95	3,690	3,460	3,280	3,060	2,860	2,720	2,600	2,570
40 / 104	4,030	3,740	3,530	3,290	3,070	2,850	2,680	2,450
45 / 113	4,480	4,130	3,850	3,540	3,290	3,060	2,840	2,510
50 / 122	5,050	4,610	4,280	3,900	3,550	3,280	3,040	2,600
55 / 131	—	5,180	4,770	4,310	3,910	3,550	3,240	2,760
Climb Wght Temp Limits °C/°F	54/129	55/131	55/131	55/131	55/131	55/131	55/131	55/131
Field Length at Temp Limits (ft)	5,580	5,180	4,770	4,310	3,910	3,550	3,240	2,760

Elevation = 1,000 Feet								
Ambient Temp	Takeoff Weight (lb)							
°C / °F	13,870	13,400	13,000	12,500	12,000	11,500	11,000	10,000
0 / 32	3,120	2,940	2,820	2,700	2,580	2,570	2,590	2,650
10 / 50	3,230	3,030	2,910	2,780	2,660	2,640	2,660	2,720
15 / 59	3,280	3,080	2,960	2,830	2,700	2,680	2,690	2,750
20 / 68	3,340	3,140	3,010	2,870	2,750	2,710	2,720	2,780
25 / 77	3,460	3,260	3,090	2,940	2,810	2,690	2,700	2,750
30 / 86	3,690	3,460	3,280	3,060	2,890	2,760	2,630	2,650
35 / 95	3,970	3,720	3,520	3,290	3,060	2,850	2,710	2,540
40 / 104	4,420	4,070	3,800	3,540	3,290	3,050	2,830	2,540
45 / 113	4,970	4,550	4,230	3,850	3,540	3,280	3,040	2,620
50 / 122	5,650	5,120	4,720	4,280	3,890	3,530	3,260	2,780
Climb Wght Temp Limits °C/°F	51/124	52/126	52/126	52/126	52/126	52/126	52/126	52/126
Field Length at Temp Limits (ft)	5,800	5,380	4,950	4,470	4,050	3,670	3,350	2,850

CITATION CJ3

LANDING PERFORMANCE

LANDING DISTANCE - ACTUAL

(Distance from 50 Feet Above the Runway)
Flaps 35°, Dry Runway, Zero Wind, Anti-Ice On or Off

Elevation = Sea Level

Ambient Temp °C / °F	Landing Weight (lb) 12,750	12,000	11,500	11,000	10,500	10,000	9,500	9,000
0 / 32	2,650	2,540	2,470	2,400	2,340	2,270	2,210	2,150
10 / 50	2,730	2,610	2,540	2,470	2,400	2,330	2,270	2,200
15 / 59	2,770	2,650	2,580	2,500	2,430	2,370	2,300	2,230
20 / 68	2,810	2,690	2,610	2,540	2,460	2,400	2,330	2,260
25 / 77	2,850	2,720	2,640	2,570	2,500	2,420	2,360	2,290
30 / 86	2,880	2,760	2,680	2,600	2,530	2,460	2,390	2,320
35 / 95	2,920	2,800	2,710	2,630	2,560	2,490	2,410	2,350
40 / 104	2,960	2,830	2,750	2,670	2,590	2,520	2,440	2,380
45 / 113	3,000	2,870	2,780	2,700	2,620	2,550	2,470	2,400
50 / 122	3,040	2,900	2,820	2,730	2,650	2,580	2,500	2,430
Lndg Wght Temp Limits °C/°F	54/129	54/129	54/129	54/129	54/129	54/129	54/129	54/129
V_{REF} (KIAS)	108	105	103	101	99	97	95	93

Elevation = 1,000 Feet

Ambient Temp °C / °F	Landing Weight (lb) 12,750	12,000	11,500	11,000	10,500	10,000	9,500	9,000
0 / 32	2,730	2,610	2,540	2,470	2,400	2,330	2,270	2,200
10 / 50	2,810	2,690	2,610	2,540	2,460	2,400	2,330	2,260
15 / 59	2,850	2,730	2,650	2,570	2,500	2,430	2,360	2,290
20 / 68	2,890	2,760	2,680	2,600	2,530	2,460	2,390	2,320
25 / 77	2,930	2,800	2,720	2,640	2,560	2,490	2,420	2,350
30 / 86	2,970	2,840	2,750	2,670	2,600	2,520	2,450	2,380
35 / 95	3,010	2,870	2,790	2,710	2,630	2,550	2,480	2,410
40 / 104	3,050	2,910	2,820	2,740	2,660	2,590	2,510	2,440
45 / 113	3,090	2,950	2,860	2,780	2,690	2,620	2,540	2,470
50 / 122	3,130	2,990	2,900	2,810	2,730	2,650	2,570	2,490
Lndg Wght Temp Limits °C/°F	52/126	52/126	52/126	52/126	52/126	52/126	52/126	52/126
V_{REF} (KIAS)	108	105	103	101	99	97	95	93

CITATION M2

2. PERFORMANCE

All performance data is based on the standard aircraft configuration, operating in International Standard Atmosphere (ISA) conditions with zero wind. Takeoff and landing field lengths are based on a level, hard surface, dry runway. Actual performance will vary with individual airplanes and other factors such as environmental conditions, aircraft configuration, and operational/ATC procedures.

Takeoff Runway Length .... 3,250 ft (991 m)
(Maximum Takeoff Weight, Sea Level, ISA,
Balanced Field Length per Part 25, 15° Flaps)

Climb Performance .... 25 min to 41,000 ft (12,497 m)
(Maximum Takeoff Weight, Sea Level, ISA)

Maximum Altitude .... 41,000 ft (12,497 m)

Maximum Cruise Speed (± 3%) .... 400 KTAS (741 km/hr) at 460 mph
(Mid-Cruise Weight, 31,000 ft (9,449 m), ISA)

NBAA IFR Range (100 nm alternate) (± 4%) .... 1,300 nm (2,408 km, 1,496 mi)
(Maximum Takeoff Weight, Full Fuel, Optimal Climb
and Descent, Maximum Cruise Thrust at 41,000 feet)

Landing Runway Length .... 2,590 ft (789 m)
(Maximum Landing Weight, Sea Level, ISA, per Part 25)

Certified Noise Levels

Takeoff .... 73.5 EPNdB
Sideline .... 85.2 EPNdB
Landing .... 88.5 EPNdB

Flight Solutions®

1981 Cessna Citation 501SP

1521 Airport Blvd., Sumner County Regional Airport (M33), Gallatin, TN USA 37066 • Phone: (615) 452-5001 Fax: (615) 451-2371 • Email: info@flightsolution.com

Corporate owned and operated Citation 501SP with a great pedigree and ready for immediate service. Garmin 725 "touch" screen equipped with Garmin ADS-B traffic and weather and full digital color radar display. Great value for the money in a "single pilot" capable light jet. Call today to find out more about this opportunity!

Aircraft Overview

Price: Make Offer!
Sale Type: For Sale, Trade,

Year: 1981
Manufacturer: Cessna
Model: Citation 501SP
S/N: 501-0195
Registration: N123KD

TTAF: 8,116.0
Total Landings: 8,252

Stage: 3
Configuration: Executive

Engine Details #1

Type: Pratt and Whitney JT-15D-1A
S/N: 76467
TTSN: 9,375
SHSI: 1,404
SMOH: 3,116

Engine Details #2

Type: Pratt and Whitney JT-15D-1A
S/N: 76110
TTSN: 9470
SHSI: 92
SMOH: 1,739

Avionics

- Sperry SPZ-500 Flight Director
- Sperry SPZ-500 Auto-Pilot
- IS & S RVSM
- Garmin 725 "touch" screen
- Garmin ADS "B" traffic and weather
- Honeywell KPG-560 TAWS "B"
- Dual Collins VHF 21A COMS
- Dual Collins VIR 32 NAVS
- 1 Collins DME 40
- Dual Collins TDR-90 Transponders
- Sperry RT 220 Radar Altimeter
- Flite Phone VI
- BFG Goodrich WX 1000+ Stormscope
- Bendix Color RDS 81 Radar displays on Garmin 725

Equipment

- Thrust Reversers
- Recognition Lights
- Keith Freon Air Conditioning
- Engine Sync
- 64 Cubic Foot O2 system
- Rosen Monorail Sun Visors
- Lead Acid Battery Conversion
- Remote gear-horn silencer on Pilot's yoke.
- Stand-by Gyro
- Sierra Radome Modification
- Full De-Ice and Anti-Ice Equipment.

Interior

Seven (7) place interior (Single pilot). Forward "slim-line" galley w/ heated Mapco and two individual thermos, forward LH Barrel Seat, single LH aft facing seat, four place club with executive tables, aft potty. Completed in Biege Leather, high gloss burle maple woodwork, gold plated fixtures and complimentary accents!

Seats re-dyed in 2015 by Lotus Aircraft Interior Services.

Exterior

New Paint completed June of 2008 by ROSE Aircraft. Overall Mattahorn White with Pearl Gold and Medium Concord Blue Stripes.

Touched up in 2015 by Lotus Aircraft Paint.

Inspection Details

- Last Inspected August 22nd, 2017
- Last Inspection Phase 1-4 B by Twin Cities Aviation - MN – August 2017
- Phase 5 by Twin Cities Aviation – 10/27/2016 – due 10-2019
- Phase 20 – 24 month pilot static/ transponder RVSM recertification – 8/22/2017
- NEW PAINT - June 2008 by ROSE Aircraft/2 year warranty – touched up 2015
- New De-Ice boots - June 2008
- Sierra Radom Modification - June 2008
- All New Stainless Steel Screws and fasteners - June 2008
- Computerized Maintenance – Sierra Com
- Factory Maintenance Program
- Complete Records
- Impeller's are "post" AD.
- Flap Gear Box OVH's - 11/09
- Interior re-dyed 2015
  ** request complete maintenance status for more information**

General Characteristics

Weights (lb)
Max Ramp 12,000
Max Takeoff 11,850
Max Landing 11,350
Zero Fuel 9500c
BOW 7,403
Max Payload 2,097
Useful Load 4,597
Executive Payload 1,200
Max Fuel 3,780

Max Fuel 3,780
Avail Payload Max Fuel 817
Avail Fuel Max Payload 2,500
Avail Fuel Exec Payload 3,397
Limits
MMO 0.705
Transition Altitude FL/VMO N/A
Cabin Pressurization (PSI) 8.5
Airport Performance
TO (Sea Level, ISA Temp) 2,930
TO (5000⊠, @25C) 5,700
Hot/High WAT 11,850
NBAA IFR Ranges 948
V2 @ SL ISA, MTOW 106
VREF 96
Landing Distance with 4 Passengers 2,017
Climb
Time to Climb/Alt N/A
Engine Out Rate fpm 826
FAR 25 Engine-Out Grad (ft/nm) 421
Ceilings (ft)
Certificated 41,000
All Eng Srv 39,000
Eng Out Service 21,000
Sea Level Cabin 22,040
Long Range Cruise
KTAS 322
Fuel Flow 685
Altitude FL 410
Specific Range 0.470
High Speed Cruise
KTAS 349
Fuel Flow 865
Altitude FL 370
Specific Range 0.403

Damage History

No known damage history.

Disclaimer

The offer for sale of this aircraft is subject to contract and the aircraft may at any time be withdrawn from the market without prior notice. Specification is subject to verification by the purchaser and is not guaranteed for accuracy and Buyer should rely on their inspection as all aircraft are sold "as is, where is".

flightsolution.com

MODEL 510 **SECTION IV - PERFORMANCE TAKEOFF**

TAKEOFF FIELD LENGTH - FEET
(OVER 35 FOOT SCREEN HEIGHT)

FLAPS - 15°
1000 FEET

CONDITIONS: DRY RUNWAY
RUNWAY GRADIENT - ZERO
LANDING GEAR - DOWN
SPEEDBRAKES - RETRACT

ANTI-ICE OFF
INOPERATIVE ENGINE - WINDMILLING AFTER V1
OPERATIVE ENGINE - TAKEOFF THRUST

SOME CONDITIONS DO NOT MEET CLIMB REQUIREMENTS. OBTAIN ALLOWABLE WEIGHT FROM MAXIMUM TAKEOFF WEIGHT TABLES.

WEIGHT = 8645 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-45	89	3960	89	2680	89	2500	89	2310	89	2140	89	97
-40	89	4010	89	2730	89	2540	89	2350	89	2170	89	97
-35	89	4060	89	2770	89	2580	89	2390	89	2210	89	97
-30	89	4110	89	2810	89	2620	89	2430	89	2250	89	97
-25	89	4160	89	2850	89	2660	89	2470	89	2290	89	97
-20	89	4210	89	2900	89	2700	89	2510	89	2330	89	97
-15	89	4270	89	2940	89	2740	89	2550	89	2370	89	97
-10	89	4320	89	2980	89	2780	89	2590	89	2400	89	97
-5	89	4370	89	3020	89	2820	89	2630	89	2440	89	97
0	89	4420	89	3070	89	2870	89	2670	89	2480	89	97
5	89	4470	89	3110	89	2910	89	2710	89	2520	89	97
10	89	4520	89	3150	89	2950	89	2750	89	2560	89	97
15	89	4580	89	3200	89	2990	89	2790	89	2600	89	97
20	89	4630	89	3240	89	3030	89	2830	89	2640	89	97
25	89	4860	89	3390	89	3180	89	2970	89	2770	89	97
30	90	5530	90	3810	90	3570	90	3340	90	3120	90	97
35	90	6470	90	4370	90	4110	90	3850	90	3600	90	97
40	91	7960	91	5240	91	4920	91	4620	91	4330	91	97
45	92	11400	92	7150	92	6740	92	6340	92	5950	92	97

WEIGHT = 8000 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-40	85	3330	85	2280	85	2120	85	1980	85	1800	85	93
-35	85	3380	85	2320	86	2150	85	1990	85	1830	85	93
-30	85	3420	85	2350	86	2190	85	2020	85	1860	85	93
-25	85	3460	85	2390	85	2220	85	2060	85	1900	85	93
-20	85	3510	85	2420	85	2250	85	2090	85	1930	85	93
-15	85	3550	85	2460	85	2290	85	2120	85	1960	85	93
-10	85	3590	85	2500	85	2330	85	2160	85	1990	85	93
-5	85	3640	86	2540	85	2360	85	2190	85	2030	85	93
0	85	3680	85	2580	85	2400	85	2220	85	2060	85	93
5	85	3720	85	2610	85	2430	85	2260	85	2090	85	93
10	85	3770	85	2650	85	2460	85	2290	85	2130	85	93
15	85	3810	85	2690	85	2500	85	2330	85	2160	85	93
20	85	3850	85	2730	86	2540	85	2380	85	2190	85	93
25	85	4030	85	2840	85	2640	85	2460	85	2290	85	93
30	86	4500	86	3130	86	2930	86	2730	86	2540	86	93
35	86	5120	86	3520	86	3300	86	3080	86	2870	86	93
40	87	6000	87	4050	87	3800	87	3550	87	3310	87	93
45	88	7570	88	4960	88	4660	88	4380	88	4070	88	93
47	88	8590	88	5530	88	5200	88	4880	88	4560	88	93

WEIGHT = 7500 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-40	84	3000	83	2120	83	1960	83	1800	83	1650	84	93
-35	84	3040	83	2160	83	1990	83	1830	83	1680	84	93
-30	84	3080	83	2200	83	2030	83	1870	83	1710	84	93
-25	84	3120	83	2230	83	2070	83	1900	83	1750	84	93
-20	84	3160	83	2270	83	2100	83	1940	83	1780	84	93
-15	84	3200	83	2310	83	2140	83	1970	83	1810	84	93
-10	84	3240	83	2340	83	2170	83	2000	83	1840	84	93
-5	84	3280	82	2380	83	2210	83	2040	83	1880	84	93
0	84	3320	82	2420	83	2240	83	2070	83	1910	84	93
5	84	3360	82	2450	83	2280	83	2110	83	1940	84	93
10	84	3400	82	2490	83	2310	83	2140	83	1980	84	93
15	84	3440	82	2530	83	2350	83	2180	83	2010	84	93
20	84	3480	82	2560	83	2380	83	2210	83	2040	84	93
25	83	3570	82	2600	82	2410	82	2240	83	2070	83	92
30	82	3880	82	2700	82	2520	82	2350	82	2180	82	90
35	83	4330	83	3000	83	2800	83	2610	83	2420	83	90
40	84	4850	84	3390	84	3170	84	2960	84	2750	84	90
45	84	5980	84	3990	84	3740	84	3490	84	3250	84	90
47	85	6540	86	4330	85	4060	85	3790	85	3530	85	90

WEIGHT = 7000 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-40	84	2750	81	2030	81	1870	81	1720	82	1560	84	93
-35	84	2790	81	2060	81	1910	81	1760	82	1610	84	93
-30	84	2830	81	2100	81	1940	81	1790	82	1640	84	94
-25	84	2870	81	2130	81	1980	81	1820	82	1670	84	94
-20	84	2910	81	2170	81	2010	81	1850	82	1700	84	94
-15	84	2950	81	2200	81	2040	81	1880	82	1730	84	94
-10	84	3000	81	2240	81	2070	81	1920	81	1770	84	94
-5	83	3040	81	2270	81	2110	81	1950	81	1790	84	94
0	83	3080	81	2310	81	2140	81	1980	81	1830	84	94
5	83	3130	81	2340	81	2180	81	2010	81	1860	84	94
10	83	3170	81	2380	81	2210	81	2050	81	1890	84	94
15	83	3220	81	2410	81	2240	81	2080	81	1920	84	94
20	83	3260	81	2450	81	2280	81	2110	81	1950	84	94
25	83	3310	80	2480	81	2300	81	2140	81	1970	83	93
30	81	3420	80	2490	80	2320	80	2140	80	1980	81	90
35	80	3880	80	2570	80	2390	80	2220	80	2050	80	87
40	80	4140	80	2860	80	2660	80	2480	80	2300	80	87
45	81	4840	81	3290	81	3070	81	2860	81	2650	81	87
47	81	5210	81	3510	81	3280	81	3050	81	2840	81	87

WEIGHT = 6500 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-40	82	2810	79	1980	79	1810	79	1650	80	1510	84	94
-35	82	2850	79	2010	79	1840	79	1680	80	1540	84	94
-30	81	2890	79	2040	79	1870	79	1710	80	1570	84	94
-25	81	2730	79	2070	79	1900	79	1740	80	1600	84	94
-20	81	2770	79	2100	79	1930	79	1770	80	1630	84	94
-15	81	2810	79	2130	79	1960	79	1800	80	1660	84	94
-10	81	2850	79	2170	79	1990	79	1830	80	1690	84	94
-5	81	2890	79	2190	79	2020	79	1870	80	1720	84	94
0	81	2930	79	2230	79	2050	79	1900	80	1750	84	94
5	81	2980	79	2260	79	2080	79	1930	80	1780	84	94
10	81	3000	79	2290	79	2110	79	1960	79	1810	84	94
15	81	3040	79	2320	79	2150	79	1990	79	1840	84	94
20	81	3080	79	2350	79	2180	79	2020	79	1870	84	94
25	81	3110	78	2360	79	2200	79	2040	79	1890	83	93
30	80	3140	78	2370	78	2200	78	2040	78	1880	81	90
35	79	3260	77	2380	77	2210	77	2040	78	1880	79	87
40	77	3480	76	2420	77	2240	77	2080	77	1920	77	84
45	77	3980	77	2730	77	2540	77	2360	77	2180	77	84
47	78	4240	78	2890	78	2690	78	2500	78	2310	78	84

WEIGHT = 6000 LBS							VENR = 118 KIAS					
TEMP DEG C	TAILWIND 10 KTS		ZERO WIND		HEADWINDS 10 KTS		HEADWINDS 20 KTS		HEADWINDS 30 KTS			
	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	V1 KIAS	DIST FT	VR KIAS	V2 KIAS
-40	80	2560	80	2030	80	1860	80	1710	80	1560	84	95
-35	80	2590	80	2060	80	1890	80	1740	80	1580	84	95
-30	80	2630	80	2090	80	1930	80	1770	80	1610	84	95
-25	80	2660	80	2120	80	1960	80	1790	80	1640	84	95
-20	80	2700	80	2160	80	1980	80	1820	80	1670	84	95
-15	80	2730	80	2190	80	2010	80	1850	80	1690	84	95
-10	80	2770	80	2220	80	2040	80	1880	80	1720	84	95
-5	80	2800	80	2250	80	2080	80	1910	80	1750	84	95
0	80	2830	80	2280	80	2110	80	1940	80	1780	84	95
5	79	2870	79	2310	79	2140	79	1970	79	1800	84	95
10	79	2900	79	2340	79	2170	79	1990	79	1830	84	95
15	79	2940	79	2370	79	2190	79	2020	79	1860	84	95
20	79	2970	79	2400	79	2220	79	2050	79	1890	84	95
25	79	2970	78	2370	78	2190	78	2020	78	1860	83	94
30	78	2980	76	2270	76	2100	76	1940	76	1790	81	91
35	78	3000	75	2250	75	2090	75	1930	76	1780	79	88
40	76	3090	74	2260	74	2090	75	1930	75	1780	76	84
45	73	3300	73	2280	73	2110	73	1960	73	1800	73	81
47	74	3490	74	2390	74	2220	74	2050	74	1890	74	81

MODEL 510

SECTION V - SUPPLEMENTS
SUPPLEMENT 2

LANDING DISTANCE - FEET ACTUAL DISTANCE

FLAPS - LAND 1000 FEET

STALL WARNING - NORMAL
ANTI-ICE - OFF / ON

CONDITIONS: LANDING GEAR - DOWN; THRUST - IDLE AT 35 FEET; SPEED BRAKES - EXTENDED; AIRSPEED - SVREF AT 35 FEET

SOME CONDITIONS MAY BE BRAKE ENERGY OR CLIMB LIMITED. OBTAIN ALLOWABLE WEIGHT FROM MAXIMUM LANDING WEIGHT TABLES.

*WEIGHT = 8645 POUNDS — SVREF = 103 KIAS — VAPP = 105 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-35	2360	1880	1740	1610	1490
-30	2390	1910	1770	1640	1520
-25	2430	1940	1800	1670	1550
-20	2460	1970	1830	1700	1570
-15	2500	2000	1860	1730	1600
-10	2540	2030	1890	1760	1630
-5	2570	2060	1920	1780	1660
0	2610	2100	1950	1810	1680
5	2650	2130	1980	1840	1710
10	2680	2160	2010	1870	1740
15	2720	2190	2040	1900	1770
20	2770	2230	2070	1930	1790
25	2810	2260	2110	1960	1820
30	2850	2300	2140	1990	1860
35	2890	2330	2180	2030	1890
40	2940	2370	2210	2060	1920
41	2940	2380	2220	2060	1920

WEIGHT = 8000 POUNDS — SVREF = 99 KIAS — VAPP = 101 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-30	2240	1780	1650	1530	1420
-25	2270	1810	1680	1560	1440
-20	2300	1840	1710	1580	1460
-15	2330	1870	1730	1610	1490
-10	2360	1890	1760	1630	1510
-5	2400	1920	1790	1660	1540
0	2430	1950	1810	1680	1560
5	2460	1980	1840	1710	1590
10	2490	2010	1870	1740	1610
15	2530	2040	1900	1760	1640
20	2570	2070	1930	1790	1660
25	2600	2100	1960	1820	1690
30	2640	2130	1980	1850	1720
35	2680	2160	2010	1880	1750
40	2720	2190	2050	1910	1770
45	2750	2230	2080	1940	1800
46	2760	2230	2080	1940	1800

WEIGHT = 7500 POUNDS — SVREF = 96 KIAS — VAPP = 98 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-30	2120	1690	1560	1450	1340
-25	2150	1710	1590	1470	1360
-20	2180	1740	1610	1490	1380
-15	2210	1770	1640	1520	1400
-10	2240	1790	1660	1540	1430
-5	2270	1810	1690	1560	1450
0	2300	1840	1710	1590	1470
5	2330	1870	1740	1610	1490
10	2360	1890	1760	1640	1520
15	2390	1920	1790	1660	1540
20	2420	1950	1810	1690	1560
25	2450	1980	1840	1710	1590
30	2490	2010	1870	1740	1610
35	2520	2030	1900	1770	1640
40	2560	2060	1930	1790	1670
45	2590	2090	1950	1820	1690
47	2600	2110	1970	1830	1700

WEIGHT = 7000 POUNDS — SVREF = 93 KIAS — VAPP = 95 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-30	2010	1590	1480	1360	1260
-25	2040	1620	1500	1390	1280
-20	2060	1640	1520	1410	1300
-15	2090	1660	1550	1430	1320
-10	2120	1690	1570	1450	1340
-5	2140	1710	1590	1470	1360
0	2170	1740	1610	1490	1380
5	2190	1760	1630	1520	1400
10	2220	1780	1660	1540	1420
15	2250	1810	1680	1560	1450
20	2280	1830	1710	1580	1470
25	2310	1860	1730	1610	1490
30	2340	1890	1760	1630	1520
35	2370	1910	1780	1660	1540
40	2400	1940	1810	1680	1560
45	2440	1970	1830	1710	1580
47	2450	1980	1840	1720	1590

WEIGHT = 6500 POUNDS — SVREF = 89 KIAS — VAPP = 91 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-30	1900	1500	1390	1280	1180
-25	1920	1520	1410	1300	1190
-20	1950	1540	1430	1320	1210
-15	1970	1560	1450	1340	1230
-10	1990	1580	1470	1360	1250
-5	2020	1610	1490	1380	1270
0	2040	1630	1510	1400	1290
5	2070	1650	1530	1420	1310
10	2090	1670	1550	1440	1330
15	2120	1690	1570	1460	1350
20	2140	1720	1600	1480	1370
25	2170	1740	1620	1500	1390
30	2200	1770	1640	1530	1410
35	2230	1790	1670	1550	1430
40	2250	1810	1690	1570	1450
45	2280	1840	1710	1590	1480
47	2300	1850	1720	1600	1490

WEIGHT = 6000 POUNDS — SVREF = 86 KIAS — VAPP = 87 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-30	1790	1410	1300	1190	1100
-25	1810	1430	1320	1210	1110
-20	1830	1450	1340	1230	1130
-15	1850	1470	1350	1250	1150
-10	1870	1490	1370	1270	1160
-5	1900	1500	1390	1290	1180
0	1920	1520	1410	1300	1200
5	1940	1540	1430	1320	1220
10	1960	1560	1450	1340	1240
15	1980	1580	1470	1360	1250
20	2010	1600	1490	1380	1270
25	2030	1630	1510	1400	1290
30	2060	1650	1530	1420	1310
35	2090	1670	1550	1440	1330
40	2110	1690	1570	1460	1350
45	2140	1720	1590	1480	1370
47	2150	1730	1600	1490	1380

510FM S2 02 01

TO OBTAIN LANDING DISTANCE WITH NEGATIVE (DOWNHILL) RUNWAY GRADIENT, REFER TO LANDING PROCEDURES

* FOR USE IN AN EMERGENCY WHICH REQUIRES LANDING IN EXCESS OF THE MAXIMUM DESIGN LANDING WEIGHT OF 8000 POUNDS

CITATION CJ1+

TAKEOFF PERFORMANCE

TAKEOFF FIELD LENGTH – FLAPS 15°

(Over 35 Foot Screen Height)
Dry Runway, Zero Wind, Anti-Ice Off, Cabin Bleed Air On

Elevation = Sea Level

Ambient Temp °C / °F	Takeoff Weight (lb) 10,700	10,300	9,900	9,500	9,000	8,500	8,000	7,500
0 / 32	3,060	2,830	2,610	2,480	2,430	2,390	2,350	2,320
10 / 50	3,180	2,940	2,710	2,580	2,530	2,480	2,440	2,410
15 / 59	3,250	3,000	2,760	2,630	2,570	2,520	2,480	2,450
20 / 68	3,310	3,060	2,820	2,680	2,620	2,560	2,520	2,490
25 / 77	3,530	3,250	2,990	2,750	2,550	2,500	2,450	2,410
30 / 86	3,990	3,550	3,210	2,950	2,640	2,420	2,360	2,320
35 / 95	4,470	4,010	3,570	3,160	2,830	2,540	2,300	2,240
40 / 104	5,110	4,600	4,090	3,590	3,060	2,730	2,450	2,210
45 / 113	—	5,270	4,740	4,210	3,550	2,960	2,640	2,350
50 / 122	—	—	—	4,890	4,200	3,530	2,860	2,540
Climb Wght Temp Limits °C/°F	41/106	45/113	48/118	51/124	54/129	54/129	54/129	54/129
Field Length at Temp Limits (ft)	5,250	5,270	5,160	5,035	4,760	4,060	3,370	2,720

Elevation = 1,000 Feet

Ambient Temp °C / °F	Takeoff Weight (lb) 10,700	10,300	9,900	9,500	9,000	8,500	8,000	7,500
0 / 32	3,190	2,950	2,720	2,580	2,520	2,470	2,430	2,400
10 / 50	3,320	3,070	2,830	2,680	2,620	2,560	2,520	2,490
15 / 59	3,390	3,120	2,880	2,730	2,670	2,610	2,560	2,530
20 / 68	3,520	3,240	2,990	2,750	2,660	2,610	2,560	2,520
25 / 77	3,900	3,480	3,200	2,940	2,640	2,520	2,470	2,420
30 / 86	4,390	3,920	3,480	3,150	2,820	2,530	2,380	2,330
35 / 95	4,920	4,420	3,950	3,500	3,040	2,710	2,430	2,260
40 / 104	—	5,090	4,560	4,030	3,400	2,920	2,620	2,330
45 / 113	—	—	5,230	4,680	3,990	3,320	2,820	2,510
50 / 122	—	—	—	—	4,670	3,970	3,270	2,720
Climb Wght Temp Limits °C/°F	38/100	42/107	45/113	48/118	52/126	52/126	52/126	52/126
Field Length at Temp Limits (ft)	5,340	5,370	5,230	5,110	4,960	4,240	3,530	2,810

CITATION
CJ1+

LANDING PERFORMANCE

LANDING DISTANCE – ACTUAL

(Distance from 50 Feet Above the Runway)
Flaps Land, Dry Runway, Zero Wind, Anti-Ice On or Off

Elevation = Sea Level								
Ambient Temp	Landing Weight (lb)							
°C / °F	9,900	9,700	9,500	9,300	8,900	8,500	8,000	7,500
0 / 32	2,510	2,470	2,440	2,410	2,340	2,280	2,200	2,120
10 / 50	2,570	2,530	2,500	2,470	2,400	2,330	2,250	2,160
15 / 59	2,590	2,560	2,530	2,490	2,420	2,360	2,270	2,190
20 / 68	2,630	2,590	2,560	2,520	2,460	2,390	2,300	2,210
25 / 77	2,660	2,620	2,590	2,560	2,480	2,420	2,330	2,240
30 / 86	2,690	2,660	2,620	2,590	2,510	2,450	2,360	2,270
35 / 95	2,730	2,690	2,650	2,620	2,540	2,470	2,390	2,290
40 / 104	2,780	2,720	2,680	2,650	2,570	2,500	2,410	2,320
45 / 113	2,830	2,750	2,710	2,680	2,600	2,530	2,440	2,340
50 / 122	2,880	2,800	2,740	2,710	2,630	2,560	2,470	2,370
Lndg Wght Temp Limits °C/°F	50/122	52/126	54/129	54/129	54/129	54/129	54/129	54/129
V_{REF} (KIAS)	109	108	107	106	103	101	98	95

Elevation = 1,000 Feet								
Ambient Temp	Landing Weight (lb)							
°C / °F	9,900	9,700	9,500	9,300	8,900	8,500	8,000	7,500
0 / 32	2,570	2,530	2,500	2,470	2,400	2,330	2,250	2,160
10 / 50	2,630	2,590	2,560	2,530	2,460	2,390	2,300	2,210
15 / 59	2,660	2,620	2,590	2,560	2,480	2,420	2,330	2,240
20 / 68	2,690	2,660	2,620	2,590	2,510	2,450	2,360	2,270
25 / 77	2,730	2,690	2,650	2,620	2,550	2,470	2,390	2,290
30 / 86	2,780	2,720	2,690	2,650	2,580	2,500	2,410	2,320
35 / 95	2,840	2,760	2,720	2,680	2,610	2,530	2,440	2,350
40 / 104	2,890	2,810	2,750	2,710	2,640	2,560	2,470	2,370
45 / 113	2,940	2,860	2,780	2,740	2,670	2,590	2,500	2,400
50 / 122	—	—	2,820	2,770	2,700	2,620	2,530	2,430
Lndg Wght Temp Limits °C/°F	48/118	49/120	51/124	52/126	52/126	52/126	52/126	52/126
V_{REF} (KIAS)	109	108	107	106	103	101	98	95

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° **PRESSURE ALTITUDE 1000 FEET**

LANDING - FLAPS LAND **ANTI-ICE SYSTEMS OFF**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	FIELD LENGTH - FT	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
13300	-30	95.8	105	103	106	114	2570	2130	151	94.9	93.2			
	-20	97.4	105	103	106	114	2660	2220	151	96.4	94.7			
	-10	99.0	104	103	106	114	2760	2300	151	97.9	96.1			
	0	100.6	104	103	106	114	2850	2390	151	99.4	97.6			
	10	100.4	105	104	106	114	3020	2530	151	98.3	97.8			
	20	98.3	106	105	106	114	3420	2840	151	96.2	95.5			
	30	96.3	106	106	106	114	4130	3350	151	94.1	93.2			
	40	94.4	107	107	107	114	5100	4120	151	91.9	90.9			
13000	-30	95.8	103	102	105	113	2460	2040	149	94.8	93.2			
	-20	97.4	103	102	105	113	2550	2120	149	96.4	94.7			
	-10	99.0	103	102	105	113	2640	2200	149	97.9	96.1			
	0	100.6	103	101	105	113	2730	2290	149	99.4	97.6			
	10	100.4	103	102	105	113	2890	2430	149	98.3	97.8			
	20	98.3	105	104	105	113	3240	2710	149	96.2	95.5			
	30	96.3	105	105	105	113	3910	3170	149	94.1	93.2			
	40	94.4	105	105	105	113	4790	3870	149	91.9	90.9			
12700	-30	95.8	101	100	103	112	2350	1950	147	94.8	93.2	108	2130	1880
	-20	97.4	101	100	103	112	2440	2030	147	96.4	94.7	108	2170	1920
	-10	99.0	101	100	103	112	2530	2110	147	97.9	96.1	108	2210	1960
	0	100.6	101	100	103	112	2610	2180	147	99.4	97.6	108	2260	2000
	10	100.4	101	100	103	112	2760	2320	147	98.3	97.8	108	2300	2040
	20	98.3	103	102	104	112	3090	2580	147	96.2	95.5	108	2350	2090
	30	96.3	104	104	104	112	3690	2990	147	94.2	93.2	108	2440	2130
	40	94.4	104	104	104	112	4510	3640	147	91.9	90.9	108	2530	2170
12000	-30	95.8	97	96	100	109	2120	1740	143	94.8	93.2	106	2070	1820
	-20	97.4	97	96	100	109	2190	1810	143	96.3	94.7	106	2110	1860
	-10	99.0	97	96	100	109	2270	1880	143	97.9	96.1	106	2150	1900
	0	100.6	97	96	100	109	2350	1950	143	99.4	97.6	106	2190	1940
	10	100.4	97	96	100	109	2480	2070	143	98.4	97.8	106	2230	1980
	20	98.3	99	98	101	109	2760	2310	143	96.3	95.5	106	2270	2020
	30	96.3	101	100	101	109	3220	2650	143	94.2	93.2	106	2310	2060
	40	94.4	101	101	101	109	3900	3150	143	91.9	90.9	106	2350	2100
11500	-30	95.8	94	93	98	107	1950	1600	140	94.8	93.2	104	2030	1780
	-20	97.4	94	93	98	107	2030	1670	140	96.3	94.7	104	2070	1820
	-10	99.0	94	93	98	107	2100	1730	140	97.9	96.1	104	2100	1860
	0	100.6	94	93	98	107	2170	1800	140	99.4	97.6	104	2140	1890
	10	100.4	94	93	98	107	2290	1900	140	98.4	97.8	104	2180	1930
	20	98.3	96	95	98	107	2550	2120	140	96.3	95.5	104	2220	1970
	30	96.3	99	97	99	107	2920	2430	140	94.2	93.2	104	2260	2010
	40	94.4	99	99	99	107	3510	2830	140	91.9	90.9	104	2300	2040
11000	-30	95.8	90	90	95	104	1800	1470	137	94.8	93.2	101	1980	1740
	-20	97.4	90	89	95	104	1870	1530	137	96.3	94.7	101	2020	1780
	-10	99.0	90	89	95	104	1930	1590	137	97.8	96.1	101	2060	1810
	0	100.6	90	89	95	104	2000	1650	137	99.4	97.6	101	2100	1850
	10	100.4	91	90	96	104	2110	1750	137	98.4	97.8	101	2130	1880
	20	98.3	93	92	96	104	2340	1940	137	96.3	95.5	101	2170	1920
	30	96.3	95	94	96	104	2680	2230	137	94.2	93.2	101	2210	1960
	40	94.4	96	96	96	105	3160	2560	137	92.0	90.9	101	2240	1990
10500	-30	95.8	87	86	93	102	1650	1350	134	94.8	93.2	99	1940	1700
	-20	97.4	87	86	93	102	1710	1400	134	96.3	94.7	99	1980	1730
	-10	99.0	87	86	93	102	1770	1460	134	97.8	96.1	99	2010	1770
	0	100.6	87	86	93	102	1830	1510	134	99.4	97.6	99	2050	1800
	10	100.4	87	87	93	102	1930	1600	134	98.4	97.8	99	2080	1840
	20	98.3	89	88	93	102	2140	1780	134	96.3	95.5	99	2120	1870
	30	96.3	92	91	94	102	2450	2030	134	94.2	93.2	99	2150	1910
	40	94.4	94	93	94	102	2830	2330	134	92.0	90.9	99	2190	1940
9500	-30	95.8	80	79	88	97	1380	1120	128	94.7	93.2	95	1860	1620
	-20	97.4	80	79	88	97	1430	1160	128	96.3	94.7	95	1890	1650
	-10	99.0	80	79	88	97	1480	1210	128	97.8	96.1	95	1920	1680
	0	100.6	80	79	88	97	1530	1250	128	99.3	97.6	95	1950	1710
	10	100.4	80	80	88	97	1610	1320	128	98.5	97.8	95	1980	1740
	20	98.3	82	82	88	97	1780	1470	128	96.4	95.5	95	2020	1770
	30	96.3	85	84	89	97	2020	1670	128	94.3	93.2	95	2050	1800
	40	94.4	88	86	89	97	2310	1910	128	92.0	90.9	95	2080	1830
8500	-30	95.8	72	72	83	92	1140	920	121	94.7	93.2	90	1770	1530
	-20	97.4	72	72	83	92	1180	950	121	96.2	94.7	90	1800	1560
	-10	99.0	72	72	83	92	1220	990	121	97.8	96.1	90	1830	1590
	0	100.6	72	72	83	92	1260	1020	121	99.3	97.6	90	1850	1620
	10	100.4	73	72	83	92	1320	1080	121	98.5	97.8	90	1880	1640
	20	98.3	75	74	83	92	1460	1190	121	96.4	95.5	90	1910	1670
	30	96.3	78	77	83	92	1650	1350	121	94.3	93.2	90	1940	1700
	40	94.4	80	79	84	92	1870	1530	121	92.1	90.9	90	1970	1730

MODEL 560

SECTION VII
FLIGHT PLANNING AND PERFORMANCE

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 1000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
15900	-30	90.4	101	103	107	115	2950	2540	167	90.0	89.6			
	-20	92.2	101	102	107	115	3060	2650	167	91.8	91.4			
	-10	94.0	100	102	107	115	3170	2750	167	93.6	93.2			
	0	95.8	100	102	107	115	3280	2850	167	95.4	95.1			
	10	97.6	100	102	107	115	3400	2960	167	96.7	95.0			
	20	98.7	100	102	107	115	3650	3180	167	95.5	93.9			
	30	97.5	102	103	107	115	4050	3530	167	94.2	92.9			
	40	96.3	103	104	107	115	4580	3980	167	92.9	91.9			
15500	-30	90.4	100	101	106	114	2810	2420	167	90.0	89.6			
	-20	92.2	99	101	106	114	2920	2520	167	91.8	91.4			
	-10	94.0	99	101	106	114	3020	2610	167	93.6	93.2			
	0	95.8	99	100	106	114	3130	2710	167	95.4	95.1			
	10	97.6	99	100	106	114	3240	2810	167	96.7	95.0			
	20	98.7	99	101	106	114	3480	3020	167	95.5	93.9			
	30	97.5	100	102	106	114	3850	3350	167	94.2	92.9			
	40	96.3	102	103	105	114	4340	3780	167	92.9	91.9			
15200	-30	90.4	98	100	105	113	2710	2340	166	90.0	89.6	106	2630	2270
	-20	92.2	98	100	105	113	2810	2430	166	91.8	91.4	106	2700	2340
	-10	94.0	98	100	105	113	2910	2520	166	93.6	93.2	106	2770	2400
	0	95.8	98	99	105	113	3020	2610	166	95.4	95.1	106	2850	2470
	10	97.6	97	99	105	113	3120	2710	166	96.7	95.0	106	2930	2540
	20	98.7	98	100	105	113	3350	2910	166	95.5	93.9	106	3000	2610
	30	97.5	99	101	105	113	3710	3230	166	94.2	92.9	106	3070	2670
	40	96.3	101	102	104	113	4180	3630	166	92.9	91.9	106	3140	2740
14500	-30	90.4	96	97	102	110	2500	2150	165	90.0	89.6	103	2520	2180
	-20	92.2	96	97	102	110	2590	2230	165	91.8	91.4	103	2580	2240
	-10	94.0	95	97	102	110	2680	2320	165	93.6	93.2	103	2650	2300
	0	95.8	95	97	102	111	2780	2400	165	95.4	95.1	103	2720	2360
	10	97.6	95	96	102	111	2870	2490	165	96.7	95.0	103	2790	2430
	20	98.7	95	97	102	110	3060	2660	165	95.5	93.9	103	2860	2490
	30	97.5	97	98	102	110	3390	2950	165	94.2	92.9	103	2920	2550
	40	96.3	98	99	102	110	3810	3310	165	92.9	91.9	103	2990	2610
13500	-30	90.4	92	94	99	108	2220	1900	164	90.0	89.6	100	2370	2050
	-20	92.2	92	94	99	108	2300	1980	164	91.8	91.4	100	2420	2100
	-10	94.0	92	93	99	108	2380	2050	164	93.6	93.2	100	2480	2150
	0	95.8	91	93	99	108	2460	2120	164	95.4	95.1	100	2550	2210
	10	97.6	91	93	99	108	2540	2200	164	96.7	95.0	100	2610	2270
	20	98.7	92	93	99	107	2710	2340	164	95.5	93.9	100	2660	2320
	30	97.5	93	94	99	106	2960	2570	164	94.2	92.9	100	2720	2370
	40	96.3	94	96	99	106	3320	2880	164	92.9	91.9	100	2780	2430
12500	-30	90.4	90	90	95	105	2030	1670	163	90.0	89.6	96	2220	1920
	-20	92.2	90	90	95	105	2110	1740	163	91.8	91.4	96	2270	1970
	-10	94.0	90	90	95	105	2190	1810	163	93.6	93.2	96	2330	2020
	0	95.8	90	90	95	105	2270	1880	163	95.4	95.1	96	2380	2070
	10	97.6	89	89	95	105	2360	1950	163	96.8	95.0	96	2430	2120
	20	98.7	88	89	95	104	2380	2060	163	95.5	93.9	96	2480	2160
	30	97.5	89	90	95	103	2590	2250	163	94.2	92.9	96	2530	2210
	40	96.3	90	91	95	103	2880	2490	163	92.9	91.9	96	2580	2260
11500	-30	90.4	90	90	94	104	2000	1650	161	89.9	89.6	92	2090	1800
	-20	92.2	90	90	94	104	2080	1720	161	91.8	91.4	92	2130	1840
	-10	94.0	90	90	94	105	2160	1790	161	93.6	93.2	92	2180	1880
	0	95.8	90	90	94	105	2240	1860	161	95.4	95.1	92	2220	1930
	10	97.6	90	90	94	105	2320	1930	161	96.8	95.0	92	2270	1970
	20	98.7	88	88	92	102	2310	1920	161	95.5	93.9	92	2310	2010
	30	97.5	85	86	92	100	2260	1950	161	94.2	92.9	92	2360	2050
	40	96.3	86	87	91	99	2490	2150	161	93.0	91.9	92	2400	2090
10500	-30	90.4	91	91	94	106	1990	1660	160	89.9	89.6	88	1950	1690
	-20	92.2	91	91	94	106	2070	1720	160	91.7	91.4	88	1990	1730
	-10	94.0	91	91	95	106	2150	1790	160	93.5	93.2	88	2030	1760
	0	95.8	91	91	95	106	2230	1860	160	95.3	95.1	88	2070	1800
	10	97.6	91	91	95	106	2300	1920	160	96.8	95.0	88	2110	1830
	20	98.7	89	89	93	103	2290	1910	160	95.5	93.9	88	2150	1870
	30	97.5	85	85	89	99	2200	1830	160	94.2	92.9	88	2180	1900
	40	96.3	81	83	88	96	2140	1840	160	93.0	91.9	88	2220	1930

CITATION XLS+

TAKEOFF PERFORMANCE

TAKEOFF FIELD LENGTH - 15° FLAPS

(Over 35 Foot Screen Height)
Dry Runway, Zero Wind, Anti-Ice Off, Cabin Bleed Air On

Elevation = Sea Level

Ambient Temp °C / °F	Takeoff Weight (lb) 20,200	20,000	19,500	18,500	17,500	16,500	15,500	14,500
0 / 32	3,400	3,350	3,210	2,960	2,710	2,620	2,630	2,670
10 / 50	3,510	3,450	3,320	3,050	2,790	2,690	2,710	2,740
15 / 59	3,560	3,510	3,370	3,100	2,840	2,730	2,750	2,780
20 / 68	3,620	3,560	3,420	3,140	2,880	2,770	2,790	2,820
25 / 77	3,670	3,610	3,470	3,190	2,920	2,810	2,830	2,860
30 / 86	3,910	3,840	3,670	3,370	3,090	2,810	2,730	2,750
35 / 95	4,230	4,150	3,960	3,600	3,290	2,990	2,710	2,630
40 / 104	4,640	4,550	4,340	3,940	3,560	3,220	2,910	2,620
45 / 113	5,280	5,150	4,830	4,340	3,910	3,510	3,140	2,820
50 / 122	—	—	—	4,890	4,300	3,850	3,430	3,040
Climb Wght Temp Limits °C/°F	45/113	45/113	47/117	50/122	50/122	50/122	50/122	50/122
Field Length at Temp Limits (ft)	5,280	5,150	5,140	4,890	4,300	3,850	3,430	3,040

Elevation = 1,000 Feet

Ambient Temp °C / °F	Takeoff Weight (lb) 20,200	20,000	19,500	18,500	17,500	16,500	15,500	14,500
0 / 32	3,550	3,490	3,350	3,080	2,820	2,660	2,680	2,710
5 / 41	3,600	3,550	3,400	3,130	2,870	2,700	2,720	2,750
10 / 50	3,660	3,600	3,460	3,180	2,910	2,740	2,760	2,790
15 / 59	3,720	3,660	3,510	3,230	2,950	2,780	2,800	2,820
20 / 68	3,770	3,710	3,560	3,270	3,000	2,820	2,840	2,860
25 / 77	3,920	3,850	3,690	3,390	3,110	2,830	2,800	2,830
30 / 86	4,230	4,150	3,960	3,610	3,300	3,000	2,720	2,710
35 / 95	4,590	4,500	4,300	3,900	3,530	3,200	2,900	2,610
40 / 104	5,060	4,950	4,710	4,260	3,850	3,450	3,110	2,800
45 / 113	—	—	—	4,700	4,220	3,790	3,380	3,010
Climb Wght Temp Limits °C/°F	42/108	42/108	44/111	48/118	48/118	48/118	48/118	48/118
Field Length at Temp Limits (ft)	5,380	5,260	5,230	5,140	4,480	4,010	3,570	3,160

CITATION XLS+

LANDING PERFORMANCE

LANDING DISTANCE - ACTUAL

(Distance from 50 Feet Above the Runway)
Flaps 35°, Dry Runway, Zero Wind, Anti-Ice On or Off

Elevation = Sea Level								
Ambient Temp °C / °F	Landing Weight (lb) 18,700	18,500	18,000	17,000	16,000	15,000	14,000	13,000
0 / 32	3,060	3,040	2,980	2,860	2,740	2,610	2,490	2,370
10 / 50	3,140	3,120	3,060	2,930	2,810	2,680	2,550	2,430
15 / 59	3,180	3,160	3,100	2,970	2,850	2,720	2,580	2,460
20 / 68	3,220	3,200	3,140	3,010	2,890	2,750	2,620	2,490
25 / 77	3,260	3,240	3,180	3,050	2,920	2,780	2,650	2,520
30 / 86	3,310	3,280	3,220	3,080	2,960	2,820	2,680	2,540
35 / 95	3,350	3,320	3,250	3,120	2,990	2,850	2,710	2,570
40 / 104	3,390	3,360	3,290	3,160	3,030	2,880	2,740	2,600
45 / 113	3,430	3,400	3,330	3,200	3,060	2,920	2,770	2,630
50 / 122	3,470	3,440	3,370	3,230	3,100	2,950	2,800	2,660
Lndg Wght Temp Limits °C/°F	50/122	50/122	50/122	50/122	50/122	50/122	50/122	50/122
V_{REF} (KIAS)	117	117	115	112	109	106	102	99

Elevation = 1,000 Feet								
Ambient Temp °C / °F	Landing Weight (lb) 18,700	18,500	18,000	17,000	16,000	15,000	14,000	13,000
0 / 32	3,140	3,120	3,060	2,930	2,810	2,680	2,550	2,430
5 / 41	3,190	3,160	3,100	2,970	2,850	2,720	2,590	2,460
10 / 50	3,230	3,200	3,140	3,010	2,890	2,750	2,620	2,490
15 / 59	3,270	3,240	3,180	3,050	2,930	2,790	2,650	2,520
20 / 68	3,310	3,290	3,220	3,090	2,960	2,820	2,680	2,550
25 / 77	3,360	3,330	3,260	3,130	3,000	2,860	2,720	2,580
30 / 86	3,400	3,370	3,300	3,170	3,040	2,890	2,750	2,610
35 / 95	3,440	3,410	3,340	3,210	3,070	2,930	2,780	2,640
40 / 104	3,480	3,450	3,380	3,250	3,110	2,960	2,810	2,670
45 / 113	3,520	3,490	3,420	3,280	3,150	3,000	2,850	2,700
Lndg Wght Temp Limits °C/°F	48/118	48/118	48/118	48/118	48/118	48/118	48/118	48/118
V_{REF} (KIAS)	117	117	115	112	109	106	102	99

CITATION SOVEREIGN

TAKEOFF PERFORMANCE

TAKEOFF FIELD LENGTH - 15° FLAPS

(Over 35 Foot Screen Height)
Dry Runway, Zero Wind, Anti-Ice Off, Cabin Bleed Air On

Elevation = Sea Level								
Ambient Temp	Takeoff Weight (lb)							
°C / °F	30,300	30,000	29,000	28,000	27,000	25,000	23,000	21,000
0 / 32	3,460	3,410	3,240	3,140	3,120	3,080	3,050	3,040
10 / 50	3,580	3,520	3,350	3,230	3,210	3,170	3,140	3,120
15 / 59	3,640	3,580	3,400	3,280	3,250	3,210	3,180	3,160
20 / 68	3,690	3,640	3,460	3,320	3,300	3,250	3,220	3,200
25 / 77	3,750	3,700	3,510	3,370	3,340	3,290	3,260	3,230
30 / 86	3,810	3,750	3,570	3,410	3,390	3,340	3,300	3,270
35 / 95	3,940	3,880	3,680	3,490	3,380	3,330	3,290	3,250
40 / 104	4,130	4,060	3,850	3,650	3,450	3,270	3,230	3,190
45 / 113	4,380	4,300	4,050	3,830	3,620	3,220	3,160	3,120
50 / 122	4,760	4,640	4,290	4,020	3,790	3,370	3,100	3,050
Climb Wght Temp Limits °C/°F	55/131	55/131	55/131	55/131	55/131	55/131	55/131	55/131
Field Length at Temp Limits (ft)	5,290	5,140	4,700	4,300	4,000	3,530	3,100	2,990

Elevation = 1,000 Feet								
Ambient Temp	Takeoff Weight (lb)							
°C / °F	30,300	30,000	29,000	28,000	27,000	25,000	23,000	21,000
0 / 32	3,580	3,520	3,350	3,230	3,200	3,160	3,130	3,110
10 / 50	3,700	3,640	3,460	3,320	3,300	3,250	3,220	3,200
15 / 59	3,760	3,700	3,520	3,370	3,340	3,300	3,260	3,230
20 / 68	3,820	3,760	3,580	3,420	3,390	3,340	3,300	3,280
25 / 77	3,880	3,820	3,630	3,460	3,430	3,390	3,350	3,320
30 / 86	3,990	3,930	3,730	3,540	3,440	3,390	3,350	3,320
35 / 95	4,190	4,120	3,900	3,700	3,500	3,340	3,290	3,250
40 / 104	4,420	4,340	4,090	3,870	3,660	3,280	3,230	3,190
45 / 113	4,780	4,660	4,330	4,070	3,840	3,410	3,170	3,120
50 / 122	5,280	5,140	4,700	4,320	4,030	3,570	3,140	3,060
Climb Wght Temp Limits °C/°F	52/126	52/126	52/126	52/126	52/126	52/126	52/126	52/126
Field Length at Temp Limits (ft)	5,520	5,370	4,900	4,480	4,140	3,640	3,200	3,030

CITATION SOVEREIGN

LANDING PERFORMANCE

LANDING DISTANCE - ACTUAL

(Distance from 50 Feet Above the Runway)
Flaps 35°, Dry Runway, Zero Wind, Anti-Ice On or Off

Elevation = Sea Level								
Ambient Temp °C / °F	Landing Weight (lb)							
	27,100	26,000	25,000	24,000	23,000	22,000	21,000	20,000
0 / 32	2,560	2,490	2,420	2,360	2,290	2,220	2,160	2,080
10 / 50	2,610	2,550	2,480	2,410	2,350	2,280	2,200	2,130
15 / 59	2,650	2,580	2,510	2,440	2,370	2,300	2,230	2,160
20 / 68	2,680	2,610	2,540	2,470	2,400	2,330	2,250	2,180
25 / 77	2,710	2,640	2,570	2,500	2,430	2,360	2,280	2,210
30 / 86	2,750	2,670	2,600	2,530	2,460	2,390	2,310	2,230
35 / 95	2,780	2,700	2,630	2,560	2,490	2,410	2,340	2,260
40 / 104	2,810	2,730	2,660	2,590	2,520	2,440	2,360	2,280
45 / 113	2,840	2,770	2,690	2,620	2,550	2,470	2,390	2,310
50 / 122	2,870	2,800	2,720	2,650	2,580	2,500	2,410	2,340
Lndg Wght Temp Limits °C/°F	55/131	55/131	55/131	55/131	55/131	55/131	55/131	55/131
V_{REF} (KIAS)	110	107	105	103	101	99	96	94

Elevation = 1,000 Feet								
Ambient Temp °C / °F	Landing Weight (lb)							
	27,100	26,000	25,000	24,000	23,000	22,000	21,000	20,000
0 / 32	2,620	2,550	2,480	2,420	2,350	2,280	2,200	2,130
10 / 50	2,680	2,610	2,540	2,470	2,400	2,330	2,260	2,180
15 / 59	2,710	2,640	2,570	2,500	2,430	2,360	2,280	2,210
20 / 68	2,750	2,670	2,600	2,540	2,460	2,390	2,310	2,230
25 / 77	2,780	2,710	2,640	2,570	2,490	2,410	2,340	2,260
30 / 86	2,810	2,740	2,670	2,600	2,520	2,440	2,370	2,290
35 / 95	2,850	2,770	2,700	2,630	2,550	2,470	2,400	2,320
40 / 104	2,880	2,800	2,730	2,660	2,580	2,500	2,420	2,340
45 / 113	2,920	2,830	2,760	2,690	2,610	2,530	2,450	2,370
50 / 122	2,950	2,870	2,800	2,720	2,640	2,560	2,480	2,400
Lndg Wght Temp Limits °C/°F	52/126	52/126	52/126	52/126	52/126	52/126	52/126	52/126
V_{REF} (KIAS)	110	107	105	103	101	99	96	94

SIMPLIFIED TAKEOFF ANALYSIS
FLAP 2 – DRY RUNWAY
ICE PROTECTION (WINGSTAB+ENG) OFF – ATR OFF

PW535E ENGINES

Airport Pressure Altitude: 1000 ft

TEMP (ºC)	TAKEOFF WEIGHT (kg) MINIMUM REQUIRED RUNWAY LENGTH (m) $V_1/V_R/V_2$ (KIAS)							
	6000	6400	6800	7200	7600	8000	8340	LIMITED WEIGHT
-40	789 110/110/122	776 106/106/118	765 103/103/115	754 100/100/111	752 98/98/108	812 101/101/111	865 104/104/113	8340
-35	801 109/109/122	787 106/106/118	776 103/103/115	766 100/100/111	764 98/98/108	825 101/101/111	879 104/104/113	8340
-30	813 109/109/122	799 106/106/118	788 103/103/115	777 100/100/111	775 98/98/108	837 101/101/111	893 104/104/113	8340
-25	824 109/109/122	810 106/106/118	799 103/103/115	789 100/100/111	787 98/98/108	850 101/101/111	906 104/104/113	8340
-20	836 109/109/122	822 106/106/118	810 103/103/115	800 100/100/111	799 98/98/108	863 101/101/111	920 104/104/113	8340
-15	847 109/109/122	833 106/106/118	822 103/103/114	811 100/100/111	811 98/98/108	876 101/101/111	934 104/104/113	8340
-10	859 109/109/122	845 106/106/118	833 103/103/114	822 100/100/111	822 98/98/108	889 101/101/111	948 104/104/113	8340
-5	870 109/109/122	856 106/106/118	844 103/103/114	834 100/100/111	834 98/98/108	902 101/101/111	962 104/104/113	8340
0	882 109/109/122	867 106/106/118	855 103/103/114	845 100/100/111	846 98/98/108	915 101/101/111	976 104/104/113	8340
5	893 109/109/122	878 106/106/118	866 103/103/114	855 100/100/111	858 98/98/108	928 101/101/111	991 104/104/113	8340
10	904 109/109/121	889 106/106/118	877 102/102/114	866 100/100/111	871 98/98/108	942 101/101/111	1006 104/104/113	8340
15	914 109/109/121	900 105/105/118	888 102/102/114	877 99/99/110	883 98/98/108	956 101/101/111	1021 104/104/113	8340
20	926 109/109/121	911 105/105/117	899 102/102/114	888 99/99/110	899 98/98/108	974 102/102/111	1040 104/104/113	8340
25	923 106/106/118	910 103/103/114	898 100/100/110	887 97/97/107	945 99/99/108	1025 102/102/111	1112 105/105/113	8340
30	919 103/103/114	906 100/100/110	895 97/97/106	920 97/97/106	1003 100/100/108	1116 103/103/111	1225 106/106/113	8340
35	914 99/99/109	902 96/96/106	901 94/94/103	993 98/98/106	1115 101/101/108	1257 104/104/111	1388 107/107/113	8340
40	910 96/96/105	898 93/93/101	977 95/95/103	1106 99/99/106	1255 102/102/108	1422 105/105/111	1575 108/108/113	8340
45	906 93/93/101	953 92/92/100	1094 96/96/103	1252 99/99/106	1427 103/103/108	- -	- -	7928
48	903 91/91/98	1019 93/93/100	1180 97/97/103	1356 100/100/106	1553 103/103/108	- -	- -	7608
V_{FS}	117	121	125	128	132	135	138	

WARNING: THE VALUES ABOVE DO NOT TAKE INTO ACCOUNT OBSTACLES.

PHENOM™ BY EMBRAER

PHENOM 300
Airplane Flight Manual

Performance

UNFACTORED LANDING DISTANCE (m)

ENGINE ICE PROTECTION OFF/ON – WINGSTAB OFF
FLAP 3

PW535E ENGINES

Weight (kg)	ALTITUDE							
	-1000 ft				0 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
5600	777	652	613	574	790	665	625	586
5800	793	667	627	589	807	680	640	601
6000	809	683	642	603	823	696	656	616
6200	825	698	657	618	840	712	671	631
6400	842	713	673	633	857	728	687	646
6600	857	728	687	647	873	743	701	661
6800	873	743	702	661	889	758	716	675
7000	889	758	716	676	905	773	731	690
7200	905	773	731	690	922	789	747	705
7400	920	788	745	704	937	804	761	719
7600	936	802	759	718	953	819	776	733
7800	952	817	774	732	973	833	790	748
8000	974	831	788	746	996	849	805	762
8200	996	846	803	760	1019	864	820	777

Weight (kg)	ALTITUDE							
	1000 ft				2000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
5600	805	679	639	599	820	693	652	613
5800	821	694	654	614	837	709	668	628
6000	838	710	670	630	854	725	684	644
6200	855	726	685	645	872	742	700	660
6400	873	743	701	661	889	758	716	676
6600	889	758	716	676	906	774	732	691
6800	906	774	732	691	923	790	748	706
7000	923	790	747	706	940	806	763	722
7200	939	806	763	721	957	823	779	737
7400	955	821	777	735	974	838	795	752
7600	972	836	792	750	995	853	810	767
7800	995	851	807	765	1018	869	825	782
8000	1019	866	822	779	1043	885	841	797
8200	1043	882	838	794	1068	901	856	812

CAUTION: SHADED AREAS REPRESENT CONDITIONS WHERE THE MAXIMUM LANDING WEIGHT OR CLIMB LIMITED WEIGHT WAS EXCEEDED.

Eclipse Jet Performance and Specifications

PERFORMANCE

TAKEOFF DISTANCE TO 50 FT SEA LEVEL, ISA TO 50 FT (15 M) @ MGTOW	2,394 FT	730 M
LANDING DISTANCE, 4 PAX, NBAA IFR RESERVE	2,342 FT	714 M
RATE OF CLIMB - 2 ENGINES[1]	3,456 FT / MIN	1,053 M / MIN
RATE OF CLIMB - 1 ENGINE[2]	1010 FT / MIN	308 M / MIN
TIME TO CLIMB - 41,000 FT (12,497 M)	29 MIN	29 MIN
TAKEOFF AT 5,000 FT (1,524 M) AT ISA + 15˚C	3,843 FT	1,171 M
SINGLE ENGINE TAKEOFF CLIMB AT 5,000 FT (1,524 M)[3] AT ISA + 15˚C	697 FT / MIN	212 M / MIN
MAX CRUISE SPEED (TAS)	375 KT	695 KM / HR
V_{SO}	73 KT	135 KM / HR
V_{MCA}[4]	NOT APPLICABLE	
V_{MCG}	60 KT	111 KM / HR
V_{MO} / M_{MO}	285 KEAS	0.64 MACH
MAXIMUM ALTITUDE	41,000 FT	12,497 M
SINGLE ENGINE SERVICE CEILING	35,000 FT	10,668 M
RANGE - MAX NBAA IFR 100 NM ALTERNATE, 4 OCCUPANTS, 200-LB (90-KG) PILOT, THREE 170-LB (77-KG) PASSENGERS	1,125 NM	2,084 KM
RANGE - MAX IFR 45-MINUTE RESERVE, 4 OCCUPANTS, 200-LB (90-KG) PILOT, THREE 170-LB (77-KG) PASSENGERS	1,300 NM	2,408 KM

1 Flaps up, gear up, sea level, isa, max takeoff power
2 Flaps up, gear up, sea level, isa, max takeoff power + automatic power reserve
3 Flaps up, gear up, max takeoff power + automatic reserve
4 The V_{MC} speeds of the Eclipse 500 do not exist because they are less than V_{SO}

Data subject to change.

EXTERIOR DIMENSIONS

LENGTH	33.5 FT	10.2 M
WINGSPAN	37.9 FT	11.6 M
HEIGHT	11.0 FT	3.4 M

INTERIOR DIMENSIONS

LENGTH	148 IN	376 CM
HEIGHT (MAX)	50 IN	127 CM
WIDTH (MAX)	56 IN	142 CM

WEIGHTS

MAXIMUM RAMP	6,034 LB	2,737 KG
MAXIMUM TAKEOFF	6,000 LB	2,722 KG
MAXIMUM LANDING	5,600 LB	2,540 KG
EMPTY	3,634 LB	1,648 KG
FUEL CAPACITY	1,698 LB / 251 GAL	770 KG / 950 L
USEFUL LOAD	2,400 LB	1,089 KG

ENGINES

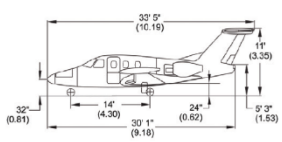
2 PRATT & WHITNEY CANADA	PW610F TURBOFANS	
TAKEOFF THRUST AT SEA LEVEL ISA + 15˚C	900 LBF (EACH)	4.00 KN (EACH)

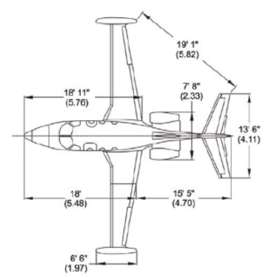
ACCOMODATIONS

SEATS	6 MAX

PRESSURIZATIONS

SEA LEVEL CABIN TO	21,500 FT	6,533 M
CABIN ALTITUDE AT 41,000 FT	8,000 FT	2,438 M





PC-24

THE SUPER VERSATILE JET

The Pilatus PC-24 is the world's first and only Super Versatile Jet. It combines the practicality of a turboprop with the cabin size of a medium light jet and the performance of a light jet.

Its flexible interior and generous cargo door make loading fast and easy. The PC-24 is designed to operate from short, paved and even unpaved surfaces, giving pilots access to almost 20,000 additional airports worldwide. That's why the PC-24 is a Super Versatile Jet: more runways, more space, more possibilities.

FEATURES

1 Pilatus ACE™ avionics system, single pilot and flight into known icing conditions certified
2 Spacious cabin 501 ft³ (14.20 m³) with continuous flat floor
3 2 Williams FJ44-4A engines; normal take-off thrust 3,420 lbf (1,551 kgf) each
4 Revolutionary Quiet Power Mode™ on right-hand engine
5 Dual-wheel main landing gear designed for operations from paved and unpaved surfaces
6 Optimized wing geometry combining excellent short field performance with competitive cruise speed
7 All-internal, pressurised baggage compartment 90 ft³ (2.50 m³)
8 Large cargo door 51 × 49 in (1.30 × 1.25 m) for ease of loading

PERFORMANCE

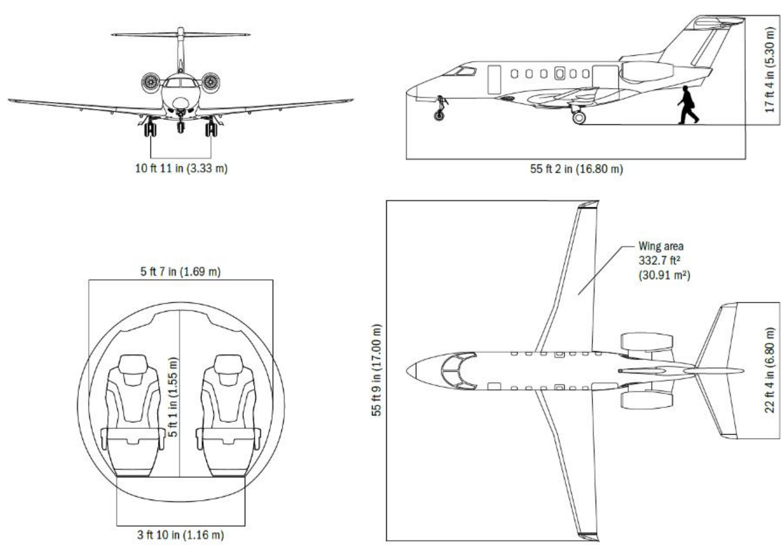
The PC-24 has the following performance under international standard atmospheric conditions:

Balanced field length (MTOW, sea level, dry paved runway)	2,930 ft	893 m
Landing distance over 50 ft (15 m) obstacle (MLW, sea level, dry paved runway)	2,375 ft	724 m
Max. rate of climb (MTOW, sea level, 200 KCAS)	4,070 ft/min	20.70 m/s
Max. cruise speed (flight level 280)	440 KTAS	815 km/h
Range with 4 passengers (800 lb payload, LRC, NBAA IFR reserves of 100 nm + 30 min VFR)[1]	2,000 nm	3,704 km
Max. certified altitude	45,000 ft	13,716 m
Stall speed (landing configuration, MLW)	82 KIAS	151 km/h

WEIGHTS

Basic operating weight[1]	11,720 lb	5,316 kg
Max. take-off weight	18,300 lb	8,300 kg
Max. landing weight	16,900 lb	7,665 kg
Max. payload[1]	2,500 lb	1,134 kg
Max. payload with full fuel[1]	715 lb	324 kg

[1] Executive configuration (6 seat), incl. one pilot



PERFORMANCE & SPECIFICATIONS

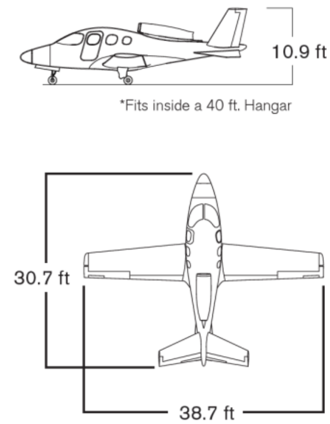
The Vision Jet is a breakthrough in personal aviation. It goes faster: 300+ KTAS cruising speed. It goes farther: over 1,200 nm. It carries more payload: up to five adults and two children. But the remarkable achievement is that you can have this level of jet performance in a true personal aircraft that doesn't require an entire flight operations department to fly and maintain it.

STANDARD FEATURES

Full Authority Digital Engine Control (FADEC)
Cirrus Airframe Parachute System® (CAPS®)
Perspective Touch+™ by Garmin®
Dual WAAS GPS/Comm/Nav Radios
Aircraft Systems Synoptics Display
Dual AHRS, ADC & Pitot Static
NextGen Transponder (ADS-B Out)
Synthetic Vision Technology
FliteCharts & SafeTaxi[1,3]
Weather Datalink & Audio Entertainment
300 lb Baggage Capacity
Certified Flight Into Known Ice
Modular Seating for Five Adults
Intelligent Batteries

GFC 700 Autopilot including:
- Electronic Stability & Protection (ESP)
- Emergency Descent Mode
- Blue Level Button
- Autopilot Stall Protection

Leather Interior
Air Conditioning with Automatic Climate Control
USB Power Ports
Stall Protection Stick Shaker & Pusher
Fits inside Standard 40 ft (12.2 m) Hangar
Cargo X-Tend™
ADS-B In Weather and Traffic
TAWS-B



OPTIONAL EQUIPMENT

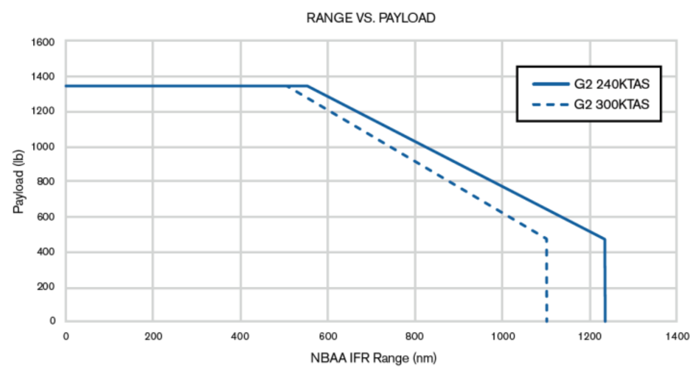
Digital Real-Time Weather Radar
SurfaceWatch™
6th and 7th Third Row Seats
Executive Seating Configuration
22" Entertainment Display
115 VAC Power
Rear Passenger Climate Controls
Cirrus Global Connect

Xi® (Individualized Exterior & Interior)
Multi-Tone Paint
Enhanced Interior Lighting
Enhanced Vision System Camera
Gold Reflective Windshield & Cabin Windows
Relief Station
Auto Throttle
Interior Sound Reduction

DIMENSIONS	US UNITS	METRIC
Wingspan	38.7 ft	11.7 m
Length	30.7 ft	9.3 m
Height	10.9 ft	3.3 m
Cabin Width	5.1 ft	1.5 m
Cabin Height	4.1 ft	1.2 m

ENGINE		
Manufacturer	Williams International	
Model	FJ33-5A	
Thrust (Approx.)	Approx. 1800 lbs	

PERFORMANCE*	US UNITS	METRIC
Takeoff	2036 ft	621 m
Max Operating Altitude	FL310	FL310
Stall Speed with Flaps	67 KCAS	67 KCAS
High Speed Cruise	305 KTAS	305 KTAS
Landing Ground roll	1628 ft	496 m



CIRRUS AIRCRAFT

800.279.4322 or +1.218.529.7200
CIRRUS AIRCRAFT 4515 TAYLOR CIRCLE DULUTH, MINNESOTA 55811 USA

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2300 LBS

SHORT FIELD

CONDITIONS:
Flaps Up
Full Throttle Prior to Brake Release
Paved, Level, Dry Runway
Zero Wind

NOTES:
1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
4. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2300	52	59	S.L.	720	1300	775	1390	835	1490	895	1590	960	1700
			1000	790	1420	850	1525	915	1630	980	1745	1050	1865
			2000	865	1555	930	1670	1000	1790	1075	1915	1155	2055
			3000	950	1710	1025	1835	1100	1970	1185	2115	1270	2265
			4000	1045	1880	1125	2025	1210	2175	1300	2335	1400	2510
			5000	1150	2075	1240	2240	1335	2410	1435	2595	1540	2795
			6000	1265	2305	1365	2485	1475	2680	1585	2895	1705	3125
			7000	1400	2565	1510	2770	1630	3000	1755	3245	1890	3515
			8000	1550	2870	1675	3110	1805	3375	1945	3670	2095	3990

Figure 5-4. Takeoff Distance (Sheet 1 of 2)

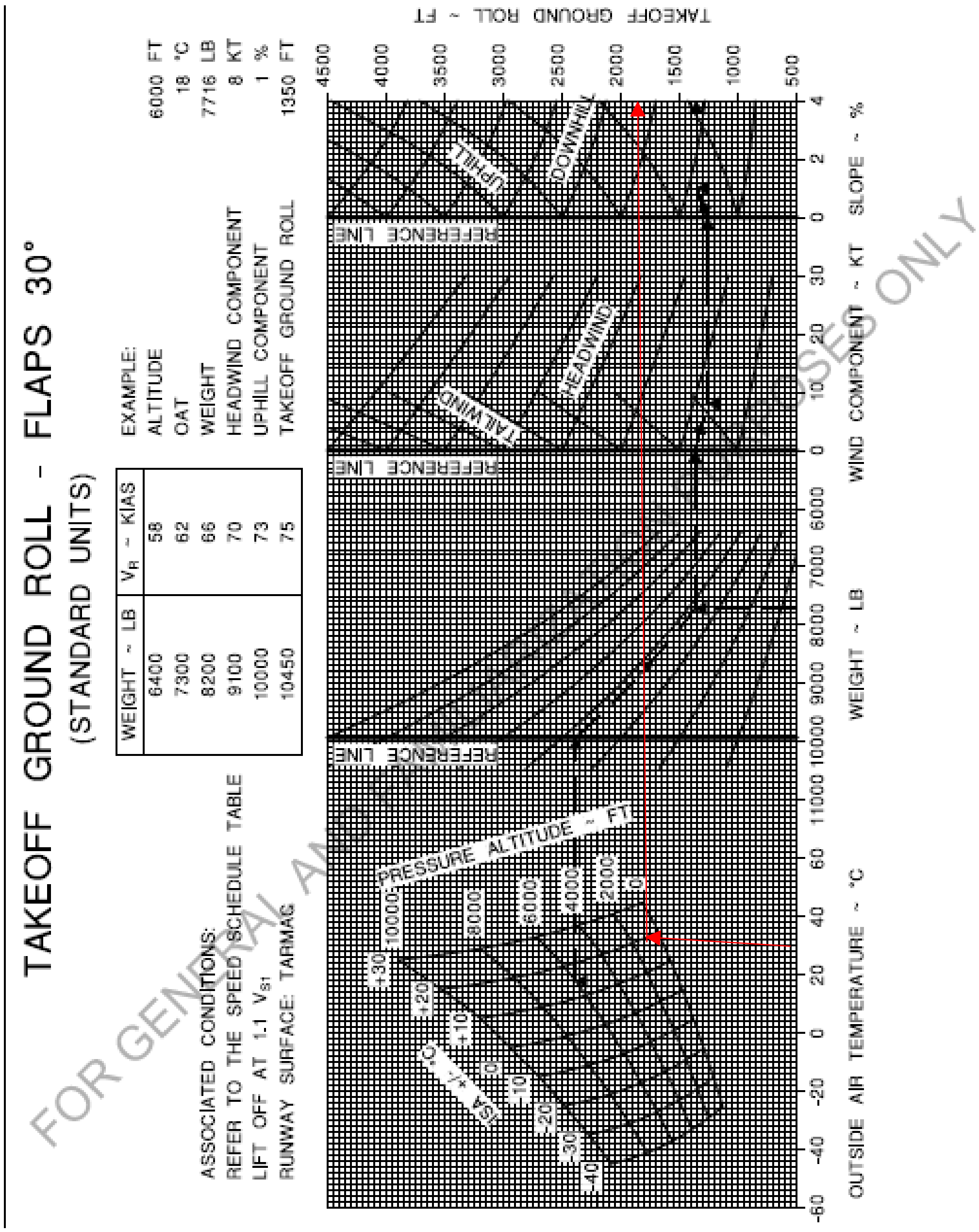
Takeoff Distance

WEIGHT = 3400 LB **Speed at Liftoff = 73 KIAS** **Speed over 50 Ft. Obstacle = 78 KIAS** Flaps - 50% · Takeoff Pwr · Dry Paved					**Headwind:** Subtract 10% for each 12 knots headwind. **Tailwind:** Add 10% for each 2 knots tailwind up to 10 knots. **Runway Slope:** Ref. Factors. **Dry Grass:** Add 15% to Ground Roll.		
PRESS ALT FT	**DISTANCE FT**	**TEMPERATURE ~ °C**					
		0	**10**	**20**	**30**	**40**	**ISA**
SL	**Grnd Roll**	910	982	1058	1137	1219	1020
	50 ft	1414	1520	1629	1742	1860	1574
1000	**Grnd Roll**	1003	1084	1167	1254	1344	1108
	50 ft	1554	1670	1790	1915	2044	1706
2000	**Grnd Roll**	1108	1196	1289	1385	1484	1206
	50 ft	1710	1837	1970	2107	2248	1851
3000	**Grnd Roll**	1224	1322	1424	1530	1640	1312
	50 ft	1883	2024	2169	2320	2476	2010
4000	**Grnd Roll**	1354	1463	1575	1693	1814	1430
	50 ft	2076	2231	2392	2558	2730	2185
5000	**Grnd Roll**	1500	1620	1746	1875	2009	1560
	50 ft	2291	2462	2640	2823	3013	2377
6000	**Grnd Roll**	1663	1796	1935	2078	2228	1704
	50 ft	2532	2721	2917	3120	3330	2590
7000	**Grnd Roll**	1846	1994	2147	2307	2473	1862
	50 ft	2801	3010	3227	3452	3684	2824
8000	**Grnd Roll**	2052	2216	2387	2564	2748	2038
	50 ft	3103	3335	3575	2823	4080	3083
9000	**Grnd Roll**	2284	2466	2656	2853	3058	2233
	50 ft	3442	3698	3965	4240	4526	3370
10000	**Grnd Roll**	2544	2748	2959	3179	3407	2449
	50 ft	3822	4107	4403	4709	5026	3687

Figure 5-9
Sheet 1 of 2

SECTION 5
PERFORMANCE

PILATUS PC12



See FLIGHT IN ICING CONDITIONS para for info on effect of icing

Figure 5-19. Takeoff Ground Roll - Flaps 30° (standard units)

Report No: 02211 Issued: March 30, 2001
5-20 Revision 3: October 28, 2005

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2950 LBS

SHORT FIELD

CONDITIONS:
Flaps 20°
2400 RPM, Full Throttle and Mixture Set Prior to Brake Release
Cowl Flaps Open
Paved, Level, Dry Runway
Zero Wind

NOTES:
1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 5000 feet elevation, the mixture should be leaned to give maximum power in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
4. Where distance value has been deleted, climb performance after lift-off is less than 150 fpm at takeoff speed.
5. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2950	49	57	S.L.	635	1220	680	1305	730	1395	780	1490	835	1590
			1000	690	1335	745	1430	795	1530	850	1635	910	1745
			2000	755	1465	810	1565	870	1680	930	1800	995	1925
			3000	825	1605	890	1725	950	1850	1020	1985	1090	2130
			4000	905	1770	970	1905	1045	2050	1120	2205	1195	2370
			5000	995	1965	1065	2115	1145	2280	1230	2460	1315	2655
			6000	1090	2185	1175	2360	1260	2555	1350	2765	1450	3005
			7000	1200	2450	1290	2655	1390	2885	1490	3145	---	---
			8000	1325	2765	1425	3015	1530	3300	---	---	---	---

Figure 5-4. Takeoff Distance (Sheet 1 of 2)

SPECIFICATIONS

ENGINE
Turbocharged Lycoming TIO-540-AE2A
Horsepower: 350 hp
Number of Cylinders: 6
TBO: 2,000 hours

PROPELLER
Hartzell 3-Blade | Composite | Constant Speed

WEIGHTS
Maximum Takeoff Weight: 4,340 lbs | 1,969 kg
Maximum Ramp Weight: 4,358 lbs | 1,977 kg
Standard Equipped Weight: 3,003 lbs | 1,362 kg
Standard Useful Load: 1,355 lbs | 615 kg

MAXIMUM CRUISE SPEED
213 ktas | 395 km/h

FUEL CAPACITY, USABLE
120 US gal | 454 liters

RANGE WITH 45 MINUTE RESERVE
1,343 nm | 2,487 km

MAXIMUM APPROVED ALTITUDE
25,000 ft | 7,620 m

TAKEOFF DISTANCE
Ground Roll: 1,087 ft | 331 m
Total Over 50 ft Obstacle: 2,090 ft | 637 m

LANDING DISTANCE
Ground Roll: 1,020 ft | 311 m
Total Over 50 ft Obstacle: 1,968 ft | 600 m

DIMENSIONS
Wingspan: 43 ft | 13.1 m
Height: 11 ft 3 in | 3.4 m
Length: 28 ft 11 in | 8.8 m

STANDARD FEATURES

AVIONICS
Garmin G1000 Avionics Suite with Autopilot:
Dual 10.4" PFDs, Single 15" MFD, Dual GIA 63W NAV/COM/GPS, GFC 700 Autopilot with GMC 710 AP Controller and Yaw Damper System, Dual GRS 77 AHRS Computers, GCU 476 Keypad, Garmin FliteCharts, Garmin SafeTaxi, GMA 347 Audio Panel, Dual GDC 74A Air Data Computers, GTX 33 ES Mode S Transponder, and Standby Flight Instruments

OTHER EQUIPMENT
PiperAire Air Conditioning, Hardwired Cockpit Bose A20 Headsets, One Matrix Pilot Initial Training Course, Supplemental Oxygen System, 110 Volt AC Power Outlet

INTERIOR
Mesa or Summit Interior

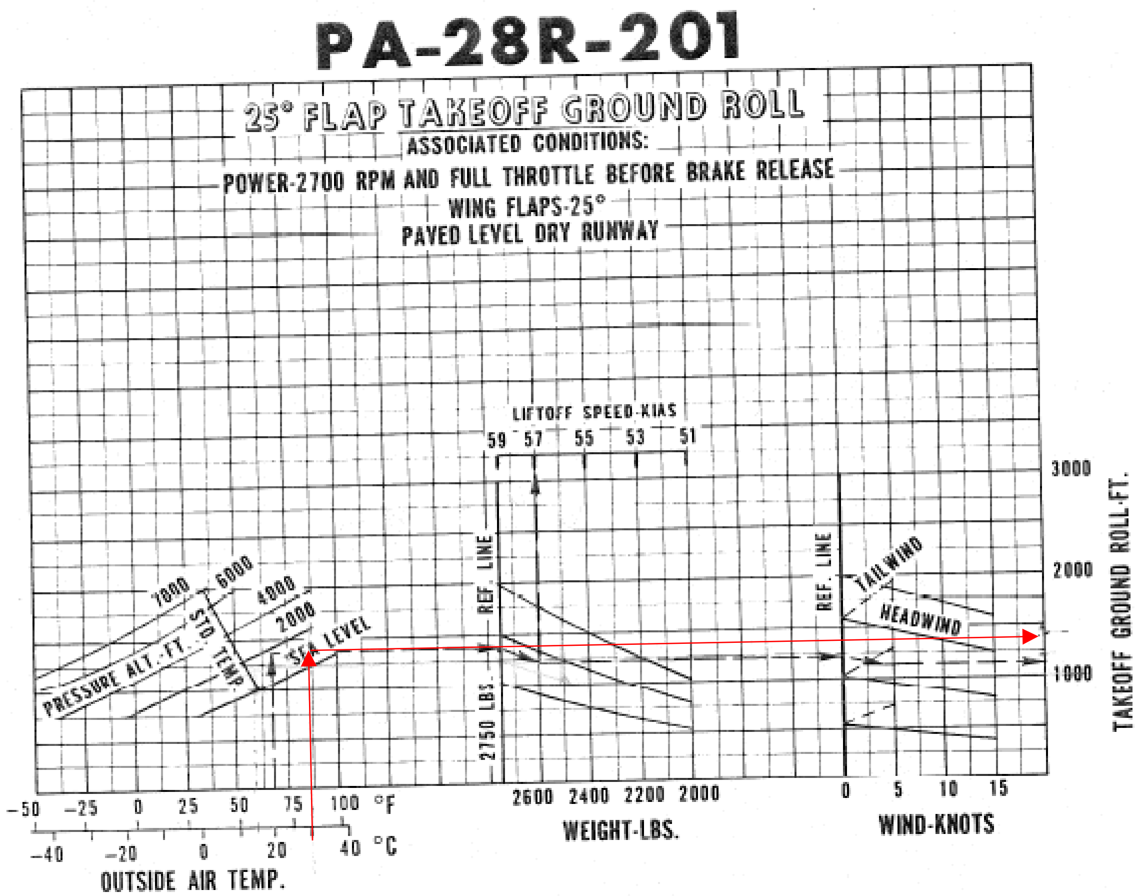
PACKAGING OPTIONS
Piper is pleased to offer you bundled options with pricing advantages. Take the uncertainty out of option shopping and allow us to help guide you through the process.

ASSURANCE PACKAGE
Garmin Synthetic Vision, Speed Brakes, GTX 33 ES Second Digital Transponder, AMSAFE Pilot & Co-Pilot Air Bag Seatbelts

AWARENESS PACKAGE
Jeppesen ChartView (one year subscription to Jeppesen PilotPak), TAWS-B (Terrain Awareness and Warning System), KTA 870 Traffic Advisory System

WEATHER PACKAGE
GWX 68 Weather Radar, GDL 69A SiriusXM Satellite Weather (includes GRC 10 remote), Flight Into Known Icing (FIKI), L3 WX-500 Stormscope

Contact your dealer for pricing and additional options.



Example:
Pressure altitude: 1900 ft.
Outside air temperature: 20°C
Weight: 2600 lbs.
Surface wind: 4 kts. (headwind)
Liftoff speed: 57 KIAS
Takeoff ground roll: 1125 ft.

25° FLAP TAKEOFF GROUND ROLL
Figure 5-7

LITHO-KING AIR 350I-092518

BEECHCRAFT KING AIR 350i

With best-in-class range and payload, the Beechcraft® King Air® 350i aircraft is the aviation solution without compromise. The King Air 350i takes more passengers and cargo farther on less fuel, allowing you to quickly and efficiently move your business teams on important missions.

- **Experience intuitive flight control using Rockwell Collins™ Pro Line Fusion™ avionics, featuring icon-based touch screens.**
- **Short runways and heavy payloads give you access to thousands more airports and the business opportunities that go with them.**
- **With an innovative square-oval fuselage and double-club seating, the King Air 350i offers the most cabin comfort in its class.**
- **Stay connected with standard Wi-Fi capability.**
- **Rest assured, you are supported by the farthest-reaching and most accessible service network.**

EXTERNAL DIMENSIONS

Wingspan	57 ft 11 in	17.65 m
Max Aircraft Length	46 ft 8 in	14.22 m
Max Tail Height	14 ft 4 in	4.37 m

INTERNAL DIMENSIONS

Length	19 ft 6 in	5.94 m
Width	4 ft 6 in	1.37 m
Height	4 ft 9 in	1.45 m

ENGINES	Pratt & Whitney Canada PT6A-60A	
Output (ISA+10°C)	1,050 shp	783 kW

WEIGHTS

Max Takeoff Weight	15,000 lb	6,804 kg
Basic Operating Weight	9,955 lb	4,516 kg
Useful Load	5,145 lb	2,334 kg

MAXIMUM OCCUPANTS 11

PERFORMANCE

Max Cruise Speed (360 mph)	312 kt	578 km/h
Max Operating Altitude	35,000 ft	10,668 m
Range: Ferry	1,806 nm	3,345 km
Takeoff Field Length (MTOW)	3,300 ft	1,006 m

Typically equipped with one pilot at 200 pounds. Includes unusable fuel and oil. Available with extended range, cargo door, high-flotation landing gear and other options for special missions applications.

Contact your Textron Aviation representative.

U.S. **+1.844.44.TXTAV** | INTERNATIONAL **+1.316.517.8270** | **BEECHCRAFT.COM**



RAISBECK ENGINEERING
Document No. 09EA-52-116
Section V – Performance

BEECHCRAFT Super King Air 200/B200 Series Equipped with:
- Enhanced Aero -52 Engines
- Quiet Turbofan Propellers
- Ram Air Recovery System
- Enhanced Performance Leading Edges
- Dual Aft Body Strakes
- Fully Enclosed MLG Doors (when HFG-equipped)

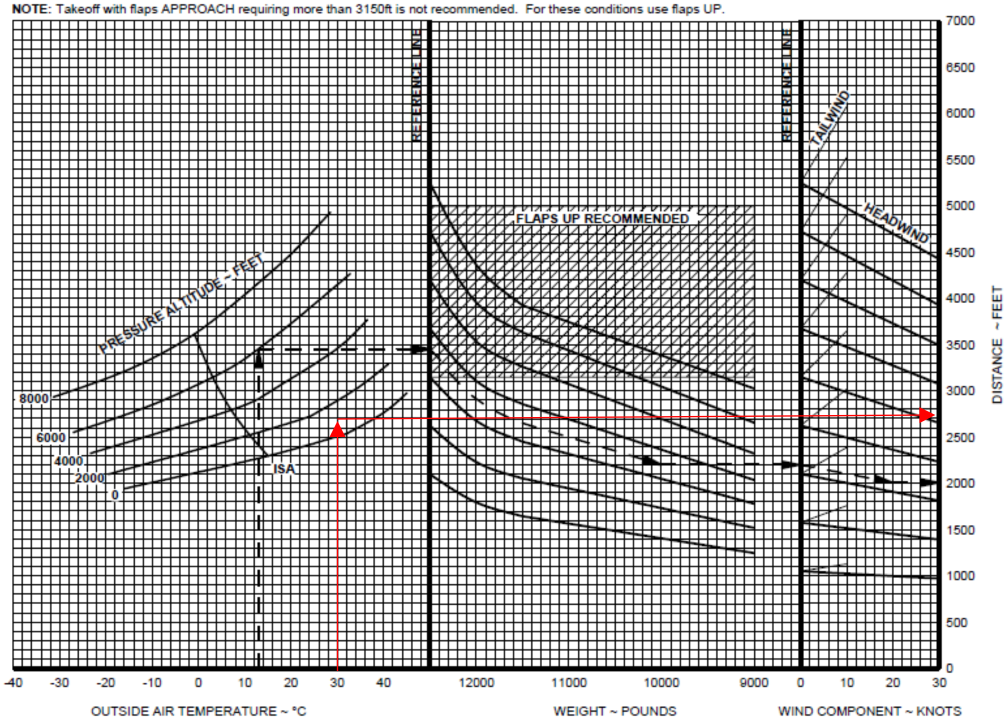
TAKE-OFF DISTANCE - FLAPS APPROACH (DISTANCE TO 50FT AGL)

ASSOCIATED CONDITIONS:
POWER.................................. TAKE-OFF POWER SET PRIOR TO BRAKE RELEASE
FLAPS.................................. APPROACH
LANDING GEAR.................................. SELECTED "UP" AT 50 FT
RUNWAY.................................. PAVED, LEVEL, DRY SURFACE

WEIGHT ~ LBS	V_R ~ KIAS	V_2 ~ KIAS
12500	96	105
12000	92	101
11700	90	99
11550	88	98
11000	87	98
10000	87	98
9000	87	98

EXAMPLE:
OAT.................................. 13°C
PRESSURE ALTITUDE.................. 6,000 FT
WEIGHT.................................. 10,000 LBS
HEADWIND COMPONENT............ 20 KNOTS
TAKE-OFF DISTANCE.................. 2,000 FEET

NOTE: Takeoff with flaps APPROACH requiring more than 3150ft is not recommended. For these conditions use flaps UP.



5-18

FAA-Approved: Revision IR: April 29, 2009

General characteristics (Model D35)

- Crew: 1
- Capacity: 3 passengers
- Length: 25 ft 2 in (7.67 m)
- Wingspan: 32 ft 10 in (10.01 m)
- Height: 7 ft 7 in (2.31 m)
- Wing area: 178 ft² (16.5 m²)
- Empty weight: 1,675 lb (760 kg)
- Max takeoff weight: 2,725 lb (1,236 kg)
- Powerplant: 1× Continental E-185-11, 205 hp (153 kW)
- Zero-lift drag coefficient: 0.0192
- Drag area: 3.48 ft² (0.32 m²)
- Aspect ratio: 6.20

Performance

- Maximum speed: 191 mph (166 kn, 306 km/h)
- Stall speed: 63 mph (55 kn, 101 km/h)
- Range: 779 mi (677 NM, 1,247 km)
- Rate of climb: 1,100 ft/min (5.6 m/s)
- Lift-to-drag ratio: 13.8

General characteristics (2009 model G36)

- Crew: 1
- Capacity: 5 passengers
- Length: 27 ft 6 in (8.38 m)
- Wingspan: 33 ft 6 in (10.21 m)
- Height: 8 ft 7 in (2.62 m)
- Wing area: 181 ft² (16.8 m²)
- Empty weight: 2,530 lb (1,148 kg)
- Loaded weight: 2,700 lb (1,225 kg)
- Max takeoff weight: 3,650 lb (1,656 kg)
- Powerplant: 1× Continental IO-550-B, 300 hp (223.7 kW)
- Fuel capacity: 80 gal (74 gal usable)

Performance

- Maximum speed: 203 mph (192 kn, 326 km/h)
- Stall speed: 70 mph (61 kn, 113 km/h)
- Range: 1060 mi (921 NM, 1,706 km)
- Service ceiling: 18,500 ft (5,639 m)
- Rate of climb: 1,230 ft/min (6.25 m/s)
- Wing loading: 20.2 lb/ft² (98.5 kg/m²)
- Power/mass: .082 hp/lb (1348 W/kg)
- Max Payload: 909 lb (412 kg)
- Takeoff distance: 1,250 ft
- Minimum landing distance: 950 ft

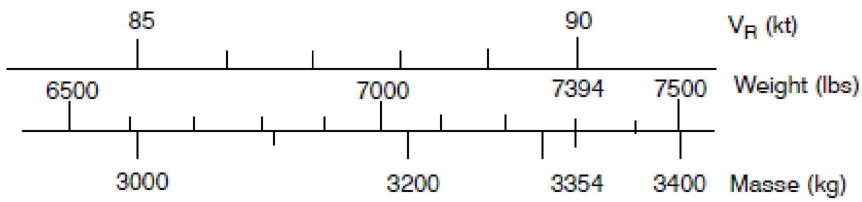
TBM 850 PILOT'S OPERATING HANDBOOK

SECTION 5
PERFORMANCE
EASA Approved

TAKEOFF DISTANCES

WEIGHT : 7394 lbs (3354 kg)

Associated conditions :
- Landing gear DN and flaps TO
- 12°5 of attitude – TRQ = 100 %
- Np = 2000 RPM – BLEED AUTO
- Hard, dry and level runway
- GR = Ground roll (in ft)
- D50 = Takeoff distance (clear to 50 ft) (in ft)
- Rotation speed choice (V_R)



WEIGHT : 7394 lbs (3354 kg) At 50 ft = 99 KIAS – 114 MPH IAS								
PRESSURE ALTITUDE ft	ISA – 35°C		ISA – 20°C		ISA – 10°C		ISA	
	GR	D50	GR	D50	GR	D50	GR	D50
0	1575	2250	1755	2495	1905	2675	2035	2840
2000	1755	2495	1970	2755	2120	2955	2280	3150
4000	1970	2755	2200	3055	2380	3285	2545	3510
6000	2185	3035	2480	3415	2675	3675	2890	3955
8000	2460	3380	2790	3825	3055	4135	3315	4445
PRESSURE ALTITUDE ft	ISA + 10°C		ISA + 20°C		ISA + 30°C		ISA + 37°C	
	GR	D50	GR	D50	GR	D50	GR	D50
0	2165	3020	2315	3200	2480	3415	2560	3530
2000	2445	3365	2595	3580	2780	3805	2920	3990
4000	2740	3760	2955	4035	3185	4300	3330	4480
6000	3135	4235	3380	4530	3625	4825	3805	5055
8000	3560	4760	3855	5105	4170	5450	4380	5710

Figure 5.9.3 – TAKEOFF DISTANCES – 7394 lbs (3354 kg)

Corrections :
. Reduce total distances of 10 % every 10 kts of headwind
. Increase total distances of 30 % every 10 kts of tail–wind
. Increase by : 7 % on hard sod; 10 % on short grass; 15 % on wet runway; 25 % on high grass; 30 % on slippery runway

NOTE :
Between ISA + 30°C and ISA + 37°C, it may be necessary to cut–off the Bleed in order to set TRQ = 100 % during takeoff while respecting the engine limitations. In this case, reduce power after takeoff to set the Bleed to AUTO.

Edition 1 – June 22, 2007
Rev. 11

Page 5.9.3

TAKEOFF DISTANCE

MAXIMUM WEIGHT 8750 LBS
SHORT FIELD

CONDITIONS:
Flaps 20°
1900 RPM
Inertial Separator - Normal
Cabin Heat - Off
Torque Set per Figure 5-8
Paved, Level, Dry Runway
Zero Wind

NOTES:
1. Short field technique as specified in Section 4.
2. Decrease distances 10% for each 11 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
3. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.
4. With takeoff power set below the torque limit (1865 ft-lbs), increase distance (both ground roll and total distance) by 3% for inertial separator in BYPASS and increase ground roll 5% and total distances 10% for cabin heat on.
5. Where distance values have been replaced by dashes, operating temperature limits of the airplane would be greatly exceeded. Those distances which are included but the operation slightly exceeds the temperature limit are provided for interpolation purposes only.

(CARGO POD INSTALLED)

WT. LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	-10°C		0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS	GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS	GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS	GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS	GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS	GRD ROLL FT	TOTAL FEET TO CLEAR 50 FT OBS
8750	70	83	SL	1205	2160	1280	2295	1365	2430	1445	2570	1535	2720	1625	2870
			2000	1360	2430	1455	2580	1545	2740	1645	2905	1745	3075	1910	3400
			4000	1550	2745	1655	2920	1760	3105	1875	3295	1995	3510	2290	4135
			6000	1765	3115	1890	3325	2015	3540	2145	3765	2435	4370	2805	5195
			8000	2025	3560	2165	3805	2345	4125	2670	4815	3065	5715	3565	7005
			10000	2335	4090	2585	4580	2930	5325	3370	6350	3915	7790	----	----
			12000	2875	5155	3270	6030	3745	7175	4350	8865	----	----	----	----

Figure 5-9. Takeoff Distance (Sheet 1 of 2)

Performance

	Cherokee Six 260		Cherokee Six 300	
MAXIMUM SPEED AT GROSS WEIGHT (kts.)/(km/h)				
2700 rpm at sea level		148/274		156/289
CRUISING SPEEDS AT GROSS WEIGHT				
Altitude cruise speeds (TAS) (optimum alt.)		Best Power	Best Power	Best Economy
75% power (kts./kmh)		137/254	152/282	148/274
65% power (kts./kmh)		129/239	145/269	141/261
55% power (kts./kmh)			134/248	129/239
STALL SPEED (CAS)				
Flaps Down Full 40° (kts./kmh)		55/102		55/102
Flaps Up (kts./kmh)		62/115		62/115
CRUISE RANGE (Cruising range includes 45 minute fuel reserve at maximum, range power plus allowance for fuel used during taxi, take-off, climb at MCP, cruise at optimum altitude and stated mixture plus descent)		Best Economy	Best Power	Best Economy
75% power (nm/km)		690/1279	595/1103	652/1208
65% power (nm/km)		720/1334	625/1158	700/1297
55% power (nm/km)			640/1186	730/1353
FUEL CONSUMPTION (gph/Lph)	Best Power	Best Economy	Best Power	Best Economy
75% power	18.5/70	14/52.9	18/68.13	16/60.6
65% power	15.2/57.5	12.2/46.1	16.1/60.9	13.8/52.2
55% power	12.8/48.4	10.4/39.3	14.2/53.7	11.9/45.0
SEAT MILES PER GALLON (nm/km)	Best Power		Best Power	Best Economy
75% power	43.2/80		50.7/94	55.5/103
65% power	49.8/92		54.0/100	61.3/113.6
55% power	54/100		56.6/105	65.0/120.4
RATE OF CLIMB (At Sea Level and Gross Wt.)				
Full Throttle (fpm/mpm)		775/236		1050/320
SERVICE CEILING (50 fpm) (ft./m)		12,800/3901		16,250/4953
ABSOLUTE CEILING (ft./m)		14,750/4496		18,000/5486
TAKE-OFF DISTANCE (Sea Level, zero wind, standard temperature)				
Ground Run (ft./m)		1200/366		900/274
Total over 50 ft. obstacle (ft./m)		1800/549		1350/412
LANDING DISTANCE (Sea Level, zero wind, standard temperature)				
Ground Roll (ft./m)		640/195		630/192
Total over 50 ft. obstacle (ft./m)		1000/305		1000/305

THIS PAGE INTENTIONALLY LEFT BLANK

Prepared by:
Mead & Hunt, Inc.
2605 Port Lansing Road
Lansing, Michigan 48906