Chapter Three

Facility Requirements

Proper airport planning requires the translation of forecasted aviation demand into the specific types and quantities of facilities that can adequately serve the identified demand. This chapter analyzes the existing capacities of Denton Enterprise Airport (DTO) facilities. The existing capacities will then be compared to the forecasted activity levels prepared in Chapter Two to determine the adequacy of existing facilities and identify whether deficiencies currently exist or may be expected to materialize in the future. The chapter presents the following elements:

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

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

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

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

DEMAND-BASED PLANNING HORIZONS

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

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

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

TABLE 3A | Aviation Demand Planning Horizons

	Base Year (2024)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
BASED AIRCRAFT				
Single-Engine	306	351	401	520
Multi-Engine	58	68	79	105
Jet	34	40	46	65
Helicopter	14	16	19	25
Other	0	0	1	2
TOTAL BASED AIRCRAFT:	**412**	**475**	**546**	**717**
ANNUAL OPERATIONS				
Itinerant				
Air Carrier	14	14	14	14
Air Taxi	3,075	3,400	4,300	6,100
General Aviation	102,829	113,500	125,300	152,800
Military	51	81	81	81
Total Itinerant Operations:	**105,969**	**116,995**	**129,695**	**158,995**
Local				
General Aviation	115,514	126,284	138,057	165,000
Military	4	0	0	0
Total Local Operations:	**115,518**	**126,284**	**138,057**	**165,000**
TOTAL OPERATIONS:	**221,487**	**243,279**	**267,752**	**323,995**

Source: Coffman Associates analysis

AIRFIELD CAPACITY

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

FACTORS AFFECTING ANNUAL SERVICE VOLUME

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

- **Runway Configuration |** The existing airfield configuration consists of parallel runways. Primary Runway 18L-36R is 7,002 feet long and 150 feet wide. Secondary Runway 18R-36L is 5,003 feet long and 75 feet wide. The runways are separated by 840 feet, which means they can be used simultaneously during visual flight rules (VFR) weather conditions. Each runway end is equipped with instrument approach capabilities with visibility minimums down to ¾-mile and Runway 18L is equipped with ½-mile visibility minimums.

- **Runway Use |** Runway use in capacity conditions is controlled by wind and/or airspace conditions. For DTO, the direction of takeoffs and landings is typically determined by the speed and direction of the wind or as directed by the airport traffic controller. It is generally safest for aircraft to take off and land into the wind, avoiding crosswind (wind blowing perpendicular to the travel of the aircraft) or tailwind components during these operations. Runway usage data sourced from the FAA's *IFP, Operations, and Airspace Analytics (IOAA) Tool* are summarized in **Table 3B**. The runway usage data show that most arrivals and departures utilize the primary runway (18L-36R).

TABLE 3B | Runway Usage Data

	Runway				Unknown
	18L	36R	18R	36L	
Departures	64.4%	34.8%	0.5%	0.3%	0.1%
Arrivals	62.9%	33.6%	2.3%	0.9%	0.2%

Source: FAA, IFP, Operations, and Airspace Analytics (IOAA) Tool

- **Exit Taxiways |** Exit taxiways have a significant impact on airfield capacity because the number and locations of exits directly determine the occupancy time of an aircraft on the runway. The airfield capacity analysis gives credit to taxiway exits located within the prescribed range from a runway's threshold. This range is based on the mix index of the aircraft that use the runways. Based on mix, only exit taxiways between 2,000 feet and 4,000 feet from the landing threshold count in the exit rating at DTO. The exits must be at least 750 feet apart to count as separate exit taxiways. Utilizing these criteria, Runway 18L-36R is credited with one exit taxiway in each direction and Runway 18R-36L has none.

AIRFIELD LAYOUT

Runway Configuration

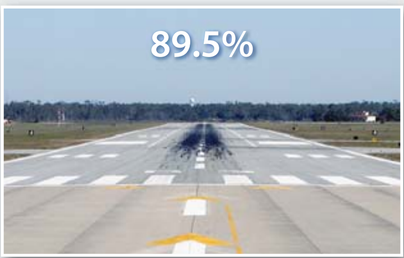
Runway Use

Number of Exits

WEATHER CONDITIONS

VMC (VFR)

Visual Meteorological Conditions

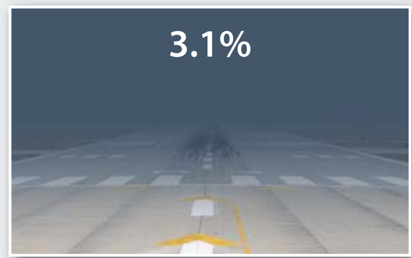


IMC (IFR)

Instrument Meteorological Conditions

PVC

Poor Visibility Conditions



AIRCRAFT MIX

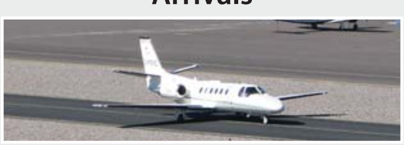
Category A & B Aircraft

Category C Aircraft

Category D Aircraft

OPERATIONS

Arrivals



Departures

Touch-and-Go Operations

Total Annual Operations

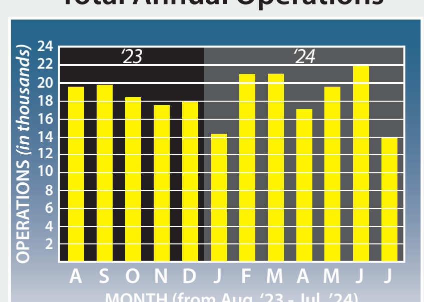


Exhibit 3A
AIRFIELD CAPACITY FACTORS

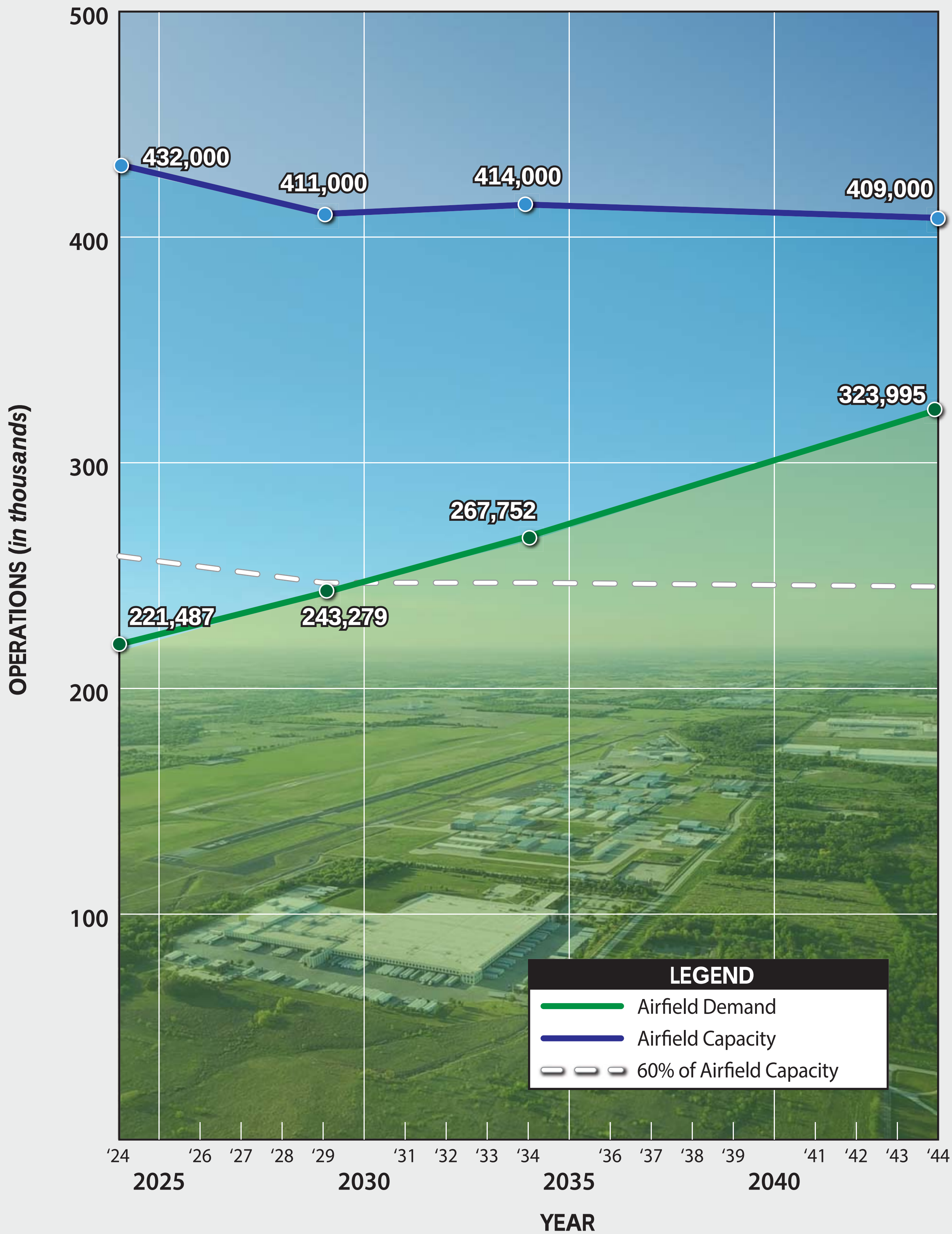


Exhibit 3A (continued)
AIRFIELD DEMAND VS. CAPACITY

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

  According to local meteorological data, the airport operates under visual meteorological conditions (VMC) approximately 89.5 percent of the time. VMC exist whenever the cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is greater than three statute miles. Instrument meteorological conditions (IMC) are defined when cloud ceilings are between 500 and 1,000 feet AGL or visibility is between one and three miles. Poor visibility conditions (PVC) apply for cloud ceilings below 500 feet and visibility minimums below one mile. **Table 3C** summarizes the weather conditions experienced at the airport over a 10-year period of time.

TABLE 3C | Weather Conditions

Condition	Cloud Ceiling	Visibility	Percent of Total
VMC	≥ 1,000' AGL	> 3 statute miles	89.5%
IMC	≥ 500' AGL to < 1,000' AGL	1-3 statute miles	7.4%
PVC	< 500' AGL	< 1 statute mile	3.1%

VMC = visual meteorological conditions
IMC = instrument meteorological conditions
PVC = poor visibility conditions
AGL = above ground level

Source: Denton Municipal Airport, TX US Station: 72258903991, 2014-2023

- **Aircraft Mix |** The aircraft mix for the capacity analysis is defined in terms of four aircraft classifications. Classes A and B consist of small- and medium-sized propeller aircraft and some jet aircraft, all of which weigh 12,500 pounds or less. These aircraft are primarily associated with general aviation activity but include some air taxi, air cargo, and commuter aircraft. Class C consists of aircraft that weigh between 12,500 pounds and 300,000 pounds. These aircraft include most business jets and some turboprop aircraft that utilize the airport on a regular basis. Class D consists of aircraft that weigh more than 300,000 pounds.

  Most operations at DTO are by aircraft in Classes A, B, and C. According to the FAA's Traffic Flow Management System Counts (TFMSC) data for 2024, there were approximately 4,266 total operations by Class C aircraft at DTO, which represents approximately 1.9 percent of all operations. Class D aircraft do not operate at DTO; therefore, remaining operations are within Classes A and B, which represent 98.1 percent of total operations. It is anticipated that operations by Class C aircraft will represent approximately 3.4 percent of total operations by 2044.

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

- **Touch-and-Go Activity |** A touch-and-go operation involves an aircraft making a landing and then an immediate takeoff without coming to a full stop or exiting the runway. As previously discussed in Chapter Two, these operations are normally associated with general aviation training activity and are classified as local operations. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and takeoff occurs within a shorter period than individual operations. Touch-and-go operations at DTO accounted for 52 percent of total annual operations in 2024. This percentage is anticipated to drop slightly to 51 percent, as itinerant operations are expected to grow at a slightly faster pace over the planning period.

- **Peak Period Operations |** Average daily operations and average peak hour operations during the peak month are utilized for the airfield capacity analysis and are based on operational data collected from the airport traffic control tower, which is operational from 6:00 a.m. to 10:00 p.m. daily. Operations activity is important in the calculation of an airport's ASV, as peak demand levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times throughout the year. The forecasts for this master plan identified current average daily operations at 735 operations and current peak hour operations at 129 operations. By the long term, average daily operations are projected to grow to 1,120 and peak hour operations are projected to increase to 197. This results in an annual operations to average daily demand ratios of 301 in 2024 and 289 by 2044. The ratio of average daily operations to peak hour operations is 5.7 through the planning period.

CALCULATION OF ANNUAL SERVICE VOLUME

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

Hourly Runway Capacity

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

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

The current and future weighted hourly capacities are presented in **Table 3D**. Weighted hourly capacity is the measure of the maximum number of aircraft operations that can be accommodated on the airfield in a typical hour. It is a composite of estimated hourly capacities for different airfield operating configurations adjusted to reflect the percentage of time in an average year that the airfield operates under each specific configuration. The current weighted hourly capacity on the airfield is 164 operations; the capacity is expected to decline slightly to 159 operations by the long-term horizon.

TABLE 3D | Airfield Capacity Summary

	Base Year (2024)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
Operational Demand				
Annual	221,487	243,279	267,752	323,995
Capacity				
Annual Service Volume	432,000	411,000	414,000	409,000
Percent Capacity	51.3%	59.2%	64.7%	79.2%
Weighted Hourly Capacity	252	250	250	249

Sources: FAA AC 150/5060-5, Airport Capacity and Delay; Coffman Associates analysis

Annual Service Volume

The ASV is determined by the following equation:

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

The current ASV for the airfield has been estimated at 432,000 operations. **The increasing percentage of larger Class C aircraft over the planning period will contribute to a decline in ASV**, lowering it to a level of approximately 409,000 operations by the end of the planning period. With 2024 operations (12 months ending July 2024) at 221,487, the airport is currently at 51.3 percent of its ASV. Long-range annual operations are forecasted to reach 323,995, which would equate to 79.2 percent of the airport's ASV.

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

AIRCRAFT DELAY

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

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

Table 3E summarizes the potential aircraft delay for DTO. Estimates of delay provide insight into the impacts steady increases in aircraft operations have on the airfield and signify the airport's ability to accommodate projected annual aircraft operations. The delay per operation represents an average delay per aircraft. It should be noted that delays of five to 10 times the average could be experienced by individual aircraft during peak periods. As an airport's percent capacity increases toward the ASV, delay increases exponentially. Furthermore, complexities in the airspace system that surrounds an airport can also factor into additional delay experienced at the facility.

TABLE 3E | Airfield Delay Summary

	Base Year (2024)	Short Term (1-5 years)	Intermediate Term (6-10 years)	Long Term (11-20 years)
Percent Capacity	51.3%	59.2%	64.7%	79.2%
Delay				
Per Operation (Seconds)	23	30	36	54
Total Annual (Hours)	1,415	2,027	2,678	4,860

Sources: FAA AC 150/5060-5, Airport Capacity and Delay; Coffman Associates analysis

Current annual delay is estimated at 23 seconds per aircraft operation, or 1,415 total annual hours. Analysis of delay factors for the long-term planning horizon indicates that annual delays can be expected to reach 54 seconds per aircraft operation, or 4,860 annual hours.

CAPACITY ANALYSIS CONCLUSION

FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 to 75 percent of the ASV. This is an approximate level to begin the detailed planning of capacity improvements. When 80 percent of the ASV is reached, capacity improvement projects should become higher-priority capital improvements. According to this analysis, operations levels at DTO will reach approximately 79 percent by the long-term planning period. As such, capacity enhancements at DTO should be considered. The projected activity levels for DTO do not warrant consideration of additional runways; however, other capacity enhancements, such as adding exit taxiways to both runways, can enhance airfield capacity. For instance, adding two to three additional exits increases operational capacity by eight to nine percent. These types of capacity enhancements will be considered in the alternatives analysis.

AIRSIDE FACILITY REQUIREMENTS

Airside facilities include those facilities related to the arrival, departure, and ground movement of aircraft. Airside facility requirements are based primarily on the runway design code (RDC) for each runway. Analysis in Chapter Two identified the existing RDCs as C-II-2400 for Runway 18L-36R and B-II-4000 for Runway 18R-36L. Ultimately, Runway 18L-36R is planned to meet RDC C/D-III-2400 design standards, while Runway 18R-36L will remain at B-II-4000 design standards.

RUNWAYS

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

Runway Orientation

According to FAA Order 5100.38D, *Airport Improvement Handbook*, only one runway at any NPIAS airport is eligible for ongoing maintenance and rehabilitation funding unless the FAA Airports District Office (ADO) has made a specific determination that a crosswind or secondary runway is justified. A runway that is not a primary runway, crosswind runway, or secondary runway is an *additional* runway, which is not eligible for FAA funding. It is not unusual for a two-runway airport to have a primary runway and an additional runway, and no crosswind or secondary runway. **Table 3F** presents the eligibility requirements for runway types.

TABLE 3F | Runway Eligibility

The following runway type…	Must meet all of the following criteria…	And is…
Primary Runway	1. A single runway at an airport is eligible for development consistent with FAA design and engineering standards.	Eligible
Crosswind Runway	1. The wind coverage on the primary runway is less than 95%.	Eligible if justified
Secondary Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. Either of the following: a. The primary runway is operating at 60% or more of its annual capacity. b. The FAA has made a specific determination that the runway is required.	Eligible if justified
Additional Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. The non-primary runway is not a secondary runway.	Ineligible

Source: FAA Order 5100.38D, AIP Handbook

FAA AC 150/5300-13B, *Airport Design*, recommends that a crosswind runway should be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecasted to use the airport on a regular basis. The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 miles per hour [mph]) for airport reference code (ARC) A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; 16 knots (18 mph) for ARC A-III, B-III, and C-I through D-II; and 20 knots (23 mph) for ARC C-III through D-IV.

As noted in the inventory chapter (see **Exhibit 1D**), wind data obtained on-site show the orientation of the parallel runways provides 96 percent or greater coverage for all applicable crosswind components; thus, the current runway orientation at DTO provides adequate wind coverage for all-weather conditions and a crosswind runway is not warranted.

For DTO to qualify for maintenance of a parallel runway, the airfield must operate at 60 percent or greater of its ASV. As previously stated, DTO is projected to exceed 60 percent of its ASV in the short- to intermediate-term period. Furthermore, DTO justified the construction of its parallel runway due to historical operations levels consistently exceeding 60 percent of a single runway ASV;[1] therefore, DTO meets the threshold for maintaining a secondary (parallel) runway, which is eligible for FAA funding.

[1] A single runway configuration has an estimated ASV of approximately 230,000 annual operations.

Runway Designations

A runway's designation is based on its magnetic headings, which are determined by the magnetic declination for the area. The magnetic declination near DTO is 2° 51' E ± 0° 6' W per year.[2] Both runways at DTO have true headings of 181°/361°. Adjusting for the magnetic declination, the current magnetic heading of both runways is 178°/358°, which would typically result in designations of 18R-36L and 18L-36R; therefore, no runway designation changes are recommended.

Runway Length

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

TABLE 3G | Airplane Weight Classification for Runway Length Requirements

Airplane Weight Category (MTOW)		Design Approach	Methodology
12,500 pounds or less	Approach speeds of less than 30 knots	Family grouping of small airplanes	Chapter 2: para. 203
	Approach speeds of at least 30 knots but less than 50 knots	Family grouping of small airplanes	Chapter 2: para. 204
	Approach speeds of 50 knots or more with fewer than 10 passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
	Approach speeds of 50 knots or more with 10 or more passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-2
Over 12,500 pounds but less than 60,000 pounds		Family grouping of large airplanes	Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2
60,000 pounds or more, or regional jets		Individual large airplanes	Chapter 4: *Airplane Performance Manuals*

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

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

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

The mean maximum daily temperature of the hottest month for DTO is 95.7 degrees Fahrenheit (°F), which occurs in July. The airport elevation is 642.7 feet mean sea level (MSL). The primary runway (18R-36L) has a gradient of 0.18 percent.

[2] National Oceanic and Atmospheric Administration (NOAA)

Small General Aviation Aircraft (≤12,500 pounds)

Most operations occurring at DTO are conducted using smaller general aviation (GA) aircraft that weigh less than 12,500 pounds. Following guidance from AC 150/5325-4B, to accommodate 95 percent of these small aircraft with fewer than 10 passenger seats, a runway length of 3,400 feet is recommended. For 100 percent of these small aircraft, a runway length of 4,000 feet is recommended. For small aircraft with 10 or more passenger seats, 4,400 feet of runway length is recommended.

Small and Mid-Size Turbine Aircraft (12,500–60,000 pounds)

Turbine operations comprise a smaller percentage of DTO operations, but this category of activity is projected to experience strong growth over the planning period. Runway length requirements for this classification of aircraft also utilize charts from AC 150/5325-4B and take into consideration the runway gradient and landing length requirements for contaminated (wet) runways. Business jets tend to need greater runway length when landing on wet surfaces because of their increased approach speeds. AC 150/5325-4B stipulates that runway length determination for business jets should consider a grouping of airplanes with similar operating characteristics. The AC provides two separate family groupings of airplanes, each of which is based on its representative percentage of aircraft in the national fleet. The first grouping is those business jets that comprise 75 percent of the national fleet, and the second group is those that comprise 100 percent of the national fleet. **Table 3H** shows example aircraft for both groups.

TABLE 3H | Aircraft Categories for Runway Length Determination

0-75 Percent of the National Fleet	MTOW (pounds)	75-100 Percent of the National Fleet	MTOW (pounds)
Challenger 300	38,850	Lear 55	21,500
Lear 40/45	20,500	Lear 60	23,500
Cessna 550 Citation II	14,100	Hawker 800XP	28,000
Cessna 560XL Excel	20,000	Hawker 1000	31,000
Cessna 650 VII	22,000	Cessna 650 III/IV	22,000
Cessna 680 Sovereign	30,775	Cessna 750X	35,700
Beechjet 400	15,800	Challenger 604	47,600
Falcon 50	18,500	Falcon 2000	42,800
MTOW = maximum takeoff weight			

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

The following is the five-step process for determining the recommended runway length for aircraft with MTOWs between 12,500 pounds and 60,000 pounds.

Step #1: Identify the critical airplane or airplane group.

This runway length analysis assumes the critical aircraft is a mid-sized business jet that weighs less than 60,000 pounds MTOW. There are more than 500 annual operations by these types of aircraft at DTO. In this case, the appropriate runway length methodology is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B for aircraft that weigh between 12,500 pounds and 60,000 pounds.

Step #2: Identify the airplanes or airplane group that will require the longest runway length at MTOW.

Business jets typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be examined for future conditions.

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

In consideration of the growing number of business jets, it is necessary to select the specific methodology to use for the business jets. Chapter 3 of the AC groups business jets that weigh over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet
- 100 percent of the fleet

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

The AC indicates that the airport designer must determine which category to use for runway length determination. DTO experiences significant levels of business jet activity from the full range of the business jet fleet.

Two runway length curves are presented in the AC under the 75-100 percent category:

- 60 percent useful load
- 90 percent useful load

The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may choose to ferry fuel so that they do not have to refuel frequently. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is typically considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category. For DTO, there are occasional long-haul operations that would suggest consideration of the 90 percent useful load classification. TFMSC data document city pairs by departing aircraft. An examination of the destinations shows there were 99 departures from DTO in 2024 to destination airports that are 1,000 miles or more away. Most flights departing DTO are short-haul flights to destinations less than 1,000 miles away, but due to the occasional long-haul flight, both the 60 and 90 percent useful load categories are included when calculating runway length requirements for business jets that weigh between 12,500 and 60,000 pounds.

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

The next step is to examine the performance charts. These charts require the following inputs:

- The mean maximum daily temperature of the hottest month: July at 95.7°F
- The airport elevation: 642.7 feet above MSL

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

The raw runway lengths calculated in Step #4 are based on no wind, a dry runway surface, and zero effective runway gradient; therefore, the following criteria are applied:

- Wet runway surface (applies to landing operations only)
- 0.18 percent effective runway gradient, 12.3 feet of elevation difference for Runway 18R-36L (applies to takeoff operations only)

To account for a wet/contaminated surface, the runway length obtained from the load performance chart used in Step #4 is increased by 15 percent, or up to 5,000 feet, for the 60 percent category and 7,000 feet for the 90 percent category (whichever is less).

The runway length obtained from Step #4 is also increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At DTO, this equates to an additional 123 feet of runway length.

Table 3J presents the results of the runway length analysis for business jets that weigh between 12,500 and 60,000 pounds, developed following the guidance outlined in the steps above. This analysis shows the existing length of primary Runway 18L-36R (7,002 feet) exceeds the recommended length for 100 percent of the business jet fleet at 90 percent useful load.

TABLE 3J | Runway Length Requirements – Aircraft Between 12,500 and 60,000 Pounds

Airport Elevation	642.7' feet above mean sea level			
Average High Monthly Temp.	95.7°F (July)			
Runway Gradient	0.18% Runway 18R-36L (12.3')			
Fleet Mix Category	**Raw Runway Length from FAA AC**	**Runway Length with Gradient Adjustment**	**Wet Surface Landing Length for Jets (+15%)[1]**	**Final Runway Length[2]**
75% of fleet at 60% useful load	4,842'	4,965'	5,500'	5,500'
100% of fleet at 60% useful load	5,880'	6,003'	5,500'	6,000'
75% of fleet at 90% useful load	7,146'	7,269'	7,000'	7,300'
100% of fleet at 90% useful load	9,375'	9,498'	7,000'	9,500'

[1]Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions
[2]Longest runway need rounded up to nearest hundred
Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Supplemental Analysis Undertaken for Typical Business Jets Operating with Local Conditions

Another method to determine runway length requirements for aircraft at DTO is to examine aircraft flight planning manuals under conditions specific to the airport. **Table 3K** provides a detailed runway length analysis for several of the most common airplane design group (ADG) C and D turbine aircraft in the national fleet. These data were obtained from UltraNav software, which computes operational parameters for specific aircraft based on flight manual data. The analysis includes the MTOW allowable and the percent useful load from 60 percent to 100 percent.

TABLE 3K | Supplemental Business Aircraft Takeoff Length Requirements

		TAKEOFF LENGTH REQUIREMENTS (feet)				
		Useful Load				
Aircraft	**MTOW**	**60%**	**70%**	**80%**	**90%**	**100%**
Challenger 300	38,850	4,554	4,988	5,437	5,909	6,400
Challenger 601	**45,100**	**5,130**	**5,710**	**6,360**	**7,090**	**7,900**
Citation III	21,500	4,596	5,060	5,562	C/L	C/L
Citation X	35,700	4,728	5,151	5,651	6,194	6,768
Falcon 2000	35,800	4,890	5,349	5,836	6,349	7,228
Falcon 50EX	41,000	4,507	4,984	5,488	6,020	6,510
Falcon 900EX	49,200	4,330	4,880	5,540	6,210	6,820
Global Express	98,000	4,831	5,409	6,017	6,653	7,323
Gulfstream G280	39,600	4,325	4,775	5,283	5,829	6,434
Gulfstream G450	74,600	4,587	5,048	5,568	6,119	6,711
Gulfstream G550	**91,000**	**4,717**	**5,400**	**6,092**	**6,844**	**7,630**
Gulfstream G650	**99,600**	**4,991**	**5,491**	**6,064**	**6,720**	**7,479**
Hawker 1000	31,000	5,460	6,100	6,740	C/L	C/L
Hawker 4000	39,500	4,371	4,746	5,147	5,586	6,151
Lear 60	23,500	5,275	5,819	6,379	6,931	7,628

Red figures are greater than 7,002 feet (length of the primary runway at DTO).
Critical aircraft is in **bold**.
Runway length calculation assumptions: 642.7' MSL field elevation; 95.7°F ambient temperature; 0.18% runway grade
C/L = climb limited: aircraft cannot maintain required climb gradient
MTOW = maximum takeoff weight

Source: UltraNav software

The analysis shows that each jet examined can operate at DTO during the hottest periods of the summer at useful loads up to 80 percent and all but three jets can operate at 90 percent useful loads. One of the three jets that are limited at 90 percent useful load is the Challenger 601 (a variant of the Challenger 600 critical aircraft). The Gulfstream G550 and G650, which are ultimate critical aircraft, can operate at 90 percent useful loads.

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

The landing length analysis shows that all jets examined are capable of landing at DTO during dry runway conditions. During wet runway conditions, the three critical aircraft, when landing at maximum landing weight and during the hottest period of the year, can land at DTO in all but the 60 percent rule condition.

TABLE 3L | Supplemental Business Aircraft Landing Length Requirements

		LANDING LENGTH REQUIREMENTS (feet)					
		Dry Runway Condition			Wet Runway Condition		
Aircraft	MLW	Part 91	80% Rule	60% Rule	Part 91	80% Rule	60% Rule
Challenger 300	33,750	2,638	3,298	4,397	5,057	6,321	8,428
Challenger 601	**36,000**	**3,370**	**4,213**	**5,617**	**4,044**	**5,055**	**6,740**
Citation III	19,000	3,794	4,743	6,323	5,443	6,804	9,072
Citation X	31,800	3,901	4,876	6,502	5,568	6,960	9,280
Falcon 2000	33,000	3,165	3,956	5,275	3,640	4,550	6,067
Falcon 50EX	35,715	2,965	3,706	4,942	3,410	4,263	5,683
Falcon 900EX	44,500	3,716	4,645	6,193	4,274	5,343	7,123
Global Express	78,600	2,702	3,378	4,503	3,107	3,884	5,178
Gulfstream G280	32,700	3,019	3,774	5,032	3,472	4,340	5,787
Gulfstream G450	66,000	3,302	4,128	5,503	5,671	7,089	9,452
Gulfstream G550	**75,300**	**2,809**	**3,511**	**4,682**	**5,101**	**6,376**	**8,502**
Gulfstream G650	**83,500**	**3,782**	**4,728**	**6,303**	**4,996**	**6,245**	**8,327**
Hawker 1000	25,000	2,915	3,644	4,858	3,982	4,978	6,637
Hawker 4000	33,500	3,272	4,090	5,453	3,763	4,704	6,272
Lear 60	19,500	3,659	4,574	6,098	4,930	6,163	8,217

Red figures are greater than 7,002 feet (length of the primary runway at DTO).
Critical aircraft is in **bold**.
Runway length calculation assumptions: 642.7' MSL field elevation; 95.7°F ambient temperature; 0.18% runway grade
MLW = maximum landing weight
Source: UltraNav software

Runway Length Summary

Many factors are considered when determining appropriate runway length for safe and efficient operations of aircraft at DTO. The airport should strive to accommodate business jets and turboprop aircraft to the greatest extent possible as demand dictates. Runway 18L-3R is currently 7,002 feet long, which exceeds the FAA's recommended length for runways accommodating 100 percent of the business jet fleet that weigh between 12,500 and 60,000 pounds when operating at 60 percent useful load (the recommended length is 6,000 feet). The existing length is 300 feet shy of meeting the FAA-recommended length of 7,300 feet for accommodating 75 percent of the business jet fleet at 90 percent useful load and 2,500 feet shy of meeting the recommended length for 100 percent of the fleet at 90 percent useful load.

The supplemental runway length analysis shows that the available length accommodates takeoff by the existing and ultimate critical aircraft up to 80 percent useful loads and landing in almost all conditions. The exception for landing is limitations on the Gulfstream G550/G650 (ultimate critical aircraft) when landing on a wet runway configuration under the Part 139/91k 60 percent rule, which requires a length of between 8,300 and 8,500 feet.

The previous master plan for DTO maintained Runway 18L-36R at its current length of 7,002 feet. The runway length analysis confirms the existing length is sufficient to accommodate the existing and future critical aircraft during most operational conditions; however, additional length is needed to cover all conditions. Extending Runway 18L-36R comes with significant challenges; Hickory Creek, located approximately 670 feet south of the runway, and Dry Fork Hickory Creek, located approximately 630 feet north of the runway, would need to be rerouted and filled/graded to support an extension in either direction. These would be significant undertakings in terms of fill alone; Hickory Creek is approximately

35 feet below the elevation of the runway platform. The creek to the north has less extreme elevation differences from the runway platform but is still approximately 15 to 20 feet lower in elevation. **Due to the existing constraints and the fact that the existing runway length is adequate in most operational conditions for the existing and future critical aircraft, it is recommended that Runway 18L-36R remain at its current length of 7,002 feet.**

Runway 18R-36L is planned to accommodate smaller aircraft operating at the airport within aircraft approach category (AAC) A and B and ADG I and II. The runway length analysis showed that the existing length of 5,003 feet exceeds the FAA-recommended length to accommodate all small general aviation aircraft with 10 or more passenger seats, which is 4,400 feet. Because the B-II category includes some small and mid-sized business jets, it is prudent to plan Runway 18R-36L to satisfy, at a minimum, the FAA-recommended length to accommodate 75 percent of the business jet fleet at 60 percent useful load, which is 5,500 feet. Unlike Runway 18L-36R, the secondary runway at DTO is less constrained by surrounding creeks, and the smaller safety areas associated with the B-II design make it a better candidate for an extension; **therefore, the alternatives chapter will consider extension options for Runway 18R-36 to a minimum length of 5,500 feet.**

Runway Width

For Runway 18L-36R, existing RDC C-II-2400 and ultimate RDC C/D-III-2400 design criteria stipulate a runway width of 100 feet. At 150 feet wide, the existing Runway 18L-36R width exceeds the design standard. Design standards only stipulate a width requirement of 150 feet if the design aircraft has a MTOW greater than 150,000 pounds. The existing critical aircraft, the Challenger 600, has a MTOW of 45,100 pounds and the ultimate critical aircraft, the Gulfstream G550/G650, have MTOWs of less than 100,000 pounds; therefore, the existing and ultimate justified width for Runway 18L-36R is 100 feet. This justification applies to FAA funding for future maintenance (major rehabilitation/reconstruction). In the event the FAA will only support maintaining 100 feet of runway width, the airport sponsor can choose to reduce the runway width or fund the maintenance of the additional 50 feet.

For Runway 18R-36L, RDC B-II-4000 standards stipulate a runway width of 75 feet. At 75 feet wide, Runway 18R-36L meets the existing/ultimate design standard. No runway width changes are planned for the secondary runway.

Runway Shoulders

Runway shoulders provide resistance to soil erosion, decrease the likelihood of engine ingestion of foreign objects, and accommodate the passage of maintenance and emergency equipment, as well as the occasional passage of aircraft deviating from the runway. Like design standards for runway width, runway shoulder width is determined by the RDC. Paved shoulders are required for ADG IV and higher runways and are recommended for ADG III runways. Turf, aggregate-turf, soil cement, or lime or bituminous stabilized soil are recommended adjacent to runways accommodating ADG I and ADG II aircraft.

Neither runway at DTO currently has paved shoulders. The ADG III shoulder width design standard is 20 feet and the ADG II shoulder width design standard is 10 feet. The alternatives will consider adding paved shoulders to both runways.

Blast Pads

Blast pads are paved surfaces adjacent to the ends of runways that provide erosion protection from jet blast and propeller wash. According to the FAA, blast pads must always be paved, must extend across the full width of the runway plus the shoulders, and must be able to support the occasional passage of the most demanding aircraft, as well as maintenance and emergency response vehicles. Blast pad dimensions are detailed in FAA AC 150/5300-13B and are determined by the RDC of the critical design aircraft ARC. Under ultimate C/D-III design standards, blast pads are not a design requirement; however, the construction of blast pads could be considered if the airport experiences significant erosion issues due to increasing jet traffic. Recommended blast pad dimensions for Runway 18L-36R are 140 feet wide and 200 feet long. Blast pad dimensions for B-II design standards that apply to Runway 18R-36L are 95 feet wide and 150 feet long.

Pavement Strength

An important feature of airfield pavement is its ability to withstand repeated use by aircraft. For Runway 18L-36R, the pavement should be designed to handle the heaviest business jets that routinely operate at DTO, including the ultimate critical aircraft, the Gulfstream G650, which has a MTOW of 99,600 pounds on dual wheel main landing gear. Secondary Runway 18R-36L should have adequate pavement strength to accommodate routine operations by smaller aircraft, including its future critical aircraft, the King Air 350, which has a MTOW of 16,500 pounds on dual wheel main landing gear.

As shown in **Table 3M**, the existing pavement strengths are adequate to accommodate the designated future critical aircraft for each runway. No additional strength is recommended for either runway.

TABLE 3M | Pavement Strength Requirements

Runway	Single Wheel Loading (SWL) Rating	Dual Wheel Loading (DWL) Rating	Future Critical Aircraft MTOW	Additional Strength Needed?
Runway 18L-36R	70,000 pounds	100,000 pounds	99,600 pounds DWL (Gulfstream G650)	No
Runway 18R-36L	30,000 pounds	50,000 pounds	16,500 DWL (King Air 350)	No

Source: Coffman Associates analysis

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

The strength rating of a runway can change over time. Regular usage by heavier aircraft can decrease the strength rating, while periodic runway resurfacing can increase the strength rating.

SAFETY AREA DESIGN STANDARDS

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

The entire RSA, ROFA, and ROFZ must be under the direct ownership of the airport sponsor to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. RPZs should also be under airport ownership. An alternative to outright ownership of the RPZ is the purchase of avigation easements (acquiring control of designated airspace within the RPZ) or having sufficient land use control measures in place that ensure the RPZ remains free of incompatible development. The various existing airport safety areas and their dimensions are presented on **Exhibit 3B**.

Runway Safety Area

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

For existing C-II-2400 and ultimate C/D-III-2400 design standards on Runway 18L-36R, the FAA calls for the RSA to be 500 feet wide and extend 1,000 feet beyond the runway ends and 600 feet prior to the landing threshold. Hickory Creek to the south of the runway and Dry Fork Hickory Creek north of the runway restrict the ability to meet the full 1,000 feet of RSA beyond the runway ends. As a result, the airport has applied declared distances, which limit the use of some runway pavement for landing and takeoff operations so the runway can meet RSA standards.

Declared distances are used to define the effective runway length for landing and takeoff when a standard RSA or ROFA cannot be achieved or an RPZ needs to be relocated.

The four declared distances include the following:

- Takeoff run available (TORA) – the runway length declared available and suitable for the ground run of an aircraft taking off (factors in the positioning of the departure RPZ)
- Takeoff distance available (TODA) – the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA; the full length of the TODA may need to be reduced because of obstacles in the departure area
- Accelerate-stop distance available (ASDA) – the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff (factors in the length of RSA/ROFA beyond the runway end)
- Landing distance available (LDA) – the runway length declared available and suitable for landing an aircraft (factors in the length of RSA/ROFA beyond the runway end and the positioning of the approach RPZ)

Due to the waterway limitations off the north and south ends of Runway 18L-36R, DTO has applied an ASDA and LDA of 6,502 feet to Runway 18L. As a result, the RSA extends for 500 feet beyond the south end of the runway, as opposed to the standard 1,000 feet. The Runway 36R threshold is displaced by 100 feet, which, when added to the 500 feet of RSA beyond the south end of the runway pavement, provides the full 600 feet of RSA prior to the landing threshold. For Runway 36R, the ASDA is reduced to 6,602 feet and the LDA is reduced to 6,502 feet, resulting in the RSA extending 600 feet beyond the north end of the runway. The TORA and TODA declared distances for Runway 18L-36R are the full pavement length of 7,002 feet.

The alternatives chapter will explore options to mitigate the impact of the waterways on the Runway 18L-36R RSA so the full runway length can be utilized for all takeoff and landing conditions.

For Runway 18R-36L, B-II-4000, design standards stipulate an RSA that is 150 feet wide and extends 300 feet beyond the runway end. There are no known incompatibilities within the Runway 18R-36L RSA, and all declared distances for the secondary runway are the full pavement length of 5,003 feet.

Runway Object Free Area

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

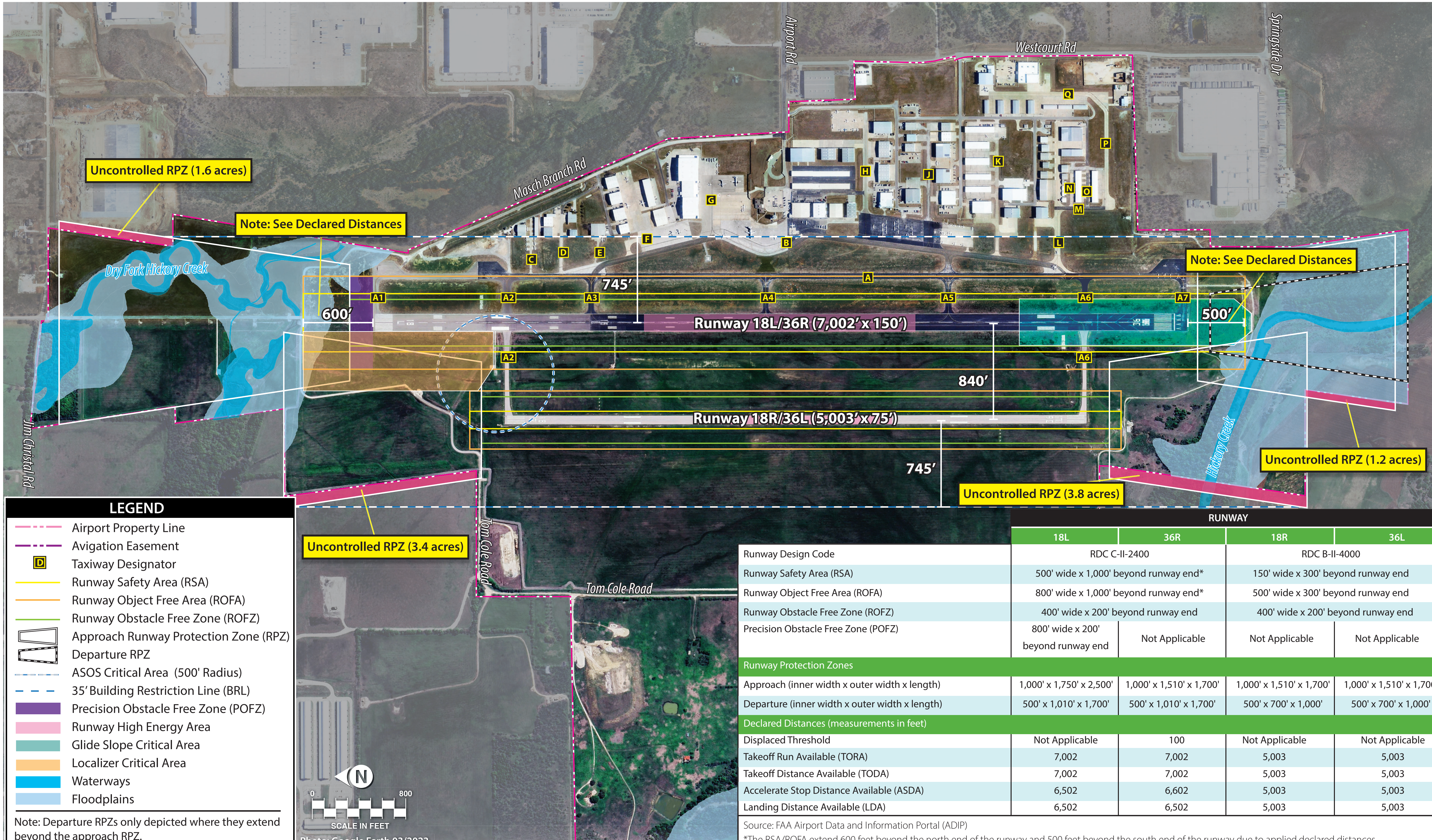
For C-II-2400 and C/D-III-2400 design standards on Runway 18L-36R, the FAA calls for the ROFA to be 800 feet wide and extend 1,000 feet beyond each runway end. At DTO, the ROFA, like the RSA, extends only 500 feet beyond the south end of the runway and 600 feet beyond the north end of the runway. This is due to the presence of waterways and the application of declared distances to mitigate the waterways. The alternatives will consider mitigation measures that could eliminate the need for declared distances on Runway 18L-36R.

For Runway 18R-36L, B-II-4000 ROFA design standards stipulate the ROFA to be 500 feet wide and extend 300 feet beyond the runway end. There are no known incompatibilities within the Runway 18R-36L ROFA.

Runway Obstacle Free Zone

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

For all runways serving aircraft over 12,500 pounds, the ROFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the runway ends. This standard applies to both runways at DTO. Under current evaluation with available data, there are no ROFZ obstructions at the airport.



	RUNWAY			
	18L	36R	18R	36L
Runway Design Code	RDC C-II-2400		RDC B-II-4000	
Runway Safety Area (RSA)	500' wide x 1,000' beyond runway end*		150' wide x 300' beyond runway end	
Runway Object Free Area (ROFA)	800' wide x 1,000' beyond runway end*		500' wide x 300' beyond runway end	
Runway Obstacle Free Zone (ROFZ)	400' wide x 200' beyond runway end		400' wide x 200' beyond runway end	
Precision Obstacle Free Zone (POFZ)	800' wide x 200' beyond runway end	Not Applicable	Not Applicable	Not Applicable
Runway Protection Zones				
Approach (inner width x outer width x length)	1,000' x 1,750' x 2,500'	1,000' x 1,510' x 1,700'	1,000' x 1,510' x 1,700'	1,000' x 1,510' x 1,700'
Departure (inner width x outer width x length)	500' x 1,010' x 1,700'	500' x 1,010' x 1,700'	500' x 700' x 1,000'	500' x 700' x 1,000'
Declared Distances (measurements in feet)				
Displaced Threshold	Not Applicable	100	Not Applicable	Not Applicable
Takeoff Run Available (TORA)	7,002	7,002	5,003	5,003
Takeoff Distance Available (TODA)	7,002	7,002	5,003	5,003
Accelerate Stop Distance Available (ASDA)	6,502	6,602	5,003	5,003
Landing Distance Available (LDA)	6,502	6,502	5,003	5,003

Source: FAA Airport Data and Information Portal (ADIP)

*The RSA/ROFA extend 600 feet beyond the north end of the runway and 500 feet beyond the south end of the runway due to applied declared distances.

Exhibit 3B
EXISTING SAFETY AREAS

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A precision obstacle free zone (POFZ) is further defined for runway ends with ½-mile visibility precision approaches, such as the instrument landing system (ILS) approach to Runway 18L. The POFZ is 800 feet wide, centered on the runway, and extends from the runway's threshold for 200 feet. The POFZ is in effect when the following conditions are met:

- The runway supports a vertically guided approach.
- The reported ceiling is below 250 feet or visibility is less than ¾-mile.
- An aircraft is on final approach within two miles of the runway threshold.

When the POFZ is in effect, a wing of an aircraft holding on a taxiway may penetrate the POFZ; however, neither the fuselage nor the tail may infringe on the POFZ. POFZ standards currently apply to Runway 18L, as it is equipped with vertically guided approaches with instrument approach minimums below ¾-mile.

Runway Protection Zone

An RPZ is a trapezoidal area centered on the extended runway centerline beginning 200 feet from the end of the runway. This safety area is established to protect the end of the runway from airspace penetrations and incompatible land uses. The RPZ dimensions are based on the established RDC and the approach visibility minimums serving the runway. While the RPZ is intended to be clear of incompatible objects or land uses, some land uses are permitted with conditions and other land uses are prohibited. According to AC 150/5300-13B, Change 1, the following land uses are permissible within the RPZ:

- Farming that meets the minimum buffer requirements
- Irrigation channels, as long as they do not attract birds
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator
- Underground facilities, as long as they meet other design criteria, such as RSA requirements, as applicable
- Unstaffed navigational aids (NAVAIDs) and facilities, such as those required for airport facilities that are fixed by function regarding the RPZ
- Aboveground fuel tanks associated with backup generators for unstaffed NAVAIDS

In September 2022, the FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*, which states that airport owner control over RPZs is preferred. Airport owner control over RPZs may be achieved through the following methods:

- Ownership of the RPZ property in fee simple
- Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.
- Possessing sufficient land use control authority to regulate land use in the jurisdiction that contains the RPZ
- Possessing and exercising the power of eminent domain over the property
- Possessing and exercising permitting authority over proponents of development within the RPZ (e.g., where the sponsor is a state)

AC 150/5190-4B further states that "control is preferably exercised through acquisition of sufficient property interest and includes clearing RPZ areas (and keeping them clear) of objects and activities that would impact the safety of people and property on the ground." The FAA recognizes that land ownership, environmental, geographical, and other considerations can complicate land use compatibility within RPZs; regardless, airport sponsors must comply with FAA grant assurances, including (but not limited to) Grant Assurance 21, *Compatible Land Use*. Sponsors are expected to take appropriate measures to "protect against, remove, or mitigate land uses that introduce incompatible development within RPZs."

For a proposed project that would shift an RPZ into an area with existing incompatible land uses, such as a runway extension or the construction of a new runway, the sponsor is expected to have or secure sufficient control of the RPZ, ideally through fee simple ownership. Where existing incompatible land uses are present, the FAA expects sponsors to "seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses" through acquisition, land exchanges, right-of-first refusal to purchase, agreement with property owners on land uses, easements, or other such measures. These efforts should be revisited during master plan or ALP updates, and periodically thereafter, and should be documented to demonstrate compliance with FAA grant assurances. If a new or proposed incompatible land use impacts an RPZ, the FAA expects the airport to take the above actions to control the property within the RPZ and adopt a strong public stance opposing the incompatible land use.

For a new incompatible land use that results from a sponsor-proposed action (e.g., an airfield project like a runway extension, a change in the critical aircraft that increases the RPZ dimension, or lower minimums that increase the RPZ dimension), the airport sponsor is expected to conduct an alternatives evaluation. The intent of the alternatives evaluation is to "proactively identify a full range of alternatives and prepare a sufficient evaluation to be able to draw a conclusion about what is 'appropriate and reasonable'." For incompatible development off-airport, the sponsor should coordinate with the FAA ADO as soon as the sponsor learns of the development, and the alternatives evaluation should be conducted within 30 days of the sponsor's first awareness of the development within the RPZ. The following items are typically necessary in an alternatives evaluation:

- Sponsor's statement of the purpose and need of the proposed action (airport project, land use change, or development)
- Identification of any other interested parties and proponents
- Identification of any federal, state, and/or local transportation agencies involved
- Analysis of sponsor control of the land within the RPZ
- Summary of all alternatives considered, including the following:
    - Alternatives that preclude introducing the incompatible land use within the RPZ (e.g., zoning action, purchase, and design alternatives, such as implementation of declared distances or displaced thresholds, runway shift or shortening, raising minimums, etc.)
    - Alternatives that minimize the impact of the land use in the RPZ (e.g., rerouting a new roadway through less of the RPZ, etc.)

 - o Alternatives that mitigate risk to people and property on the ground (e.g., tunnelling, depressing, and/or protecting a roadway through the RPZ, implementing operational measures to mitigate any risks, etc.)

- Narrative discussion and exhibits or figures depicting the alternative
- Rough order of magnitude cost estimates associated with each alternative, regardless of potential funding sources
- Practicability assessment based on the feasibility of the alternative in terms of constructability, cost, operational impacts, and other factors

Once the alternatives evaluation has been submitted to the ADO, the FAA will determine whether the sponsor has made an adequate effort to pursue and consider appropriate and reasonable alternatives.

The FAA will not approve or disapprove the airport sponsor's preferred alternative; rather, the FAA will evaluate whether an acceptable level of alternatives analysis has been completed before the sponsor makes the decision to allow or disallow the proposed land use within the RPZ.

In summary, the RPZ guidance published in September 2022 shifts the responsibility of protecting the RPZ to the airport sponsor. The airport sponsor is expected to take action to control the RPZ or demonstrate that appropriate actions have been taken. The decision to permit or disallow existing or new incompatible land uses within an RPZ is ultimately up to the airport sponsor, with the understanding that the sponsor still has grant assurance obligations, and the FAA retains the authority to review and approve or disapprove portions of the ALP that would adversely impact the safety of people and property within the RPZ.

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

The locations and dimensions of each RPZ for both runways are depicted on **Exhibit 3B**. Because Runway 36R has a 100-foot displacement, the departure RPZ extends 100 feet farther from the end of the runway than the approach RPZ, but both are fully contained within airport property. Only a small portion of each runway RPZ extends beyond airport property. The uncontrolled RPZ areas, which total approximately 10.0 acres, are largely undeveloped; however, an access road that intersects with Jim Christal Road and serves a new warehouse adjacent to the airport has been constructed within the 18L RPZ.

The alternatives analysis will consider options to mitigate RPZ incompatibilities and allow the airport to establish full control over the RPZs.

RUNWAY SEPARATION STANDARDS

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

Runway/Taxiway Separation

The design standard for the separation between runways and parallel taxiways is a function of the critical design aircraft and the instrument approach visibility minimums. The separation standard for Runway 18L-36R, which is equipped with ½-mile instrument approach visibility minimums, is 400 feet from the runway centerline to the parallel taxiway centerline. Parallel Taxiway A is 400 feet east of the Runway 18L-36R centerline, meeting the FAA design standard.

Runway 18R-36L does not have a full-length parallel taxiway. The design standard for a B-II-4000 runway is 240 feet of separation between the runway and taxiway centerlines. The alternatives in the next chapter may consider options for adding a parallel taxiway to Runway 18R-36L and meeting the minimum separation standard.

Holding Position Separation

Holding position markings are placed on taxiways leading to runways. When instructed, pilots are to stop short of the holding position marking line. For C-II-2400 design standards, which are applied in the existing condition for Runway 18L-36R, holding position markings should be situated 250 feet from the runway centerline. The existing condition meets the design standard. Under C/D-III-2400 design standards, which are applicable in the ultimate condition for Runway 18L-36R, the 250-foot separation standard is increased by one foot for every 100 feet of elevation of the airport above sea level. DTO is situated at 642.7 feet MSL, so the holding position marking separation standard is increased by six feet to 256 feet.

B-II-4000 design standards call for holding position markings to be situated 200 feet from the runway centerline. Existing markings associated with Runway 18R-36L are located at a separation distance of 260 feet, exceeding the design standard.

Aircraft Parking Area Separation

According to FAA AC 150/5300-13B, Change 1, aircraft parking positions should be located to ensure aircraft components (wings, tail, and fuselage) do not:

1. Conflict with the object free areas for the adjacent runway or taxiways:
   a. Runway object free area (ROFA)
   b. Taxiway object free area (TOFA)
   c. Taxilane object free area (TLOFA)

or

2. Violate any of the following aeronautical surfaces and areas:
   a. Runway approach or departure surface
   b. Runway visibility zone (RVZ) (not applicable at DTO)
   c. Runway obstacle free zone (ROFZ)
   d. Navigational aid equipment critical areas

There are no existing conflicts between the aircraft parking areas at DTO and the safety areas or aeronautical surfaces listed above. The main aircraft parking aprons along Taxiway B include a dashed edge marking situated 65 feet from the Taxiway B centerline to designate the edge of the taxiway object free area (TOFA); however, the ADG II TOFA design standard, which is applicable to Taxiway B, was reduced in the latest version of the *Airport Design* AC from 131 feet to 124 feet. As such, the Taxiway B painted TOFA edge marking can be relocated to a separation distance of 62 feet from the taxiway centerline. In the ultimate ADG III standard condition, which dictates a TOFA width of 171 feet, the TOFA edge marking on the apron should be relocated to 85.5 feet from the Taxiway B centerline.

TAXIWAYS

The design standards associated with taxiways are determined by the taxiway design group (TDG) or airplane design group (ADG) of the airport's critical aircraft. As previously determined, ADG II standards apply to both runways in the existing condition. ADG III standards apply to Runway 18L-36R in the ultimate condition, while Runway 18R-36L should continue to meet ADG II standards. **Table 3N** presents the various taxiway design standards related to ADG I, II, and III. The table also shows the taxiway design standards related to TDG. The TDG standards are based on the main gear width (MGW) and cockpit to main gear (CMG) distance of the critical aircraft expected to use those taxiways. Different taxiway and taxilane pavements can and should be planned to the most appropriate TDG design standards, based on usage. Taxiway and taxilane object free areas are depicted on **Exhibit 3C** with existing conditions shown on the front side and ultimate conditions shown on the reverse side. There are no identified obstructions to the existing taxiway/taxilane object free areas.

TABLE 3N | Taxiway Dimensions and Standards

STANDARDS BASED ON WINGSPAN	ADG I	ADG II	ADG III
Taxiway and Taxilane Protection			
Taxiway Safety Area Width (TSA)	49'	79'	118'
Taxiway Object Free Area Width (TOFA)	89'	124'	171'
Taxilane Object Free Area Width (TLOFA)	79'	110'	158'
Taxiway and Taxilane Separation			
Taxiway Centerline to Parallel Taxiway Centerline	70'	101.5'	144.5'
Taxiway Centerline to Fixed or Moveable Object	44.5'	62'	85.5'
Taxilane Centerline to Parallel Taxilane Centerline	64'	94.5'	138'
Taxilane Centerline to Fixed or Moveable Object	39.5'	55'	79'
Wingtip Clearance			
Taxiway Wingtip Clearance	20'	22.5'	26.5'
Taxilane Wingtip Clearance	15'	15.5'	20'
STANDARDS BASED ON TDG	**TDG 1A/B**	**TDG 2A/B**	**TDG 3**
Taxiway Width Standard	25'	35'	50'
Taxiway Edge Safety Margin	5'	7.5'	10'
Taxiway Shoulder Width	10'	15'	20'

All dimensions are in feet.
ADG = airplane design group
TDG = taxiway design group

Source: FAA AC 150/5300-13B, Airport Design, Change 1

The current design standard for all taxiways east of Runway 18L-36R is TDG 3, which dictates a width of 50 feet. All taxiways east of Runway 18L-36R are at least 50 feet wide, meeting TDG 3 standards. Taxiways west of Runway 18L-36R, which provide access to parallel Runway 18R-36L, should meet TDG 2A standards, which dictate a width of 35 feet. The two applicable taxiways are 35 feet wide, meeting the design standard.

Taxiway and Taxilane Design Considerations

FAA AC 150/5300-13B, *Airport Design*, Change 1, provides guidance on recommended taxiway and taxilane layouts to enhance safety by avoiding runway incursions. A runway incursion is defined as "any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft." The following is a list of the FAA's taxiway design guidelines and the basic rationale behind each recommendation included in the current AC, as well as previous FAA safety and design recommendations.

1. *Taxiing Method*: Taxiways are designed for cockpit-over-centerline taxiing with pavement that is wide enough to allow a certain amount of wander. On turns, sufficient pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, existing intersections should be upgraded to eliminate judgmental oversteering, which is when a pilot must intentionally steer the cockpit outside the marked centerline to ensure the aircraft remains on the taxiway pavement.

2. *Curve Design*: Taxiways should be designed so the nose gear steering angle is no more than 50 degrees, which is the generally accepted value to prevent excessive tire scrubbing.

3. *Three-Path Concept*: To maintain pilot situational awareness, taxiway intersections should provide a pilot with a maximum of three choices of travel. Ideally, these are right, left, and a continuation straight ahead.

4. *Channelized Taxiing*: To support visibility of airfield signage, taxiway intersections should be designed to meet standard taxiway width and fillet geometry.

5. *Designated Hot Spots and Runway Incursion Mitigation (RIM) Locations*: A hot spot is a location on the airfield with elevated risk of collisions or runway incursions. Mitigation measures should be prioritized for areas the FAA designates as hot spots or RIM locations. **DTO does not have any FAA-designated taxiway hot spots or RIM locations.**

6. *Intersection Angles*: Turns should be designed to be 90 degrees, wherever possible. For acute-angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.

7. *Runway Incursions*: Taxiways should be designed to reduce the probability of runway incursions.

    - *Increase Pilot Situational Awareness*: Pilots who know where they are on the airport are less likely to enter a runway improperly. Complexity leads to confusion. Taxiway systems should be kept simple by using the three-path concept.

Exhibit 3C
EXISTING TAXIWAY/TAXILANE OBJECT FREE AREAS

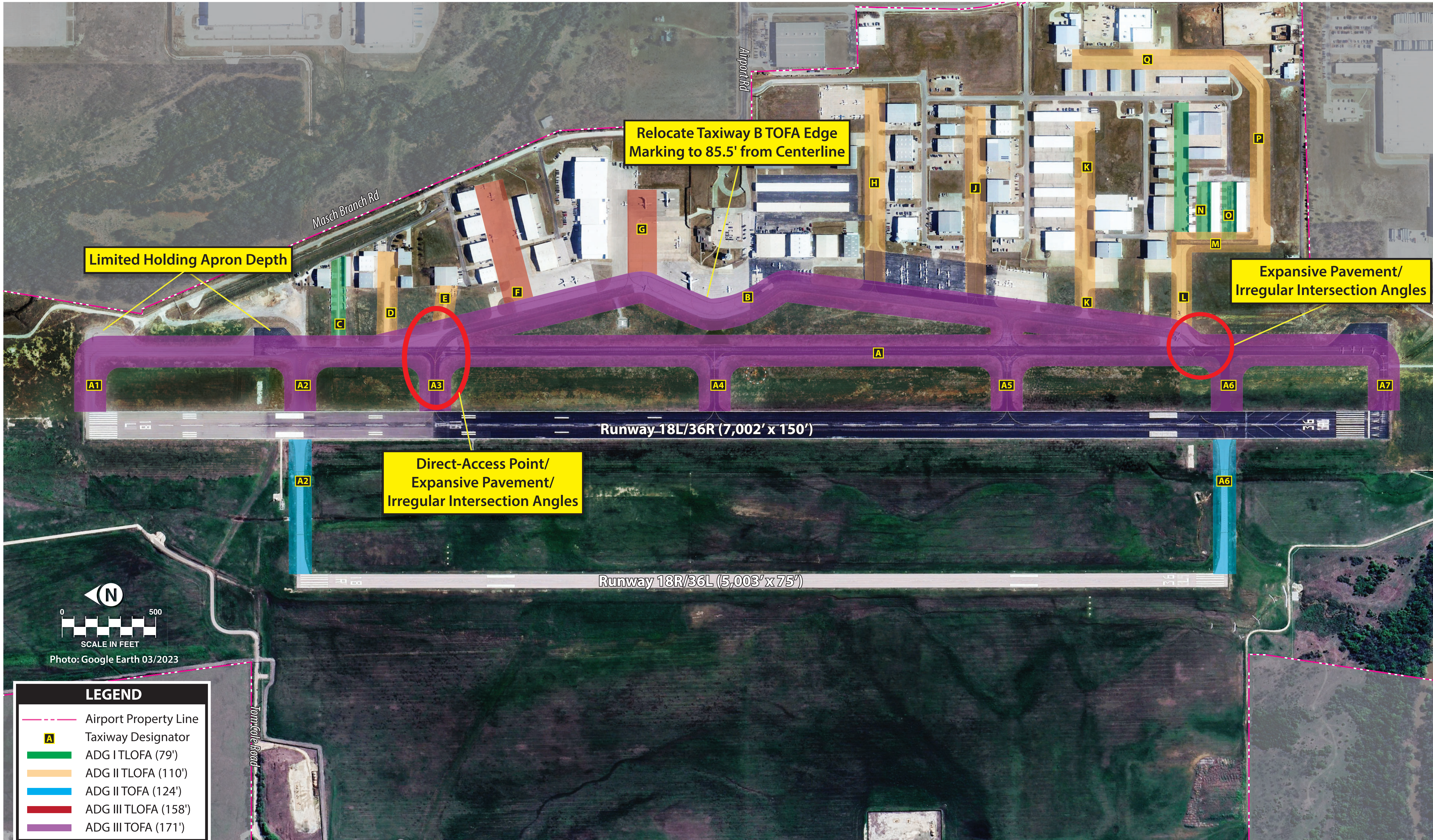

Exhibit 3C (continued)
ULTIMATE TAXIWAY/TAXILANE OBJECT FREE AREAS

- *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, direct access to a runway should be avoided.

- *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold: through a simple reduction in the number of occurrences and a reduction in air traffic controller workload.

- *Avoid High-Energy Intersections*: These are intersections in the middle thirds of runways. By limiting runway crossings to the first and last thirds of a runway, the portion of the runway where a pilot can least maneuver to avoid a collision is kept clear.

- *Increase Visibility*: Right-angle intersections between taxiways and runways provide the best visibility. Acute-angle runway exits provide greater efficiency in runway usage but should not be used as runway entrance or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of approaching a runway.

- *Avoid Dual-Purpose Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway, and only a runway.

- *Avoid Direct Access*: Taxiways should not be designed to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.

- *Mitigate Hot Spots*: Confusing intersections near runways are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other hot spots should be corrected as soon as practicable.

8. *Runway/Taxiway Intersections*:

   - *Right Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for an acute-angled exit. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so the signage is visible to pilots.

   - *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high-speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage. The construction of high-speed exits is typically only justified for runways that experience regular use by jet aircraft in approach categories C and above.

   - *Large Expanses of Pavement*: A taxiway must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, which make it difficult to provide proper signage, marking, and lighting.

9. *Taxiway/Runway/Apron Incursion Prevention*: Apron locations that allow direct access to a runway should be avoided. Taxiways should be designed in a manner that increases pilot situational awareness by forcing pilots to consciously make turns. Taxiways that originate from aprons and form straight lines across runways at mid-span should be avoided.

    - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided because such large expanses of pavement may cause pilot confusion and can make lighting and marking more difficult.

    - *Direct Access from Apron to Runway*: Taxiway connectors that cross over a parallel taxiway and directly onto a runway should be avoided. A staggered taxiway layout or a no-taxi island that forces pilots to make a conscious decision to turn should be considered.

    - *Apron to Parallel Taxiway End*: Direct connection from an apron to a parallel taxiway at the end of a runway should be avoided.

The taxiway system at DTO generally provides for the efficient movement of aircraft, and there are no FAA-designated hot spots or RIM locations. Taxiway A3 and Taxilane E create a direct-access point from a hangar apron to Runway 18L-36R. The same intersection involves expansive pavement areas and irregular taxiway intersection angles, which make it difficult for aircraft taxiing north on Taxiway B to see aircraft taxiing north on Taxiway A, creating a potential for conflict. These non-standard geometry conditions at the intersection of Taxiways A, B, and A3 and Taxilane E are highlighted in **Figure 3A**.

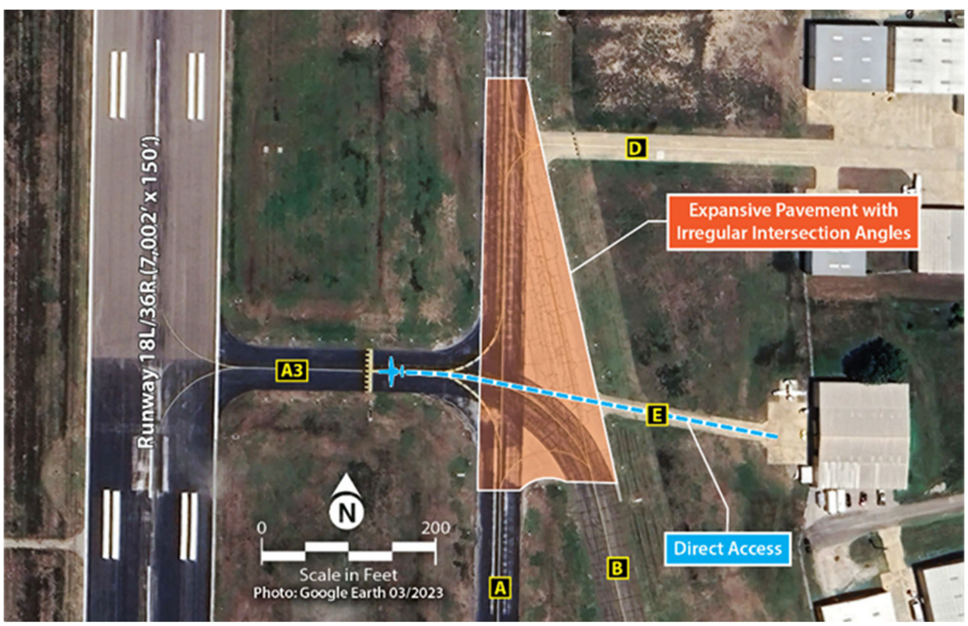

Figure 3A – Non-standard Taxiway Geometry

Similarly, the intersection of Taxiways A, B, and A6 and Taxilane L also creates the potential for conflict with expansive pavement and irregular taxiway intersection angles. This area is highlighted in **Figure 3B**.

The alternatives in the next chapter will explore options to mitigate these non-standard taxiway configurations to minimize the potential for runway incursions and improve efficiency.

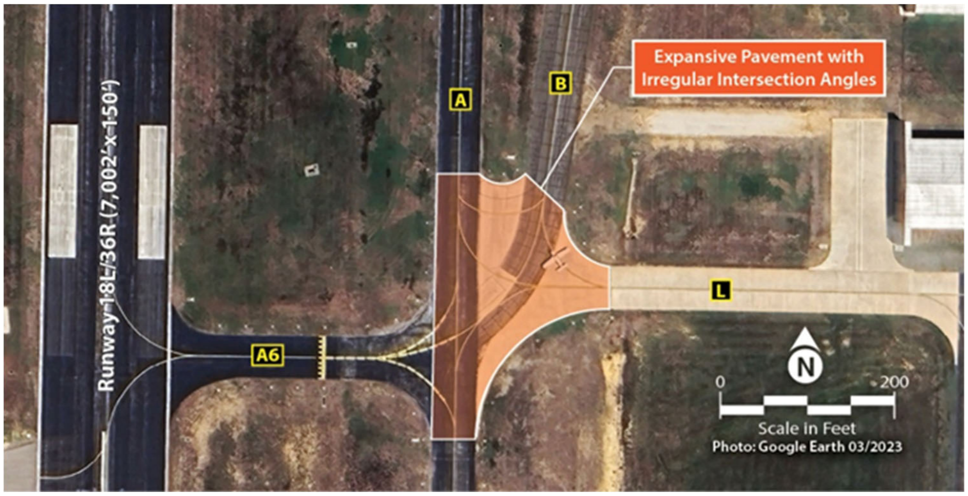

Figure 3B – Non-standard Taxiway Geometry

Taxilane Design Considerations | Taxilanes are distinguished from taxiways in that they do not provide direct access to or from the runway system. Taxilanes typically provide access to hangar areas and can be planned to varying design standards, depending on the type(s) of aircraft that utilize the taxilane, as previously described.

Helipad

The helipad at DTO, which is located between Taxiways A and B, is used infrequently and is under consideration for elimination. The alternatives analysis will consider redevelopment potential for the helipad site, as well as options for new areas for focused helicopter and other vertical takeoff and landing (VTOL) aircraft operations, if desired by airport management and operators. Continued maintenance of the existing helipad or development of new helicopter operations areas is subject to FAA AC 150/5390-2C, *Heliport Design*.

NAVIGATIONAL AND APPROACH AIDS

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

Instrument Approach Aids

DTO has five published instrument approach procedures. Runway 18L is equipped with a precision ILS approach and a global positioning system (GPS)-based localizer performance with vertical guidance (LPV) approach that provide visibility minimums down to ½-mile. Runways 18R, 36R, and 36L each have LPV approaches with visibility minimums down to ¾-mile. All of these instrument approach procedures are considered adequate and no new approaches are planned for any runway.

Runway 18L is equipped with a medium intensity approach lighting system with runway alignment indicator lights (MALSR) that supports the ILS and LPV approach procedures to achieve ½-mile visibility minimums. The MALSR extends for approximately 2,210 feet north of the Runway 18L end. The MALSR equipment is adequate and should be maintained for the duration of the planning period. No new approach lighting systems are required for the airfield.

Visual Approach Aids

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

Runway end identification lights (REILs) are flashing lights located at the runway threshold end that facilitate rapid identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify the runway thresholds and distinguish the runway end lighting from the other lighting on the airport and in the approach areas. REILs should be considered for all lighted runway ends not planned for more sophisticated approach lighting systems. Runway 18L is equipped with a MALSR; therefore, a REIL system is not needed. Consideration should be given to adding REILs to Runways 36R, 18R, and 36L.

Weather Reporting Aids

DTO has a lighted wind cone and segmented circle located between Runway 18L-36R and Taxiway A and south of Taxiway A4. The wind cone provides information to pilots regarding wind speed and direction. Typically, the wind cone is centralized on the airfield system and is often co-located within a segmented circle, which is the case at DTO. The segmented circle consists of a system of visual indicators designed to provide traffic pattern information to pilots.

DTO is equipped with an automated surface observing system (ASOS) co-located with the ILS glideslope antenna for Runway 18L. The ASOS provides weather observations 24 hours per day and updates weather observations every minute, continuously reporting significant weather changes as they occur in real time. This information is then transmitted via a designated radio frequency at regular intervals. This system should be maintained through the duration of the planning period.

Airport Traffic Control Tower

DTO has an operational airport traffic control tower (ATCT) located on the east landside area near midfield. The ATCT cab height is 140 feet AGL and the ATCT roof is 152 feet AGL. The ATCT is staffed from 6:00 a.m. to 10:00 p.m. daily. This site provides clear lines-of-sight to all areas of the airfield. Additional tower space may be needed as operation levels grow at DTO necessitating additional controllers. The need for additional staff could result in a tower cab and office space constraints in the existing tower. Consideration should be given to expanding the tower cab and office spaces to accommodate additional controllers.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

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

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

Runway and Taxiway Lighting | Runways 18L-36R and 18R-36L are equipped with medium intensity runway lighting (MIRL) systems. Runway 18R-36L's MIRL system has been upgraded to light-emitting diode (LED) fixtures, while Runway 18R-36L has incandescent MIRL fixtures. The incandescent fixtures are planned to be upgraded to LED fixtures. The taxiway system is equipped with medium intensity taxiway lighting (MITL). This system is also adequate and should be maintained. Planning should consider expansion of the MIRL and MITL systems when/if new pavements are constructed.

Pavement Markings | Runway markings are typically designed to the type of instrument approach available on the runway. FAA AC 150/5340-1K, *Standards for Airport Markings*, provides guidance necessary to design airport markings. Runway 18L has precision markings that aid in accommodating the ILS precision approach and provide enhanced identification. Runways 36R, 18R, and 36L have non-precision markings, which are adequate for the existing and ultimate conditions.

Airfield Signs | Airfield identification signs assist pilots in identifying their locations on the airfield and directing them to their desired locations. Lighted signs are installed on the runway and taxiway systems on the airfield. The signage system includes runway and taxiway designation signage, holding position signage, routing/directional signage, and mandatory instruction signs. All of these signs should be maintained through the planning period.

A summary of the airside facilities at DTO is presented on **Exhibit 3D**.

ADVANCED AIR MOBILITY (AAM)

Since the turn of the decade, private companies have been developing and testing AAM technologies. AAM, which may also be called urban air mobility (UAM), is an emerging concept of air transportation using electric vertical takeoff and landing (eVTOL) aircraft to move people and cargo between places that are not easily or currently served by surface or air modes. A common example is the air taxi, in which a person or small group of people could travel within or between metropolitan areas, including airports, using small eVTOL aircraft. Development of infrastructure in support of AAM is currently underway in test cities across the county and AAM is projected to become a key component of the nation's air transportation network. The following images show several different AAM/eVTOL aircraft currently in development that would use a vertiport like the one proposed in some alternatives.

CATEGORY	EXISTING	ULTIMATE
Runway	**18L-36R**	
Runway Design Code (RDC)	C-II-2400	C/D-III-2400
Dimensions	7,002' x 150'	Maintain Length; Consider Width Reduction to 100'
Pavement Strength	70,000 SWL; 100,000 DWL	Maintain
Blast Pads	None	Add Blast Pads (140' x 200')
RSA	RSA with Declared Distances	Consider Improvements to Eliminate Declared Distances
ROFA	ROFA with Declared Distances	Consider Improvements to Eliminate Declared Distances
ROFZ	Standard ROFZ	Maintain
POFZ	Standard POFZ (18L)	Maintain
RPZ	Approximately 2.8 Acres of Uncontrolled RPZ Property	Establish Full Control Over All RPZs
Runway	**18R-36L**	
Runway Design Code (RDC)	B-II-4000	B-II-4000
Dimensions	5,003' x 75'	Consider Extension to Minimum Length of 5,500'
Pavement Strength	30,000 SWL; 50,000 DWL	Maintain
Blast Pads	None	None
RSA	Standard RSA	Maintain
ROFA	Standard ROFA	Maintain
ROFZ	Standard ROFZ	Maintain
RPZ	Approximately 7.2 Acres of Uncontrolled RPZ Property	Establish Full Control Over All RPZs
Taxiways		
Design Group	TDG 3 (East of 18L-36R); TDG 2A (West of 18L-36R)	Maintain
Parallel Taxiway	Taxiway A (18L-36R)	Consider Full-Length Parallel Taxiway For 18R-36L
Parallel Taxiway Separation from Runway	400' (Taxiway A)	Minimum 240' Separation for Ultimate Parallel Serving 18R-36L
Widths	50' (East of 18L-36R); 35' (West of 18L-36R)	Maintain
Holding Position Separation	250' (18L-36R); 260' (18R-36L)	Increase Separation for 18L-36R Markings to 256'; Consider Relocating 18R-36L Markings to 200'
Notable Conditions	No Hot Spots; 2 Areas of Non-Standard Geometry	Consider Corrective Measures
Navigational and Weather Aids		
Instrument Approaches	ILS (18L); LPV GPS (All Runways)	Maintain
Weather Aids	ASOS, Wind Cone, Rotating Beacon, Segmented Circle	Maintain
Approach Aids	PAPI-4s (All Runways); MALSR (18L)	Add REILs to 36R, 18R, and 36L
Lighting and Marking		
Runway Lighting	MIRL (Both Runways)	Upgrade 18L-36R to LED MIRLs
Runway Marking	Precision (18L); Non-Precision (36R, 18R, 36L)	Maintain
Taxiway Lighting	MITL	Maintain
Airfield Signage	Standard Runway/Taxiway Identification, Holding Position, and Routing Signage	Maintain

KEY

ASOS - Automated Surface Observation System
DWL - Dual Wheel Loading
GPS - Global Positioning System
LPV - Localizer Performance with Vertical Guidance
MALSR - Medium Intensity Approach Lighting System
MIRL/HIRL - Medium/High Intensity Runway Lighting
MITL - Medium Intensity Taxiway Lighting
POFZ - Precision Obstacle Free Zone
PAPI - Precision Approach Path Indicator
RDC - Runway Design Code
REIL - Runway End Identification Lights
RSA - Runway Safety Area
RPZ - Runway Protection Zone
ROFA - Runway Object Free Area
SWL - Single Wheel Loading
TDG - Taxiway Design Group

Exhibit 3D
AIRFIELD SUMMARY

eVTOL Aircraft in Development (Courtesy of Archer and Joby)

DESIGN STANDARDS FOR VERTIPORTS

Design dimensions for a vertiport are established by a reference aircraft. A vertiport may consist of several facilities, including aircraft charging and storage, a passenger terminal, and takeoff and landing areas. The landside facilities of a vertiport will be specific to and determined by the unique AAM company that chooses to establish a presence in the study area. The airside facilities are the focus of FAA Draft Engineering Brief (EB) 105A, *Vertiport Design*, which was published in September 2024. The takeoff and landing area design and geometry contained in *Vertiport Design* include the TLOF, the FATO, and the safety area, which are defined in detail as follows.

- **Final Approach and Takeoff Area (FATO) |** The FATO is a defined load-bearing area over which an aircraft completes the final phase of its approach to a hover or landing, and from which the aircraft initiates takeoff. The FATO is similar to the total surface of a helipad.
- **Touchdown and Liftoff Area (TLOF) |** The TLOF is a load-bearing, generally paved area centered in a FATO on which the aircraft performs a touchdown or liftoff. The TLOF is analogous to the center "H" of a helipad.
- **Safety Area |** The safety area is a defined area surrounding the FATO that is intended to reduce the risk of damage to aircraft accidentally diverging from the FATO. The vertiport safety area is identical in purpose to a runway or taxiway safety area.

The calculations for these areas are presented in **Table 3P** and are based on the controlling dimension (designated "D") or propulsion dimension (designated "D-p") of the design eVTOL aircraft as defined for the vertiport facility (see **Figure 3C**). D is the diameter of the smallest circle enclosing the aircraft on a horizontal plane while the aircraft is in the takeoff or landing configuration with rotors/propellers turning (if applicable). D-p is the smallest circle enclosing all the propulsion units (including propellers, rotors, fans, etc.) on a horizontal plane while the aircraft is in the vertical takeoff or landing configuration with rotors turning (if applicable).

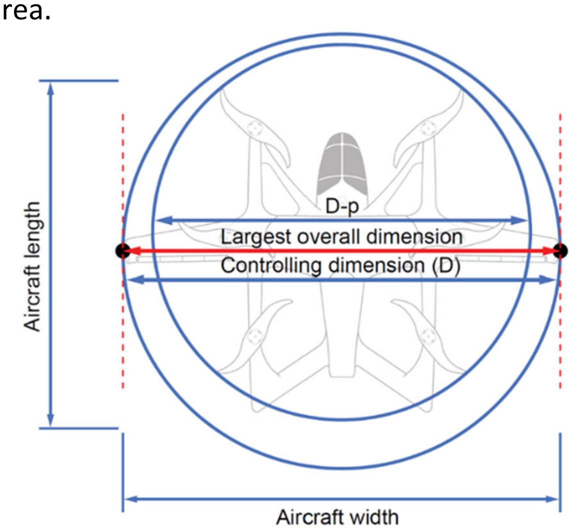

Figure 3C – eVTOL Controlling Dimensions

TABLE 3P | Takeoff and Landing Area Minimum Dimensions

	DIMENSION (length and width or diameter)	
Element	**Non-Powered Lift**	**Powered Lift**
TLOF	1.88 D-p	1 D-p
FATO	1.88 D-p	2 D-p
Safety Area	2.5 D	2.5 D
FATO = final approach and takeoff area TLOF = touchdown and liftoff area		

Source: FAA, Draft EB 105A, Vertiport Design, Table 2-1

Each element is centered within the subsequent element: the TLOF is located in the center of the FATO, which is centered within the safety area, as shown in **Figure 3D**. The "broken wheel" symbol should be used and located in the center of the TLOF to identify the site as a vertiport, as opposed to a heliport. Both the TLOF and FATO are expected to be located on level terrain or a structure, be clear of penetrations and obstructions, and support the weight of the design eVTOL aircraft. The TLOF may be circular, square, or rectangular in shape.

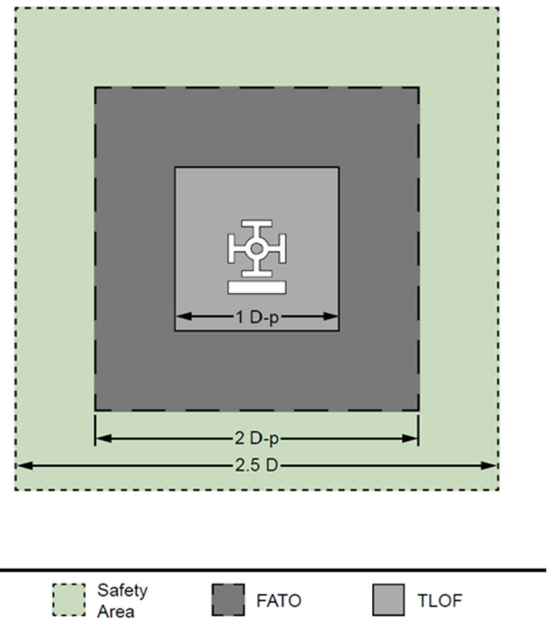

Figure 3D – Relationship and Dimensions of TLOF, FATO, and Safety Area

APPROACH PROFILES – IMAGINARY SURFACES

The imaginary surfaces defined for heliports in Title 14 Code of Federal Regulations (CFR) Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, are applicable to vertiports and include the primary surface, approach, and transitional surfaces. Section 77.23 defines these surfaces for heliports and they have been adopted for use and presented in *Vertiport Design*.

- **Primary Surface |** The primary surface is the same size and shape as the FATO. This surface is a horizontal plane at the established vertiport elevation.

- **Approach Surface |** This surface begins at each end of the vertiport's primary surface, has the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet, at which point its width is 500 feet. The slope of this surface is 8:1 and it doubles as the departure surface.

- **Transitional Surface |** The transitional surface extends outward and upward from the lateral boundaries of the primary and approach surfaces at a slope of 2:1 for 250 feet horizontally from the centerline of the primary and approach surfaces.

The primary, approach, and transitional surfaces should remain clear of penetrations whenever possible, unless an FAA analysis determines the penetrations to any Part 77 surface not to be hazardous. **Figure 3E** is a visual representation of the imaginary surfaces as they apply to vertiports.

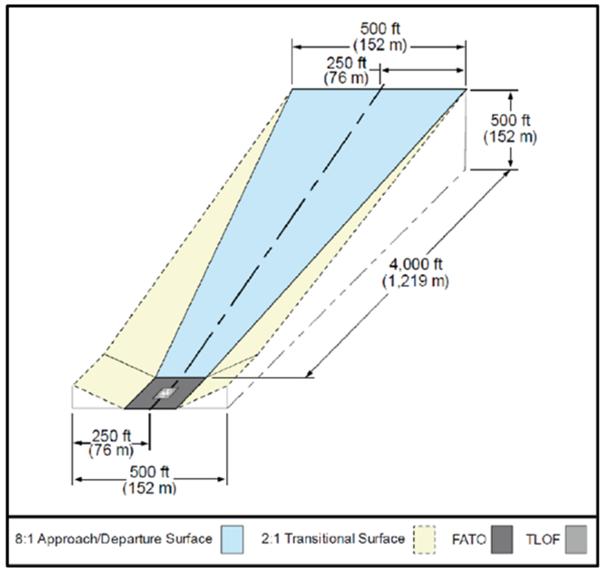

Figure 3E – Vertiport Imaginary Surfaces

VERTIPORT SUMMARY

eVTOLs and AAM/UAM represent an emerging (yet unproven) aviation market. Testing and initial adoption are likely to occur in large metropolitan areas and then expand to mid-sized and smaller markets. Full integration of eVTOL into the national airspace system may not occur for many years; however, it is prudent for this planning study to consider the potential for such activity at DTO. For this reason, the alternatives analysis includes options for a potential future vertiport on airport property. The vertiport dimensions depicted are conceptual and are not based on a specific reference aircraft.

As most eVTOL vehicles under development are powered by electricity, electrical infrastructure will be the most significant need to support vertiport development. For recharging capabilities, initial power supply estimates from manufacturers range between 500 kilowatts (kW) to 1.0 megawatts (MW) per charger with a goal to provide an 80 percent charge in 15 to 25 minutes.

LANDSIDE FACILITY REQUIREMENTS

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

GENERAL AVIATION FACILITIES

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

- General aviation terminal services
- Aircraft hangars
- Aircraft parking aprons

General Aviation Terminal Services

The general aviation terminal facilities at an airport are often the first impression of the community that corporate officials and other visitors will encounter. General aviation terminal facilities at an airport provide space for passenger waiting, a pilots' lounge, flight planning, concessions, management, storage, and many other various needs. This space is not necessarily limited to a single, separate terminal building, but can include space offered by fixed base operators (FBOs) and other specialty operators for these functions and services. At DTO, general aviation terminal services are primarily provided from the 4,800-square-foot (sf) GA Administration Building, as well as Sheltair's FBO facilities, which total approximately 18,000 sf.

The methodology used in estimating general aviation terminal facility needs was based on the number of airport users expected to utilize general aviation facilities during the design hour. Space requirements for terminal facilities were based on providing 125 square feet per design hour itinerant passenger. A multiplier of 2.5 in the short term, increasing to 3.5 in the long term, was also applied to terminal facility needs to better determine the number of passengers associated with each itinerant aircraft operation. This increasing multiplier indicates an expected increase in larger aircraft operations through the long term. These operations typically support larger turboprop and jet aircraft, which can accommodate an increasing passenger load factor. Such is the case at DTO, where an increasing number of turbine operations are anticipated.

Table 3Q outlines the space requirements for general aviation terminal services at DTO through the long-term planning period. The combined amount of space currently offered by the GA terminal and Sheltair is approximately 22,800 sf. Other specialty aviation service operators (SASOs) on the airfield also provide space for pilots and passengers; however, these areas are not widely utilized by transient operators. As shown in the table, the space currently provided is sufficient through the long-term planning horizon.

TABLE 3Q | General Aviation Terminal Area Facilities

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need
Input Data				
General Aviation Itinerant Design Hour Operations	–	30	33	41
Passenger Multiplier	–	2.0	2.2	2.5
Design Hour Passengers	–	60	73	103
Terminal Service Space Requirements				
Space per Design Hour Passenger (sf)	–	125	125	125
Terminal Building Need (sf)	22,800	9,375	12,375	18,000
Terminal Vehicle Parking Requirements				
Terminal Visitor Vehicle Space Need	87	75	99	144
FBO Visitor Space Need	144	119	137	179
Total Terminal Visitor/FBO Vehicle Parking	**231**	**194**	**236**	**323**

Red indicates a projected need that exceeds current capacity.

Source: Coffman Associates analysis

General aviation terminal service vehicle parking demands have also been determined for DTO. Space determinations for passengers were based on an evaluation of existing airport use, as well as standards set forth to help calculate projected terminal facility needs. There are currently 231 individual spaces provided by the FBO and at the GA Administration Building. As shown in the table, existing vehicle parking is adequate through the short-term period; however, additional capacity may be needed by the intermediate- and long-term periods.

The airport has an additional 499 vehicle parking spaces located throughout the landside areas associated with the various SASOs and hangar facilities. The alternatives analysis in the next chapter will consider additional parking capacity along with any new hangar development to accommodate both transient users and based tenants.

Aircraft Hangars

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

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

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

Hangar types vary greatly in size and function. T-hangars are popular with aircraft owners who need to store individual private aircraft. These hangars typically provide individual spaces within a larger structure or in portable standalone buildings. There is approximately 160,709 sf of total T-hangar storage space, including 91 individual T-hangar storage units, at DTO. For determining future aircraft storage needs, it is assumed that owners of new single-engine and other smaller aircraft (e.g., ultralights, gliders, etc.) will prefer T-hangar storage space. A planning standard of 1,200 sf per single-engine piston and other aircraft is utilized for this hangar type.

Box and conventional hangars are open-space facilities with no interior supporting structures. Box hangars can vary in size from 1,500 and 2,500 sf to nearly 10,000 sf. They are typically able to house single-engine, multi-engine, turboprop, and jet aircraft, as well as helicopters. Conventional hangars provide for bulk aircraft storage and are often utilized by airport businesses, such as FBOs or aircraft maintenance operators. Conventional hangars are generally larger than executive box hangars and can range in size from 10,000 sf to more than 20,000 sf. There is approximately 576,011 sf of space for box and conventional hangars at DTO. For future planning, standards of 3,000 sf per turboprop, 5,000 sf per jet, and 1,500 sf per helicopter are utilized for box and conventional hangars.

Future hangar requirements for the airport are summarized in **Table 3R**.

TABLE 3R | Aircraft Hangar Requirements

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Total Based Aircraft	412	475	546	717	+305
Hangar Area Requirements					
T-Hangar Area (sf)	160,709	214,700	275,900	419,900	+259,191
Box/Conventional Hangar Area (sf)	576,011	639,000	706,500	888,500	+312,489
Total Hangar Area (sf)	**736,720**	**853,700**	**982,400**	**1,308,400**	**+571,680**
Red indicates a projected need that exceeds current capacity.					

Source: Coffman Associates analysis

Because most based aircraft owners prefer enclosed hangar space, it is assumed that all based aircraft will occupy hangar spaces, as opposed to tying down on the apron. The analysis shows that future hangar requirements indicate a potential need for over 571,680 sf of new hangar storage capacity through the long-term planning period. This includes a mixture of hangar types; the largest need is projected in the box/conventional hangar category. Due to the projected increase in based aircraft, the existing demand for hangar space, annual general aviation operations, and hangar storage needs, facility planning will consider additional hangars at the airport. It is expected that the aircraft storage hangar requirements will continue to be met through a combination of hangar types.

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

Aircraft Parking Aprons

The aircraft parking apron is an expanse of paved area intended for aircraft parking and circulation. Typically, a main apron is centrally located near the airside entry point, such as the terminal building or FBO facility. Ideally, the main apron is large enough to accommodate transient airport users, as well as a portion of locally based aircraft. Smaller aprons are often available adjacent to SASO hangars and at other locations around the airport. The apron layout at DTO generally follows this pattern: the main terminal apron, which totals 33,375 square yards (sy), is adjacent to the terminal and the FBO facilities. Apron 1, which is also adjacent to the FBO, comprises 6,400 sy of pavement that is used primarily for transient aircraft. Aprons 2 and 3, which respectively total 9,200 sy and 6,700 sy, are leased to U.S. Aviation and are not available for public use and thus are used exclusively for based aircraft. Apron 4 totals 4,500 sy and is used primarily by locally based aircraft.

To determine future apron needs, the FAA-recommended planning criterion[3] of 360 sy was used for ADG I aircraft (single-engine and multi-engine piston aircraft), while a planning criterion of 490 sy was used for larger ADG II aircraft (turboprops and jets). A parking apron should also provide space for locally based aircraft that require temporary tiedown storage. Locally based tiedowns are typically utilized by smaller single-engine aircraft; thus, a planning standard of 360 sy per position was utilized in the analysis.

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[3] Per the FAA Apron Size Calculation Tool

The total apron parking requirements are presented in **Table 3S**. Existing apron pavement area at DTO encompasses approximately 60,175 sy. Using the planning standards described above and factoring in assumptions regarding operational and based aircraft growth, an additional 44,725 sy of aircraft parking apron pavement is estimated to be needed over the next 20 years.

TABLE 3S | Aircraft Parking Apron Requirements

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Aircraft Parking Area (square yards)					
Based/Local Aircraft	20,400	17,100	19,700	25,800	+5,400
Transient Small Aircraft	39,775	53,300	59,000	72,700	+39,325
Transient Jet Aircraft		3,900	4,400	6,400	
Total Apron Area	**60,175**	**74,300**	**83,100**	**104,900**	**+44,725**

Red indicates a projected need that exceeds current capacity.

Source: Coffman Associates analysis

SUPPORT FACILITIES

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

- Aviation fuel storage
- Perimeter fencing and gates

Aviation Fuel Storage

Sheltair is the airport's public fuel service provider and owns/leases all fuel storage facilities on the airport. There are a total of seven aboveground fuel storage tanks on the airport, including three tanks used for Jet A fuel that total 36,340 gallons of storage capacity and four tanks used for AvGas fuel that total 37,340 gallons of storage capacity.

Fuel flowage records for 2023 show the airport dispensed 1,344,331 gallons of Jet A fuel and 476,312 gallons of AvGas fuel. Utilizing operations reported by the FAA's TFMSC database, the number of turbine operations in 2023 totaled approximately 5,828. Dividing the total fuel flowage by the total number of operations provides a ratio of fuel flowage per operation. In 2023, the airport dispensed approximately 230.7 gallons of Jet A fuel per turbine operation and 2.2 gallons of AvGas fuel per piston operation.

Maintaining a 14-day fuel supply would allow the airport to limit the impact of a disruption of fuel delivery. Currently, the airport has enough static fuel storage to meet the 14-day supply criteria for AvGas fuel through the long-term horizon; however, the analysis shows there is a need to expand Jet A fuel storage capacity. The forecasted fuel storage requirements are summarized in **Table 3T**.

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

TABLE 3T | Fuel Storage Requirements

	Capacity	2023 Flowage Summary	Planning Horizon		
			Short-Term	Intermediate-Term	Long-Term
Jet A					
Daily Usage (gal.)	36,340	3,615	4,045	4,930	7,585
14-Day Supply (gal.)		50,754	56,633	69,022	106,189
Annual Usage (gal.)		1,344,331	1,476,500	1,799,500	2,768,500
AvGas (100LL)					
Daily Usage (gal.)	37,340	1,123	1,433	1,573	1,888
14-Day Supply (gal.)		15,769	20,068	22,020	26,431
Annual Usage (gal.)		476,312	523,200	574,100	689,100
Red indicates a projected need that exceeds current capacity.					

Sources: Historical fuel flowage data provided by airport administration; fuel supply projections prepared by Coffman Associates

Perimeter Fencing and Gates

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

- Gives notice of legal boundary of the outermost limits of the facility or security-sensitive area
- Assists in controlling and screening authorized entries into a secured area by deterring entry elsewhere along the boundary
- Supports surveillance, detection, assessment, and other security functions by providing a zone for installing intrusion detection equipment and closed-circuit television (CCTV)
- Deters casual intruders from penetrating the aircraft operations areas on the airport
- Creates a psychological deterrent
- Demonstrates a corporate concern for facilities
- Limits inadvertent access to the aircraft operations area by wildlife

DTO operations areas are completely enclosed by fencing, including 10-foot game fencing and six-foot chain-link fence topped by three-strand barbed wire. A series of controlled access gates are available for access to movement and non-movement areas that are secured either electronically or with padlocks.

A summary of the overall general aviation landside facilities is presented in **Table 3U**.

TABLE 3U | General Aviation Landside Facility Requirements

	Current Capacity	Projected Needs		
		Short-Term	Intermediate-Term	Long-Term
General Aviation Terminal Facilities and Parking				
Terminal/FBO Service Space (sf)	22,800	9,375	12,375	18,000
Total Terminal/FBO Public Vehicle Parking	231	194	236	323
Aircraft Storage Hangar Requirements				
T-Hangar (sf)	160,709	214,700	275,900	419,900
Conventional/Box Hangar (sf)	576,011	639,000	706,500	888,500
Total Hangar Storage Area (sf)	736,720	853,700	982,400	1,308,400
Aircraft Parking Apron				
Based/Local Aircraft Parking (sy)	20,400	17,100	19,700	25,800
Transient Parking (sy)	39,775	57,200	63,400	79,100
Total Apron Area (sy)	60,175	74,300	83,100	104,900
Fuel Storage				
100LL (14-Day Fuel Storage)	37,340	20,068	22,020	26,431
Jet A (14-Day Fuel Storage)	36,340	56,633	69,022	106,189

Red indicates a projected need that exceeds current capacity.

Source: Coffman Associates analysis

SUMMARY

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

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