3.0 INTRODUCTION

In the previous section, aviation demand forecasts were presented for FDK through the year 2025. These forecasts included projections of aircraft operations, based aircraft, aircraft fleet mix, and peaking characteristics for aircraft operations. In this section, specific components of the airport, including the airfield, surrounding airspace, terminal facilities, general aviation facilities and ground access are evaluated to determine their ability to accommodate the forecasted demand without an unacceptable decrease in service levels (e.g., a lack of hangar and tie-down space to accommodate current demand).

The capacities of the various airport components are identified and described in the following paragraphs and then compared to forecasted levels of demand to determine if deficiencies presently exist, or are expected to occur in future years. If deficiencies are identified, the approximate size and timing of new or additional facilities is estimated. Alternative methods of providing the required facilities identified in this section are examined in **Section 4, Alternatives Analysis**.

3.1 AIRFIELD

3.1.1 Demand/Capacity Analysis

The methodology used for analyzing airfield capacity is described in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. The methodology describes how to estimate an airfield's hourly capacity and its annual capacity, which is referred to as Annual Service Volume (ASV).

Hourly capacity is used to assess the airfield's ability to accommodate peak hour operations. Hourly capacity is defined as the maximum number of aircraft operations that can be accommodated by the airfield system in one hour.

ASV is used to assess the overall adequacy of the airfield design, including the number and orientation of runways. ASV is defined as a reasonable estimate of an airport's annual capacity. As the number of annual operations increases and approaches the airport's ASV, the average delay incurred by each operation increases. When annual aircraft operations are equal to the ASV, the average delay per aircraft operation can be up to four minutes depending upon the mix of aircraft using the airport. When the number of annual aircraft operations exceeds the ASV, moderate to severe congestion will occur.

A calculation of the airfield's hourly capacity and ASV depends upon a number of factors including the following:

- Meteorological Conditions - The percentage of time that visibility or cloud cover are below certain minimums.

- Aircraft Mix - The percentage of operations conducted by different categories of aircraft.

- Runway Use - The percentage of time that each runway is used.

- Percent Touch-and-Go - The percent of touch-and-go operations in relation to total aircraft operations.

- Percent Arrivals - The percent of arrivals in relation to departures during peak hours.

- Exit Taxiway Locations - The number and locations of exit taxiways for landing aircraft.

3.1.1.1 Meteorological Conditions

Meteorological conditions have a significant effect upon runway use, which, in turn, affects an airfield's capacity. During Visual Meteorological Conditions (VMC), runway use is usually determined by the direction of the prevailing winds. During Instrument Meteorological Conditions (IMC), runway use is dictated by the type and availability of instrument approach procedures.

Illustrations of predominant wind conditions during VMC, IMC, and all-weather conditions were previously presented in **Section 1**. That data indicated that Runway 23 is the most commonly used runway end during both VMC and IMC conditions. It is estimated that the airport operates under VMC conditions 91 percent of the time and IMC conditions 8.5 percent of the time. The FDK runways are estimated to be closed 0.5 percent of the time due to weather conditions that are less than the requisite minimums for conducting instrument operations.

3.1.1.2 Aircraft Mix

Variations in aircraft weights and approach speeds affect the generation of wake turbulence, which, in turn, affects the spacing of aircraft on final approach. Greater spacing requirements between aircraft will lower the hourly arrival capacity of a runway system. Therefore, if an airport serves an aircraft mix that has a high percentage of aircraft with greater separation requirements, the runway will have a lower capacity.

Aircraft mix is defined as the relative percentage of operations conducted by each of four classes of aircraft. **Table 3.1-1** provides a representative listing of aircraft types found in each class of aircraft.

TABLE 3.1-1 TYPICAL AIRCRAFT MIX

CLASS	AIRCRAFT TYPE	
Class A:	Small Single-Engine (Gross Weight 12,500 pounds or less)	
Examples	***Cessna 172/182***	***Mooney 201***
	Beech Bonanza	***Piper Cherokee/Warrior***
Class B:	Small, Twin-Engine (Gross weight 12,500 pounds or less)	
Examples	***Beech Baron***	***Mitsubishi MU-2***
	Cessna 402	***Piper Navajo***
	Rockwell Shrike	***Cessna Citation I***
	Beechcraft 99	***Beech King Air C90/B350***
Class C:	Large Aircraft (Gross Weight 12,500 pounds to 300,000 pounds)	
Examples	***Airbus A-320***	***Gulfstream IV/V***
	Beech 1900	***Hawker 800XP/1000***
	Boeing 737/BBJ	***Embraer 135/145***
	Cessna Citation VII/X	***Lear 45/60***
	Falcon 50/2000	***Saab 340***
Class D:	Large Aircraft (Gross Weight more than 300,000 pounds)	
Examples	***Boeing 767***	***Airbus A-300/A-310***
	Boeing 777	***Douglas DC-8-60/70***

Source: URS (2005).

FDK's *Final Environmental Assessment and Finding of No Significant Impact for the Runway Extensions and Related Improvements* (2004) provides the estimates of aircraft fleet mix and operations used in the forecast for this Master Plan Update. Class A and B aircraft currently comprise 95 percent of aircraft operations at FDK. Aircraft in Class C comprise approximately 5 percent of the total operations and there is no regular activity by Class D aircraft. Accordingly, the mix index is calculated at 5 percent, using the following equation:

Mix Index (5) = Class C Operations (5) + (3) [Class D Operations (0)]

A mix index of 5 percent is used for all the analysis presented herein. According to the FAA-approved forecast, FDK is frequently used for flight-school training of instrument operations. However, there is no data to confirm that there is a higher percentage of Class C aircraft operations than Class A and B operations during instrument conditions.

3.1.1.3 Runway Use

As discussed in **Section 1,** the airport has two runways, Runway 5-23 and Runway 12-30. According to FDK's operations staff and FBO personnel, 80 percent of the airport's total operations occur on Runway 5-23 and 20 percent are on Runway 12-30. On Runway 5-23, Runway 23 is typically used 75 percent of the time (i.e., southwest flow). On Runway 12-30, Runway 30 is typically used 90 percent of the time (i.e., northwest flow). The runway utilization pattern is primarily due to prevailing wind conditions and, to a lesser extent, noise abatement considerations. **Table 3.1-2** presents the usage of each runway end with respect to the total operations at FDK.

TABLE 3.1-2 RUNWAY END UTILIZATION

Runway End	Utilization (%)
23	60
5	20
30	18
12	2

Source: FDK personnel (2004).

3.1.1.4 Touch-and-Go Operations

A touch-and-go operation occurs when an aircraft lands and takes off without making a full stop, usually for the purpose of practicing landings. Touch-and-go operations do not occupy the runway as long as a full-stop landing or a departure. Therefore, an airfield with a high number of touch-and-go operations can normally accommodate a greater number of operations. The Frederick Flight Center and FDK Airport Administration staffs estimate that 35 percent of FDK's runway operations is touch-and-go activity.

3.1.1.5 Percentage Arrivals

The percentage of aircraft operations that are arrivals has an important influence on a runway's hourly capacity. For example, a runway used exclusively for arrivals will have a different capacity than a runway used exclusively for departures or a runway used for a mixture of arrivals and departures. Arriving aircraft usually have a longer runway occupancy time than departing aircraft. In general, the higher the percentage of arrivals, the lower the hourly capacity of a runway. At FDK, arrivals are assumed to comprise 50 percent of peak hour operations.

3.1.1.6 Exit Taxiway Locations

Exit taxiways affect airfield capacity because their location along a runway influences runway occupancy times for aircraft. The longer an aircraft remains on a runway, the lower the capacity of the runway. When exit taxiways are properly located, landing aircraft can quickly exit the runway, thereby increasing the runway's capacity.

Runway 5-23, the primary runway, has five exit taxiways on the northwest side of the runway, including the exit taxiways available at each end of the runway. According to FAA criteria, taxiway exits for a runway serving an aircraft mix of 5 percent should be in the range of 2,000 to 4,000 feet from the runway's threshold for maximum effectiveness at reducing runway occupancy time. Runway 5 has two exit taxiways (i.e., 2,800 feet and 3,800 feet) within the optimal range and Runway 23 has one exit taxiway (i.e., 2,200 feet) within this range.

Runway 12-30 has four exit taxiways along the southwest side, including an exit taxiway at each runway end and two additional exit taxiways. The exit taxiways for Runway 12-30 are located approximately 1,370 feet, 2,800 feet, and 3,580 feet from the Runway 12 end, and 800 feet, 2,230 feet and 3,580 feet from the Runway 30 end.

3.1.1.7 Capacity Analysis

The capacity of the existing airfield configuration was estimated on both an hourly and annual basis using the preceding information together with the methodologies specified in FAA Advisory Circular 150/5060-5. The results of these analyses are presented in the following paragraphs.

Hourly Capacity: Hourly capacity values were determined using the following equation:

Hourly capacity of the runway component = C x T x E

Where: C = Base Capacity
T=Touch-and-Go Factor, and
E=Exit Factor

The base capacity value [C], the touch-and-go factor [T] and the exit factor [E] are derived from the hourly airfield capacity graphs contained in the Advisory Circular. According to the capacity graphs (i.e. Graphs 3-27 and 3-59, respectively), the base capacity number C is 103 operations per hour for VMC and 62 operations per hour for IMC. The touch-and-go factor T is 1.26 for VMC and 1.00 for IMC. The exit factor E is 0.85 for VMC and 1.00 for IMC.

Using the data presented in the preceding sections and the capacity graphs, it was determined that the airfield's hourly capacity during VMC, assuming 50 percent arrivals, is 110 operations [(103)(1.26)(0.85)]. It should be noted that the hourly capacity figure is highly influenced by the touch and go factor of 1.26. If touch-and-go operations were not occurring at FDK at such a rate (i.e., estimated at 35 percent of total annual operations), the airfield's hourly capacity during VMC would be 87 operations [(103)(0.85)]. The airfield's hourly capacity during IMC, also assuming 50 percent arrivals, is 61 operations [(62)(1)(1)]. As indicated in **Table 3.1-3,** below, the unconstrained forecast of peak hour operations at FDK will not exceed 44 during the 20-year planning period through 2025. The hourly capacity of the airfield will be adequate to accommodate projected demand during the study period.

TABLE 3.1-3 HOURLY AIRFIELD CAPACITY

Year	VMC Hourly Capacity	IMC Hourly Capacity	Unconstrained Forecast Peak Hour Operations
2005	110	87	34
2010	110	87	38
2015	110	87	40
2020	110	87	41
2025	110	87	44

Source: URS (2005).

Annual Capacity: According to the FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay,* the ASV for an airfield with the configuration, instrumentation and runway use characteristics of FDK is approximately 230,000 operations. With a mix index of between 0 and 20 percent, the typical hourly VFR and IFR capacities (i.e., 98 and 59, respectively) provided in the Advisory Circular for an intersecting runway configuration are the same for a single runway use configuration as well. It is therefore reasonable to use the ASV value provided by the FAA for capacity and delay calculations at FDK. As shown in **Table 3.1-4**, the 165,578 annual operations projected for the year 2025 at FDK does not exceed the estimated ASV of 230,000. The existing airfield has adequate capacity to accommodate the forecasted annual aircraft operations.

TABLE 3.1-4 COMPARISON OF ANNUAL DEMAND AND ASV

Year	Forecasted Aircraft Operations	Estimated ASV	Forecasted Operations as a Percentage of ASV
2005	129,230	230,000	56 %
2010	**144,485**	230,000	63 %
2015	**151,667**	230,000	66 %
2020	**155,705**	230,000	68 %
2025	**165,578**	230,000	72 %

Source: URS (2005).

Delay Analysis: Delay may be defined as the difference between the actual time required for an aircraft to perform an arrival or departure, and the time required for the same operation assuming no interaction with any other aircraft (i.e., constrained versus unconstrained operating time). Although departure delays reportedly occur as a result of certain flight rules (e.g., ADIZ) in the region, there is little delay at FDK resulting from the aircraft fleet mix or the airfield configuration. The average delay per aircraft was estimated for selected years by calculating the ratio of annual demand to annual service volume, and using the delay graphs provided in Advisory Circular 150/5060-5. The analysis indicates that operational delay at FDK is approximately 12 to 36 seconds per operation at current activity levels, and would increase to 18 to 66 seconds per operation with the activity levels predicted for 2025. These delay projections are substantially under the threshold of acceptable delay times established for airports with the runway configuration at FDK. A normal range of delay would be between 2.6 and 4.0 minutes per operation.

Capacity Summary: FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS),* provides guidance for determining when airfield improvements should be undertaken. The FAA guidance indicates that planning for airfield capacity enhancements, including runway extensions, new runways, and high-speed exit taxiways, should be initiated when the forecast is expected to reach 60 to 75 percent of the ASV. As the ASV ratio exceeds 80 percent ASV, the airfield system becomes increasingly inefficient, and the airport will not be able to provide an effective level of service without additional runway capacity. As noted earlier in **Table 3.1.4**, the current airfield operational level at FDK is at 56% of ASV. The current forecast of aviation demand estimates the activity level at FDK will be at 63% in 2010, and at 72% in the year 2025. Planning for capacity improvements that are in substantial excess of the future forecast for FDK is generally not warranted. Since the timing of airfield design and construction is highly dependent on the rate of growth in operational activity over time, additional planning for capacity improvements should be deferred until such time the improvement is timely and costs are beneficial.

3.1.2 Requirements

3.1.2.1 Design Criteria

To properly and consistently plan future facilities, the design criteria for a Critical (i.e., Design) Aircraft must be identified and applied. The Critical Aircraft is that aircraft or group of aircraft with the most demanding, or largest, dimensions and the highest approach speed that uses the airport on a regular basis. Regular use of the airport means that the aircraft is either based at the airport or performs at least 500 annual itinerant operations.

Airport design criteria are specified by the Airport Reference Code (ARC), which consists of two components. The first component is the Aircraft Approach Category. This component is related to the approach speed of aircraft and provides information on the operational capabilities of aircraft using the airport. The second component is the Airplane Design Group (ADG). This component is related to the wingspan of the aircraft and provides information regarding the physical characteristics of aircraft using the airport. **Table 3.1-5** provides a listing of the aircraft approach categories and airplane design groups.

TABLE 3.1-5 AIRPORT DESIGN CRITERIA

Aircraft Approach Category	
Category	**Approach Speed**
A	Less than 91 Knots
B	91 to 120 Knots
C	121 to 140 Knots
D	141 to 165 Knots
E	166 Knots or Greater

Airplane Design Group	
Group	**Wing Span**
I	Up to 48 Feet
II	49 to 78 Feet
III	79 to 117 Feet
IV	118 to 170 Feet
V	171 to 213 Feet
VI	214 Feet or Greater

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, (September 26, 2005).

Aircraft Approach Category. Numerous aircraft in Approach Category C (i.e., approach speed of 121 knots or more but less than 141 knots) regularly use the Airport. Examples of Category C aircraft using FDK include the Falcon 2000, Gates LearJet 60, Canadair CL-600 series, Gulfstream III, Cessna Citation V and Hawker 800XP. Moreover, it is anticipated in the forecast that a Gulfstream V aircraft will be based at the Airport. Therefore, approach category C is used to plan future airfield facilities associated with Runway 5-23.

Airplane Design Group. Based on review of the forecast aircraft mix and interviews with the FBO, the most physically demanding aircraft that will use FDK on a regular basis is a Gulfstream V. The G-V has a wingspan of 93 feet and 4 inches, which places it within Airplane Design Group III (i.e., a wingspan of 79 feet up to but not including 118 feet). Therefore, future facilities associated with Runway 5-23 will be designed to meet Group III standards.

Airport Reference Code (ARC). The airport reference code is an alphanumeric combination of the aircraft approach category letter with the airplane design group number. Accordingly, the current ARC for FDK will be changed from C-II to C-III.

Applicable Standards. FAA's Advisory Circular AC 150/5300-13, *Airport Design*, designates the appropriate design standards for airports, based on the ARC. **Table 3.1-6** provides a comparison of separation standards for Runway 5-23 using both C-II and C-III criteria.

TABLE 3.1-6 ARC C-II AND C-III COMPARISON

SEPARATION STANDARDS FOR PRIMARY RUNWAY 5-23			
Design Item	**Existing Runway Conditions**	**C-II Criteria**	**C-III Criteria**
Runway/taxiway separation for runways with not lower than ¾ mile approach visibility minimums	340-feet	300-feet	400-feet
Runway/taxiway separation for runways with lower than ¾ mile approach visibility minimums		400-feet	400-feet
Taxiway/Taxilane separation standards	N/A	105-feet	152-feet
Taxiway Wingtip Clearance	N/A	26-feet	34-feet
Taxilane Wingtip Clearance	N/A	18-feet	22-feet
Runway Design Standards			
Runway Width	100-feet	100-feet	100-feet
Runway safety area dimensions (width x length beyond runway end)	500-feet x 1,000-feet	500-feet x 1,000-feet	500-feet x 1,000-feet
Blast Pad Dimensions (length x width)	None exist	150-feet x 120-feet	200-feet x 140-feet
Runway Protection Zone Size (Length x inner width x outer width)	RWY 5 Approach 1,700'x500'x1,010' RWY 23 Approach 1,700'x1,000'x1,510'	Not lower than ¾ mile 1,700'x1,000'x1,510'	Not Lower than ¾ mile 1,700'x1, 000'x1,510'
Taxiway Design Standards			
Taxiway Width	35-feet	35-feet	50-feet
Taxiway Safety Area Width	79-feet	79-feet	118-feet
Taxiway Object Free Area Width	118-feet	131-feet	186-feet
Radius of Taxiway Turn	75-feet	75-feet	100-feet
Length of Lead-in Fillet	50-feet	50-feet	150-feet
Fillet Radius for Tracking centerline	55-feet	55-feet	55-feet

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, (September 26, 2005).

3.1.2.2 Runway Safety Areas

Runway Safety Areas (RSAs) are defined by the FAA as "surfaces surrounding a runway that are prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway." An RSA is a relatively flat graded area that is free of objects and vegetation that could damage aircraft. According to FAA guidance, the RSA should be capable, under dry conditions, of supporting aircraft rescue and fire fighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

The current RSAs meet all FAA standards and requirements. Furthermore, the FAA-approved 2003 ALP identifies an extension on both Runway 5-23 ends for a total of 6,000-feet of runway length. The existing and planned RSAs meet all standards based on ARC C-III criteria for Runway 5-23 and ARC B-II criteria for Runway 12-30.

3.1.2.3 Runway Object Free Area

In addition to the RSA, an object free area (OFA) is also defined around a runway in order to enhance the safety of aircraft operations. The OFA is cleared of all objects except those that are related to navigational aids and aircraft ground maneuvering. The OFA for Runway 5-23, serving aircraft in approach categories C and D, has a width of 800 feet and a length beyond the runway end of 1,000 feet. The OFA for Runway 12-30, serving aircraft in approach categories A and B, has a width of 500 feet and length beyond the runway end of 300 feet. The OFAs at FDK meet the requirements associated with the current use of each runway.

3.1.2.4 Runway Separation Standards

Separation standards refer to the distance that runways, taxiways, aprons and other operational areas must be located from runways. Separation standards ensure that aircraft can operate simultaneously without significant risk of collision. These standards also ensure that no part of an aircraft on a taxiway penetrates the RSA or obstacle free zone (OFZ).

The runway-to-taxiway separation standard for a C-II runway with visibility minimums not lower than ¾ statute miles is 300 feet. The current separation between Runway 5-23 and Taxiway A is 340 feet, which is 40 feet more than the requirement and adequate. A C-III runway requires 400 feet separation between the runway centerline and the taxiway centerline. Therefore, Runway 5-23, an ultimate C-III runway, would require an additional 60 feet of separation or a total of 400 feet from the parallel taxiway to meet design criteria.

The Runway OFZ and the Inner-approach OFZ, and when applicable the Inner-transitional OFZ and Precision OFZ, may apply in an analysis of the obstacle free zone. For the primary Runway 5-23 at FDK, the OFZ analysis encompasses only the first two parameters:

The Runway OFZ is a defined volume of airspace centered above the runway centerline, with an elevation at any point that is the same as the nearest point on the runway centerline. The Runway OFZ extends 200 feet beyond each runway end and, to serve large airplanes, must be 400 feet wide. There are no runway OFZ obstructions to the existing runway or the extended runway as depicted on the existing ALP.

The Inner-approach OFZ applies to runways with an approach lighting system. The purpose of this surface is to ensure that no obstacles block a pilot's view of the approach lights. The existing Omni Directional Approach Lighting System (ODALS) on Runway 23 provides visual guidance, but it is a system intended for non-precision instrument approach runways. In this case, the inner-approach OFZ clearance criteria were applied to the proposed Runway 23 Medium Intensity Approach Light System with Sequenced Flashers (MALSF) identified on the existing ALP. The inner- approach OFZ begins 200 feet from the runway threshold and extends 200 feet beyond the last light unit in the proposed MALSF system. The width is the same as the runway OFZ and rises at a slope of 50 horizontal to 1 vertical from its beginning. There would be no penetrations of the inner-approach OFZ associated with the MALSF depicted on the existing ALP.

3.1.2.5 Number of Runways

The number of runways required at an airport depends upon factors such as wind coverage, operational capacity, and forecast demand. Wind coverage indicates the percentage of time that crosswind components are below an acceptable velocity. The FAA recommends that an airport provide wind coverage of at least 95 percent. This means that the runway is able to accommodate aircraft operations that fall within their limits of crosswind performance 95 percent of the time. If an airport does not provide the recommended wind coverage, additional runways or, if not cost effective, a wider runway should be considered.

A review of wind coverage data presented in **Section 1** indicates that both runways combined provide adequate wind coverage of 98.58 percent for all-weather conditions (i.e., 98.97 percent coverage during VMC and 99.34 percent coverage during IMC) for all types of aircraft. On the basis of wind coverage, the existing airfield is adequate.

In addition to wind coverage, the required number of runways also depends upon capacity needs. The results of the demand/capacity analysis indicate that the existing airfield will provide sufficient capacity on an hourly and annual basis to meet the projected operational needs over the next 20 years.

3.1.2.6 Turf Runway Feasibility

A location for a turf runway that meets all FAA runway standards will be determined as a part of the alternatives analysis in this Master Plan Update. **Section 2, Forecast of Aviation Demand**, identifies 38 glider/sport aircraft currently based at FDK and projects an increase of this aircraft type to 42 over the 20-year study period.

The glider aircraft at FDK have a typical wingspan in the range of 48 to 60 feet, which would be primarily in Airplane Design Group II if they were powered aircraft. The tow-planes used in glider operations include a Piper Pawnee and a PA-18 Super Cub. For planning purposes a turf runway length was calculated using the Piper Pawnee as the most "demanding" aircraft. The Piper Pawnee has a ground roll requirement at take-off of 625 feet, versus 420 feet for the Super Cub. Turf runway planning guidelines recommend adding 20 percent to the runway length requirements of a given aircraft for operations on grass. Accordingly, a minimum turf runway length of 1,500 feet has been established by using 120 percent of the runway length requirements for a Piper Pawnee, with a multiplier of two to account for the effects of a glider attached to the powered aircraft.

3.1.2.7 Runway Length Requirements

As described in **Section 1**, FDK has intersecting runways. Runway 5-23 is the primary runway at 5,220 feet by 100 feet, and Runway 12-30 is a secondary runway at 3,600 feet by 75 feet.

Runway length recommendations at FDK were estimated using FAA *Airport Design* computer program Version 4.2. This program, which is based on Chapter 2 of the FAA Advisory Circular 150/5325-4A, *Runway Length Requirements for Airport Design*, calculates the recommended runway length based on various groupings of aircraft type. The FAA's Airport Design computer program considers the following items:

- Airport elevation
- Mean daily maximum temperature of the hottest month
- Maximum difference in runway centerline elevation
- Length of haul for airplanes of more than 60,000 pounds
- Pavement conditions (wet or dry)

Information relevant to FDK for the above items was entered into the program. The results of the program's calculations are divided into two main categories, aircraft of more than 60,000 pounds and aircraft of less than 60,000 pounds. The category of less than 60,000 pounds is further subdivided into groups of aircraft and their gross takeoff weight (i.e., percent of useful load). An aircraft group is selected by using either 75 percent or 100 percent of the fleet. **Table 3.1-7** lists some of the aircraft types that comprise 75 and 100 percent of the fleet. Gross takeoff weight is determined by using either 60 percent or 90 percent of the useful load.

TABLE 3.1-7 AIRCRAFT FLEET

Large aircraft less than 60,000 pounds that comprise 75 percent of the fleet include the following:	
Manufacturer	**Model**
Gates Learjet	Lear Jet (20, 30 & 50 series)
Rockwell International	Sabreliner (40, 60, 75, & 80 series)
Cessna	Citation (II & III)
Dassault Brequet	Falcon (10, 20, & 50 series)
British Aerospace	HS-125 (400, 600, &b 700 series)
Beechcraft	1900 series

Large aircraft less than 60,000 pounds that comprise 100 percent of the fleet include the aircraft listed above and the following:	
Manufacturer	**Model**
Canadair	Challenger 601
Dassault Brequet	Falcon (900 series)
Grumman	Gulfstream (I-IV)
Lockheed	Jetstar

Source: URS Corporation (2004).

The results of the runway length analysis using the Airport Design Program methodology are presented in **Table 3.1-8**. FAA criteria specify that the runway length recommendations for an airport such as FDK be determined using the "75 percent fleet at 60 percent useful load" unless a critical aircraft having a greater requirement can be identified. As **Table 3.1-8** indicates, a runway length of 5,370 feet was calculated to support current and future operational needs for aircraft of 60,000 pounds or less. However, for aircraft of more than 60,000 pounds, such as the Gulfstream V, and with a typical haul length of 1,000 miles, the runway length calculation is 6,080 feet.

TABLE 3.1-8 RUNWAY LENGTH ANALYSIS

Airport Data	Information Entered
Airport elevation	303 feet
Mean daily maximum temp. of the hottest month	86.6 Degree Fahrenheit
Maximum difference in runway centerline elevation	27 Feet
Length of haul for airplanes of more than 60,000 pounds	500 miles
Dry or wet and slippery	Wet and Slippery
Category	**Recommended Runway Length (Feet)** [1]
Aircraft of 60,000 Pounds or Less	
75% of these aircraft at:	
60% useful load	5,370
90% useful load	7,000
100% of these aircraft at:	
60% useful load	5,620
90% useful load	8,370
Aircraft more than 60,000 pounds[2]	6,080

Source: FAA Advisory Circular 150/5325-4A.
[1] Assumes wet and slippery runway conditions.
[2] Assumes a haul length of 1,000 miles.

In October 2003, a *Runway Extension and Exit Taxiway Analysis*, prepared by URS, determined the maximum runway length given the existing constraints at FDK. The analysis concluded and recommended that primary Runway 5-23 could be extended from 5,220 feet to a maximum length of 6,000 feet. The additional runway length would include a 600-foot extension on Runway 5 and a 180-foot extension on Runway 23. While this is 80 feet short of the recommended runway length in the table above, it is the maximum possible for Runway 5-23 without impacting the Monocacy River or development adjacent to the Runway 5 end. The extensions would also eliminate or reduce current runway incursions of aircraft by providing locations for holding outside of the glide slope critical areas.

Furthermore, the analysis also concluded and recommended an extension of Runway 12-30 by adding 130 feet at the Runway 30 end. This extension will avoid interference with the Runway 23 ILS. Aircraft taxiing to takeoff from the Runway 30 end must currently hold short on parallel Taxiway D west of Taxiway A during IFR weather to avoid the existing Glide Slope Critical Area located near the east end of Taxiway D. The runway and holding pad extensions will provide adequate space for aircraft to hold on Taxiway D to the east of Runway 5-23, outside the Glide Slope Critical Area.

The analysis was submitted to the FAA and City of Frederick in December 2003 and approved. In addition, a *Final Environmental Assessment* was completed and *a Finding of No Significant Impact* was issued by the FAA for the runway extensions and related improvements. In summary, Runway 5-23 is inadequate for existing operations and should be developed to a length of 6,000 feet to accommodate current and future aircraft use. The length of Runway 12-30 is adequate for both current and forecast operations.

3.1.2.8 Runway Width

Runway width requirements are determined by airplane design group standards. The recommended width for primary Runway 5-23, serving aircraft in Design Group III, is 100 feet. The FAA standard for runways serving aircraft in Design Group III with maximum certified takeoff weights greater than 150,000 pounds (e.g., a Boeing 757-200 at 240,000 pounds) is 150 feet. Runway 5-23 currently has a width of 100 feet and, with no aircraft with takeoff weights greater than 150,000 pounds in the 20-year forecast; it is adequate for existing and future aircraft use. The secondary Runway 12-30 serving Design Group II aircraft has a width of 75 feet. Both runway widths meet standards and are adequate to serve all aircraft projected to use FDK on a regular basis throughout the study period.

3.1.2.9 Runway Strength

Pavement strength requirements are related to three primary factors: the weight of aircraft anticipated to use the airport; the landing gear type and geometry; and the number of aircraft operations. During the recent rehabilitation of Runway 5-23 and associated improvements at the Airport, the pavement strength was upgraded to 68,700 pounds dual-wheel capability. The rehabilitated pavement was designed to accommodate the equivalent of 1,200± annual departures by G-III type aircraft over a 20-year pavement life. The pavement strength is sufficient to accommodate all existing and future aircraft projected to regularly operate at FDK through the year 2025.

The current ALP lists the pavement strength of Runway 12-30 as 12,500 pounds single-wheel loading. This pavement strength is sufficient to accommodate all existing and future aircraft projected to regularly operate at FDK on this runway.

3.1.2.10 Runway Pavement Markings

Runway 5-23 currently has precision and non-precision runway markings. The runway markings are adequate for the existing non-precision and precision approaches to the respective Runway 5 and Runway 23 ends. Runway 12-30 currently has non-precision runway markings. This type of runway markings is also adequate for the existing visual approaches to Runway 12 and Runway 30.

3.1.2.11 Taxiways

Taxiways are needed to accommodate the movement of aircraft between parking aprons and runways. In order to provide for the efficient movement of aircraft, it is desirable to have a parallel taxiway and several exit taxiways associated with each runway. The recommended width is 35 feet for taxiways serving aircraft in Design Group II, and 50 feet for taxiways serving Design Group III. As noted in **Section 1**, most of the taxiways at FDK have a width of 35 feet, which is adequate to support Group II aircraft. Taxiways D and H have widths of 40 and 100 feet, respectively. All taxiways serving an ultimate C-III Runway 5-23 would need to be widened to a width of 50 feet. The fillets for RW 5-23 would need to have a lead-in length of 150 feet and a fillet radius of 55 feet for tracking. The existing fillet radii are adequate for Design Group III but the lead-ins would need to be lengthened. All taxiways serving the existing and future B-II Runway 12-30 have an adequate width of 40 feet.

3.1.2.12 Holding Aprons

The purpose of holding aprons is to provide space for one aircraft to pass another in order to reach the runway end. Holding aprons reduce airfield delays by accommodating aircraft conducting engine run-ups, preflight checks, or awaiting departure clearance. There are two existing holding aprons on the taxiway system at FDK. Holding aprons are located on Taxiway D next to Runway 12 end and on Taxiway A, next to the Runway 23 end. Two new holding aprons would be required in conjunction with extended runways. One holding apron would be on Taxiway D to serve extended Runway 30, and a second holding apron would be on Taxiway A, associated with extended Runway 5. The holding aprons for Runway 12-30 and Runway 5-23 would accommodate one Group II or Group III aircraft, respectively, while allowing a second Group II or III aircraft to pass by on the parallel taxiway. These holding aprons were included in the *Final Environmental Assessment*, which received a *Finding of No Significant Impact* in July 2004.

3.1.3.13 Navigational Aids

The existing navigation aids and published approach procedures at FDK are described in **Section 1**, and generally consist of the following:

- Category I ILS approach to Runway 23;
- Localizer (LOC) approach to Runway 23;
- RNAV (GPS) Y approach to Runway 23;
- RNAV (GPS) Z approach to Runway 23 (i.e., WAAS);
- GPS approach to Runway 5; and,
- VOR-A approach.

A typical Category I ILS consists of a localizer antenna, a glide slope antenna, and outer marker beacon. Provided all critical surfaces are clear of obstructions, a Category I ILS will allow for a Decision Height (DH) of not less than 200 feet above ground level, and a horizontal visibility of ¾-mile. Due to the presence of one or more off-airport obstructions (e.g., trees) in the approach to Runway 23, the current minimums at FDK are not less than 684 feet above mean sea level (i.e., 388 feet above touchdown zone elevation) and a horizontal visibility of 1½ miles. Installation of new or additional navigation aids will not improve the current minimums until the critical surfaces are clear of obstructions. An analysis of close-in obstructions should be prepared during development of the Airport Layout Plan.

The existing Omni directional Approach Lighting System (ODALS) for Runway 23 extends 1,500 feet into the approach from the Runway 23 threshold. It is an approach lighting system that provides visual guidance for non-precision instrument approach runways and it does not provide any additional visibility credit for the published ILS approach. To obtain an additional ¼-mile visibility credit and potentially lower the minimums to a 200-foot DH and ½-mile visibility, one of the following approach lighting systems must be installed.

- Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR);
- Simplified Short Approach Lighting System with Runway Alignment Indicator Lights (SSALSR); or,
- High Intensity Approach Lighting System with Sequenced Flashers (ALSF-1).

Each of the approach lighting systems noted above consists of a series of lights that extend 2,400 feet from the landing threshold into the approach. The MALSR is frequently the approach lighting system of choice for a new ILS should an airport sponsor desire to obtain the ½-mile visibility minimum. However, as noted in the November 2003 *Runway Extension and Taxiway Exit Location Analysis* for FDK, the installation of a MALSR would not be economically or environmentally prudent. Given the 2,400-foot length beyond the threshold required to site the MALSR, several light stations would have to be constructed on both banks of the Monocacy River and within the 100-year floodplain. Instead, it was recommended that the existing ODALS be removed and replaced with a Medium Intensity Approach Light System with Sequenced Flashers (MALSF). The ODALS consist of a single light unit beginning 300 feet from the landing threshold, with an additional light every 300 feet to a point 1,500 feet from the landing threshold, for a total of five lights. The MALSF consists of a series of five lights per station beginning 200 feet from the landing threshold, with an additional set of five lights spaced every 200 feet to a point 1,400 feet from the landing threshold. There are three sets of five lights at the station 1,000 feet from the landing threshold. Unlike the MALSR, the stations for the MALSF end well short of the river. Provided that all critical surfaces are clear of obstructions, the best available minimums for a Category I ILS with MALSF are a 200-foot DH and a horizontal visibility of ¾-mile.

The existing approaches noted above should be maintained, together with the existing visual aids previously noted in **Section 1.** The visual aids include a Precision Approach Path Indicator (PAPI) and Runway End

Identifier Lights (REIL) to all four runway ends. Together, the navigation and visual aids noted above would be sufficient to support current and future operations at FDK.

A Very High Frequency Omni-directional Radio Range (VOR) facility is located on the airport about 1,650 feet north of the Runway 5 threshold and 500 feet east of the Runway 5-23 centerline. As noted in **Section 1** this navigation aid is classified as a terminal altitude T-VOR and serves as the initial approach fix to the airport for VOR or GPS-A approach procedures. Montgomery County Airpark, Carroll County Regional, Leesburg Executive, and Reagan National Airports also use the FDK VOR facility in various procedures. Relocation of the existing VOR was explored during the preparation of the current ALP to accommodate a future south parallel runway and taxiway. Although the approved ALP depicts a potential site for the future relocation of the VOR, the site was not studied in detail or submitted to FAA Air Traffic Organization (ATO) for comment. Accordingly, the existing location and three alternative sites on or contiguous to airport property have been evaluated in anticipation of planning for future airfield improvements as part of this Master Plan Update. The alternative VOR site locations were selected with reference to siting criteria from the following documents:

- FAA Advisory Circular 150/5300-13, *Airport Design*;
- FAA Order 6820.7A, *Maintenance of Navigational Aids Facilities and Equipment*; and
- FAA Order 6820.10, *VOR, VOR/DME, and VORTAC Siting Criteria*.

VOR Site 1. This site is located north of Runway 23 end and would require acquisition of a portion of the Fout farm for the VOR Critical Area. The farmstead is in an agricultural trust through the Maryland Agriculture Land Preservation Program. Acquisition in fee or adequate control of land use within the critical area would be required. Site 1 is not a desirable alternative due to the high probability of litigation, high costs and delays.

VOR Site 2A. This site is located in the midfield area between Taxiways D and H and Runway 5-23. Site 2A is not desirable alternative because the site is in the existing Runway Visibility Zone, and the associated critical area would prohibit future midfield area development.

VOR Site 2B. Site 2B is also located in the midfield area, northwest of Site 2A. The limitations of this site are that the critical area would conflict with opportunities for future midfield area development, and several existing T-hangars would need to be removed.

Existing VOR Site. After consideration of the probable VOR equipment and site preparation costs, potential impacts to existing facilities and limitations on future midfield development, the existing VOR site was ultimately recommended to remain in place. It is the preferred site for planning of airfield alternatives and has been recommended through the FAA-Washington Airports District Office to the FAA ATO for their confirmation.

3.1.3.14 Runway and Taxiway Lighting.

Runways 5-23 is equipped with High Intensity Runway Lights (HIRL), and Runway 12-30 is equipped with Medium Intensity Runway Lights (MIRL). The HIRL is standard for precision instrument approach runways such as Runway 5-23. The MIRL is standard for runways with non-precision or visual instrument approaches. Taxiways are currently equipped with Medium Intensity Taxiway Lights (MITL), except for Taxiway D, which is unlighted. The MITL are adequate for all lighted taxiways, and should be installed on Taxiway D.

3.2 TERMINAL AREA

There is no centralized public use passenger terminal facility at FDK. The FBO (i.e., Frederick Aviation) provides general aviation pilot and passenger service, including facilities for flight planning and flight crew support, and corporate/charter passenger arrival and departure processing. Limited meeting space is also available in the FBO office facility. The existing terminal building (i.e., the Delaplaine Building) houses the Airport Administrative offices and the Airways Inn restaurant. The terminal area also includes a vehicle parking area generally bounded on the north by the FBO, on the east by the Delaplaine Building, on the south by the Frederick Flight Center building, and by Aviation Way on the west. General aviation hangar development, and the based and transient aircraft parking aprons complete the terminal area. The capacity of each terminal area component to meet future demands is addressed in the following paragraphs.

3.2.1 Terminal Building

The airport administrative offices and a restaurant are in the original (circa 1947-49) Delaplaine Terminal Building. The Airways Inn restaurant is the primary use of the first floor (2,200± square feet) and the airport offices are in the second floor (840± square feet). According to the Maryland State Historic Preservation office, the Delaplaine building is: eligible for listing in the National Register of Historic Places, for its association with local history; and eligible for listing as a representative example of the "Moderne" architectural style. According to a recent physical condition evaluation: the building needs a new roof; the exterior skin and underlying masonry (i.e., cement plastered concrete block) in the walls is cracked; the windows should be replaced for efficient heating and cooling; the electrical system is substandard; and the building does not meet the building code requirements for access and use by the handicapped. In the future, the building can be restored, remodeled and/or expanded by the City for use as a mixed-use office and restaurant. However, all building code requirements for that building type will apply retroactively to both existing and new construction. The Delaplaine building can also be demolished in favor of a new aviation-related use. In the event the building is razed in favor of new construction, a photographic record of the building, with construction drawings or similar archival documentation, would be required by the State Historic Preservation office

There is no evidence to suggest that Frederick Aviation or a combination of FBOs cannot adequately support the needs of pilots and passengers related to the forecasted growth in aircraft operations in the study period. Accordingly, the Master Plan Technical Advisory Committee developed the following guidance for terminal area planning:

- Designate an area for redevelopment as an aviation-related use that encompasses the existing Delaplaine building and the existing Frederick Flight Center building;

- Maintain airport administrative offices, a restaurant and aviation-related tenant uses in the terminal area, and incorporate those uses in a building complex designed with an aviation signature style;

- Consider the axial approach from Hughes Ford in the planning and design of the future terminal area redevelopment, so that it serves as a gateway to the airport; and,

- Accomplish the terminal redevelopment with no net reduction in aircraft tie-down spaces.

3.2.2 Terminal Area Vehicle Parking

The existing central terminal area parking lot accommodates approximately 130 vehicles in its current arrangement. The users of this parking facility include FBO patrons and staff, Airport Administrative visitors and staff, and Airways Inn patrons and staff. On normal business days, the existing number of spaces is considered by airport management to be adequate to meet public and employee parking needs. However, FDK accommodates several regional and national events, and during these peak periods, the capacity of the terminal area parking area is exceeded.

Table 3.2-1 lists the estimated parking requirements in the terminal area for future years. For this evaluation of parking lot demand and capacity it is assumed that the current number of parking spaces is equivalent to 90 percent of the peak demand. When public parking lots reach 85 to 90 percent of capacity, excessive automobile circulation and motorist conflicts typically occur due to a lack of readily available parking space. The existing number of spaces (i.e., 130) is considered adequate for average daily demand. Using the 90 percent factor, the existing parking capacity is converted to a demand for 144 spaces during peak periods, which is equivalent to 4 spaces per peak hour operation. Application of the estimated vehicle parking space factor to the peak hour aircraft operations forecast in the table below indicates that the demand for parking spaces, currently in the range of 130 to 144 spaces, will increase to between 158 and 176 spaces at the end of the study period. The table also provides an estimate of the need for overflow parking if the peak period space requirement can be met in an alternate location.

TABLE 3.2-1 TERMINAL AREA PARKING REQUIREMENTS

Year	Airport Operations forecast	Normal Day Spaces Required	Peak Hour Operations	Peak Period Spaces Required
2005	129,230	130	34	144
2010	144,485	137	38	152
2015	151,667	144	40	160
2020	155,705	148	41	164
2025	165,578	158	44	176

Source: URS (2005).

It should be noted that in order to provide the existing 130 parking spaces, all of the 6,000 square yard paved area fronting the Delaplaine Building is currently devoted to vehicle parking and circulation. Any enlargement of the Delaplaine building footprint or its redevelopment, or any extraordinary parking demands triggered by new or expanded tenant activity (e.g., Frederick Aviation), will strain the existing capacity of the parking lot.

The final determination of the overall number of spaces required in the parking lot of a future new or enlarged terminal area building must consider the needs of the proposed new building(s) and the existing tenants, especially the FBO. The City of Frederick Zoning Requirements (i.e., Article 6, S 607, *Parking for Transportation, Communication, Information and Utilities – Airfield, General Aviation*) establishes minimum parking standards for airport facilities. For the terminal redevelopment area, one space for every four seats accommodating waiting passengers, plus one space for every two employees on the largest shift of employment would be required. Using the current parking standard from the zoning code, the parking requirements for the existing facilities in the terminal area were calculated. The existing facilities are the Airport Office and Airways Inn Restaurant in the Delaplaine Building, Frederick Flight Center, and Frederick Aviation. The standard for passengers was applied to both Frederick Flight Center and Frederick Aviation, and to the restaurant by treating customers as passengers. A total of 58 passengers/customers was estimated. The standard for employees was applied equally to the FDK Airport Office and to the three businesses, with an estimated total of 63 employees on the largest shift. Calculations of the minimum parking requirements for passengers/customers (i.e., 15 spaces), and for employees (i.e., 32 spaces) resulted in a total requirement of only 47 parking spaces. This analysis of minimum standards underscores the need to carefully evaluate the employee and customer parking needs when improvements to this aviation-related development area are initiated.

3.2.3 Aircraft Storage Hangars

The demand for hangars is dependent upon the number and types of aircraft based at the Airport, as well as local climatic conditions, airport security, insurance requirements and owner preferences. Demand for storage hangars is typically estimated by assuming that a certain percentage of aircraft owners will desire hangars, which varies by type of aircraft. In theory, a higher percentage of owners of high-performance aircraft will desire storage space in a hangar as compared to owners of low performance aircraft. For example, 60 to 80 percent of single-engine and light twin-engine piston aircraft owners typically desire hangar space as compared to100 percent of turboprop, jet and rotorcraft owners. Single and light twin-engine aircraft owners seek storage space in T-hangars. Owners of larger, high performance aircraft usually house their aircraft with other similar aircraft in a conventional open-bay group hangar, or in a corporate hangar facility.

For this demand/capacity analysis of T-hangars and open-bay storage hangars at FDK, the existing distribution of types of hangar spaces by type of aircraft was examined utilizing interviews, airport administration data and observation. There are presently 12 T-hangar buildings with a total of 125 spaces, and the waiting list of 117 names includes 33 based aircraft. The majority of the T-hangar buildings constructed most recently at FDK are 12-unit, nested facilities, the most common type constructed today. FDK also has 7 corporate and 3 conventional hangars, encompassing 86,000 square feet of open-bay aircraft storage space. The corporate and conventional group hangars currently house approximately 21 aircraft of various types.

T-Hangars. This analysis of storage hangar demand assumes that 70 percent of the future based single- and light-twin engine piston aircraft will be stored in T-hangar type spaces. For the year 2005, 154 of the 220 single-engine and light-twin engine piston aircraft based at FDK would be stored in T-hangars and would almost fill 13 standard 12-unit T-Hangar buildings. Although 125 occupied T-hangar spaces plus a waiting list of 33 based aircraft equals 158 spaces, it is reasonable to assume that not all of the aircraft owners on the current waiting list will lease T-hangar space. The rental of units is highly sensitive to market rates.

Group Hangars. This analysis also assumes that 100 percent of the based turboprop, jet aircraft and rotorcraft would be stored in open-bay group hangars, either conventional or corporate. There are currently 30 turboprop, jet and similar high performance aircraft based at FDK. Open-bay hangars can accommodate a large number of stored aircraft depending on aircraft size and parking position. To estimate the requirements for open-bay storage space, this analysis is based on current hangar planning factors. Space factors of 1,300 square feet for rotorcraft, 2,500 square feet for turboprop aircraft, and 4,500 square feet for jet engine aircraft are used.

Table 3.2-2 is a summary of the estimated future demand for hangar space in accordance with the forecast of the based aircraft fleet mix presented in **Section 2**. The table presents information that will be useful in planning of alternatives to accommodate storage hangar development at FDK.

TABLE 3.2-2 HANGAR SPACE DEMAND

Aircraft/Hangar Type	2005	2010	2015	2020	2025
T-Hangar Spaces 12-Unit Buildings	154* 13	175 15	182 16	184 16	193 17
Turbo-Prop Spaces Area @ 2,500 sf each	4 10,000 sf	4 10,000 sf	5 12,500 sf	6 15,000 sf	7 17,500 sf
Jet Spaces Area @ 4,500 sf each	13 58,500 sf	15 67,500 sf	18 81,000 sf	21 94,500 sf	25 112,500 sf
Rotorcraft Spaces Area @ 1,300 sf each	13 16,900 sf	15 19,500 sf	17 22,100 sf	18 23,400 sf	20 26,000
Other (Glider)					
Total Open-Bay Area Need	**85,400 sf****	**97,000 sf**	**115,600 sf**	**132,900 sf**	**156,000 sf**

* Total Existing (2005) T-Hangar Storage Spaces: 125
** Total Existing (2005) Open-Bay Storage Area: 86,000 sf

- Based on the waiting list and the assumptions regarding the percentage of current and future based aircraft owners seeking T-hangar space, there is an immediate demand for approximately 29 spaces, or two 12-unit nested T-Hangar buildings. The net space requirement will increase over time if any T-hangar storage units are removed.

- The equivalent of four or five additional 12-unit nested T-hangar buildings would be required over the 20-year planning period. Area requirements for T-hangar buildings necessarily include both buildings (e.g., 20,000 s.f. per building) and taxilanes. For example, four T-hangar buildings with taxilanes would require an area of approximately 220,000 square feet, not including tenant vehicle parking.

- The current demand for open-bay group hangars is roughly equal to the existing capacity. However, the forecasted addition of two new business jet aircraft by 2010 would trigger the need for at least 10,000 square feet of suitable hangar space, and supportive apron improvements. If one of the future based business jets were a Gulfstream V, which is a Group III jet aircraft, it would likely require a 10,000 s.f. hangar facility alone.

- Vehicle parking requirements for T-hangars, conventional group hangars and corporate hangars should be developed on a case-by-case basis. In general, the vehicular parking requirement for T-hangars rarely exceeds one space per storage unit. Automobile parking for open-bay conventional hangars and corporate hangars requires consideration of the number of aircraft, the number of aircraft maintenance and office personnel if any, and the prevailing zoning/building code requirement for the building type. Vehicle parking, circulation and support systems (e.g., AFFF fire suppression tanks) for large corporate hangars frequently require the same landside area as the hangar-building footprint.

- All T-hangar buildings, and open-bay conventional and corporate hangars, require extensions of sanitary sewers, water service, power, natural gas and communications that require coordination with the internal roadway circulation system.

3.2.4 Based Aircraft Apron: Demand/Capacity Analysis

Apron areas should be provided for based aircraft that are not stored in hangars. Although parking areas for based aircraft at FDK are not entirely segregated from transient aircraft parking, the areas primarily devoted to based aircraft tie-downs include the large paved ramp area south and east of the existing terminal (i.e., about 25,000 square yards), a paved section of Taxiway H (i.e., about 10,000 square yards), and a combination of grass infield areas fronting the terminal and FBO area (i.e., about 5,000 square yards). The total area available for based aircraft encompasses about 40,000 square yards and 172 parking positions with tie-downs. Based aircraft currently uses approximately 82 tie-down positions. The majority of the aircraft stored or parked on the apron are single-engine piston aircraft, together with a mix of twin-engine types.

The approach to estimating the demand for future based aircraft apron space utilizes the hangar space demand analysis, and the forecast of based aircraft and fleet mix. One key assumption is that the 20-year demand for based aircraft tie-down space is estimated by subtracting the number of aircraft stored in T-hangars from the total number of based single- and light-twin based aircraft (i.e., 220 aircraft). For the 2005 base year, the demand for T-hangar storage is 154 aircraft (i.e., 70 percent of 220 aircraft). The remainder of the single- and light-twin engine aircraft that require apron tie-down space is 66 (i.e., 61 single- and 5 twin-engine based aircraft).

Table 3.2-3 presents the based aircraft apron requirements, including the number of tie-down positions and the approximate apron area required. The planning standards used for estimating the apron area requirements are 311 square yards for single-engine, and 533 square yards for twin-engine aircraft. The latter figure is weighted to reflect the presence of larger twin-engine aircraft in the based aircraft fleet.

TABLE 3.2-3 BASED AIRCRAFT APRON REQUIREMENTS

Category	Existing Capacity	2005	2010	2015	2020	2025
Total Tie-Down Positions	172	66	75	78	78	82
Single-Engine Positions	-	61	67	69	69	73
S.E.P. Apron Area (S.Y.)	-	18,970	20,835	21,460	21,460	22,705
Twin-Engine Positions	-	5	8	9	9	9
T.E.P. Apron Area (S.Y.)	-	2,665	4,265	4,795	4,795	4,795
Total Based Apron Area (S.Y.)	**40,000**	**21,635**	**25,100**	**26,255**	**26,255**	**27,500**

Source: URS Corporation (2005).

As stated earlier, the available area includes 35,000 of paved apron and approximately 5,000 of turf area. Accordingly, the surplus apron area in 2005, for example, can be estimated as either 13,365 square yards of paved apron area, or 18,365 square yards including the grassed infield areas in current use. Based on the foregoing analysis, the existing apron areas allocated to based aircraft parking are sufficient to meet future demand.

3.2.5 Transient Aircraft Apron

Transient aircraft visiting FDK typically park at the apron in front of the FBO, in front of the terminal, and other areas approved by the Airport. The estimated apron area currently available for transient aircraft is 20,000 square yards, including 15,000 square yards in pavement and 5,000 square yards in turf. At an average of 600± square yards per aircraft, the current area will accommodate 33 aircraft. The average parking area per aircraft is weighted to account for visiting turboprop and business jet aircraft.

The demand for transient ramp space is usually estimated by applying a factor to design day aircraft landings. Design day is useful in this application since it is a division of the peak month. Design day landings are assumed to be 50 percent of the forecast design day operations. In this instance, aircraft apron area for transient aircraft was calculated by applying the same design standard of 600 square yards per itinerant aircraft to the number of transient aircraft expected to park at the airport at any one time. Based on consultation with the FBO staff, 20 percent of itinerant operations during the design day is assumed for calculating the number of aircraft that will require parking at the same time.

FDK also accommodates a moderate level of rotorcraft activity. Aircraft types range from a Bell 206 Jet Ranger to the Presidential CH-3. In addition to the fixed wing aircraft parking positions, transient apron space should be allocated for three rotorcraft parking positions. A design standard of 300 square yards for each rotorcraft position should be used, and each position should be segregated from fixed wing aircraft to avoid rotor wash damage when, for example, helicopters are air taxiing. All rotorcraft facilities should be designed in accordance with FAA AC 150/5390-2B, *Heliport Design*.

As indicated in **Table 3.2-4**, the total transient aircraft apron area required over the 20 year planning period is 32,700 square yards, or approximately 12,700 square yards of additional area allocated for transient aircraft parking, including rotorcraft positions.

TABLE 3.2-4 TRANSIENT AIRCRAFT APRON REQUIREMENTS

Category	Existing Capacity	2005	2010	2015	2020	2025
Design Day Landings	-	207	231	243	249	265
Transient Aircraft Positions	33	41	46	49	50	53
Transient Apron Area (S.Y.)	20,000	24,600	27,600	29,400	30,000	31,800
Rotorcraft Positions	-	3	3	3	3	3
Rotorcraft Apron Area (S.Y.)	-	900	900	900	900	900
Total Transient Apron (S.Y.)	**20,000**	**25,500**	**28,500**	**30,300**	**30,900**	**32,700**

Source: URS Corporation (2005).

3.3 SURFACE TRANSPORTATION

The purpose of this section is to evaluate existing and future vehicle traffic operations and identify any improvement needs for the surface transportation system supporting FDK.

Bucheimer Road and Hughes Ford Road currently provide access to FDK. These roads lead into East Patrick Street (Maryland Route 144) via Monacacy Boulevard. The City is planning for the northerly extension of Monacacy Boulevard from Hughes Ford Road, which presents an opportunity to secure a secondary access route to FDK. East Patrick Street provides access to the City of Frederick as well as to Interstate 70 (I-70). I-70 provides a direct link to the cities of Baltimore and Hagerstown. Interstate 270 intersects I-70 approximately 2.5 miles to the west of the Patrick Street/I-70 interchange. I-270 is a major highway linking Frederick County to Washington D.C. The regional access to the Airport is sufficient for the 20-year planning period.

3.4 SUPPORT FACILITIES

3.4.1 Airport Traffic Control Tower

In October, 2005 the Requirements Branch of the FAA Airport Traffic Division – Eastern Region notified the Airport Manager that FDK achieved a preliminary benefit/cost (B/C) ratio of 1.22 for an Airport Traffic Control Tower (ATCT). The FAA conducted the B/C analysis pursuant to FDK's interest in the Contract Airport Control Tower Program. This communication confirms FDK's eligibility as a candidate to enter the cost-sharing program if the FAA chooses to fund the Airport as a location for air traffic control services. The design, building, and equipping of a new ATCT remains the responsibility of the Airport.

An ATCT Feasibility and Siting Study is currently underway as a part of this Master Plan Update. A preliminary line of site (i.e., shadow) study was applied to the future airport configuration illustrated on the approved 2003 Airport Layout Plan, and presented to the Master Plan Technical Committee on October 25, 2005. The study, which also incorporated the standards of the new Airport Traffic Control Tower Siting Order 6480.XX, ultimately identified two candidate sites that are acceptable within the context of the existing ALP. The MPTC determined that until the results of the ATCT feasibility study are complete, the two ATCT sites should be incorporated in the planning of alternatives under this Master Plan Update. Additional opportunities to site a future ATCT resulting from the new alternative plans will be analyzed accordingly.

3.4.2 Aircraft Rescue and Firefighting

Rescue and firefighting services at FDK are provided through Station No. 3 of the Frederick County Division of Fire and Rescue Services. The fire station has two vehicles for immediate response and the ability to provide additional equipment through other companies in the Division of Fire and Rescue. Station No. 3 has a foam-equipped truck for aircraft fires and, if necessary, can provide additional foam truck service through an on-call assistance contract with United States Army Base at Fort Detrick. The station is located approximately 2 miles from the Airport, and the response time is approximately seven minutes, depending on time of day and traffic in the City.

The evaluation of airfield alternatives should include an estimate of the changes in response time triggered by any new arrangement of runways and taxiways, together with a review of alternate means of access to the airfield if required by emergency response vehicles. As stated in **Section 1**, the current emergency response procedures have been in place since 1999, but the Police Fire Rescue Personnel (PFRP) procedures have not been formally accepted by the City of Frederick. The procedures indicate emergency staging area locations, descriptions and locations of Airport facilities, a list of airport representatives, and diagrams of emergency response routes.

3.4.3 Aviation Fuel Storage Facilities

Frederick Aviation currently provides aircraft fuel storage and fueling services. As stated in the **Section 1, Table 1.4-1**, the FBO has a capacity of 15,950 gallons of Avgas, including 14,150 gallons in three above ground tanks, and 1,800 gallons of “rolling” storage in two refueler trucks. For jet fueling, Frederick Aviation has a total capacity 27,475 gallons of Jet A, including 12,275 gallons in two above ground tanks and 5,200 gallons of storage in two refueler trucks. Tanker trucks deliver either Avgas or Jet A to the fuel farm as required, in increments of 7,500 gallons. In 2005, there were approximately 40 deliveries of Avgas (i.e., every ten days), and 93 deliveries of Jet A (i.e., every four days). Frederick Aviation is currently planning to add one 12,000 gallon above ground tank for JetA, and to replace one 2,200 gallon Jet A refueler truck with a 5,000 gallon truck, or a net increase of 14, 800 gallons in Jet A capacity.

Table 3.4-1 presents historical fuel sales at FDK from 2001 through 2005. Year 2003 fuel sales figures reflect the closures of Runway 5-23 for construction, and the lack of sufficient runway length for both based and transient high-performance aircraft during that time. Although the events of September 11, 2001 had a measurable effect on aircraft operations and fuel sales in 2001 and 2002, and the runway closures depressed the Jet A fuel sales in 2003, there is clearly an upward trend in fueling of turbine engine aircraft at FDK. The Avgas fuel sales have remained flat over the last five years.

TABLE 3.4-1 HISTORICAL FUEL SALES (GALLONS)

Year	Avgas	Avgas %	Jet A	Jet A %	Total Fuel
2001	281,160	34	555,410	66	836,570
2002	310,707	34	602,156	66	912,863
2003	261,132	40	398,782	60	659,914
2004	284,832	32	605,268	68	890,100
2005*	284,480	28	731,520	72	1,016,000

Source: Frederick Aviation (2005).
* Through December 16, 2005

Notable comments by the fuel farm operators include the following:

- There are no operational conflicts associated with refueler truck access to and from the existing fuel farm and the apron fueling areas. Tanker trucks that deliver fuel do not have problems using the current access route from the highway(s) to the fuel farm. However, there should be a pull- ahead circulation system at the fuel farm that would eliminate backing by these 8,000± gallon capacity tank trucks.

- Approximately 50 percent of the total Avgas sold annually is purchased by three businesses on the airport. The Frederick Flight Center purchases 30 percent of the total Avgas, and Advanced Helicopter Concepts and Richard Crouse and Associates purchases approximately 20 percent of the total. The remainder of the Avgas is split between based aircraft owners (i.e., 35 percent) and transient aircraft owners (i.e., 15 percent). Approximately 20 percent of the Avgas is pumped through the 2,000-gallon self-serve tank located between the main apron and Taxiway H.

- Avgas sales at FDK appear to be diminishing in comparison to Jet A. One factor may be the extraordinary airspace restrictions (e.g., ADIZ and Camp David) that place greater operational demands on single- and twin-engine piston aircraft, but not necessarily on the high performance aircraft. Daily visits to FDK by transient turbine-engine aircraft have increased from 1.5 per day in 2003 to 2.25 per day in 2005. The FBO operator expects the average to reach 3.0 transient turbine aircraft trips per day in 2006.

- The based charter fleet of five turbine aircraft consumes about 50 percent of the jet fuel. Another 25 percent of the jet fuel is purchased by other based tenant aircraft (i.e., 20 percent) and the military (i.e., 5 percent). The remaining 25 percent of Jet A is purchased by transient aircraft. Approximately one-half of the total jet fuel purchased by transient aircraft, or 13 percent of the total annual Jet A sold, is purchased by one company with offices in Frederick, but with no based jet aircraft at FDK.

In summary, the Avgas storage facilities at FDK are sufficient to meet the projected demand over the 20-year study period with respect to capacity. The fuel farm operator maintains a 10-day supply, and Avgas sales have been relatively flat over the last five years. Based aircraft consume about 85 percent of the Avgas sold at FDK, and the forecasted increase in single- and twin-engine aircraft (from Section 2, Table 2.3-2) that use Avgas is not more than 25 percent over the next 20 years. With respect to Jet A fuel storage, the airport fuel farm operator currently maintains a 4-day supply and is not comfortable with the existing capacity or the increasing need to deliver fuel to the storage facility more frequently. The statistical evidence supports the concern that the existing capacity will be insufficient for the forecasted growth in based turbine engine aircraft in less than ten years. Over 731,000 gallons of jet fuel was delivered to FDK in 2005, and based turbine aircraft used about 75 percent (i.e., 548,000 gallons) of the jet fuel sold. A 35 percent increase in based turbine aircraft is predicted by 2015, which will generate a total need for 739,000 gallons for based aircraft alone, without any increased demand by transient aircraft. Accordingly, the FBO's plan to increase the existing fixed and mobile jet fuel storage capacity by 58 percent (i.e., 14,800 gallons) is sensible and, in the short term, will increase the on-site supply to about 6 days.

3.4.4 Airport Maintenance

As described in **Section 1**, City of Frederick Department of Public Works (DPW) personnel perform general maintenance of the airport, ranging from grass cutting to snow removal to spot patching of pavement. Based upon the consultation with Airport management and DPW Staff, the general airport maintenance will continue to be provided in this manner. A future consolidated maintenance vehicle and equipment storage facility should be located on the Airport for convenient access to the airfield as well as the primary access roadways at FDK. The building should be sized to house two dump trucks, a loader, a snow blower, a snow basket and plows, and a 16-foot snow pusher, with space for light maintenance and restrooms. The approximate size of a building would be 4,000 square feet, with a vehicle parking apron and employee spaces.

3.4.5 Airport Security Fencing

The airfield and landside development areas need to be protected from unauthorized access. The most widely used method of controlling vehicular and pedestrian access is through appropriately located perimeter fencing and automated or manual access gates. There are currently no perimeter security systems or facilities at FDK. FDK is in the process of generating design plans for airport perimeter fencing, which will be included on the final ALP. While the design and construction will be completed as a long-term location, plans should be reviewed during ALP updates to accommodate additional airfield and landside facilities.

3.5 SUMMARY OF FACILITY REQUIREMENTS

The results of the demand/capacity analyses and examination of facility requirements are summarized below.

3.5.1 Airfield

The hourly and annual capacity of the airfield will accommodate projected demand during the study period. FAA guidance indicates that planning for airfield capacity enhancements should be initiated when the forecast is expected to reach 60 to 75 percent of the ASV. The current airfield operational level at FDK is at 56% of ASV. The current forecast of aviation demand estimates the activity level at FDK will be at 63% in 2010, and at 72% in the year 2025. Planning for capacity improvements that are in substantial excess of the future forecast for FDK is generally not warranted and should be deferred until such time the improvement is timely and costs are beneficial.

A turf runway with a minimum of 1,500 feet length, and meeting all FAA safety and separation criteria, should be located on the airfield.

The existing and planned RSAs meet all standards based on ARC C-III criteria for Runway 5-23 and ARC B-II criteria for Runway 12-30.

The OFA at FDK meet the requirements associated with the current use of each runway.

Runway 5-23, as an ultimate C-III runway, would require an additional 60 feet of runway-taxiway separation, to a total of 400 feet, to meet design criteria.

There are no Runway OFZ obstructions to the existing runway, or the extended runway as depicted on the existing ALP.

There would be no penetrations of the inner-approach OFZ surface associated with the MALSF depicted on the existing ALP.

There are no penetrations of the inner-transitional OFZ for existing Runway 23.

The existing airfield provides adequate wind coverage.

For aircraft weighing more than 60,000 pounds, and with a haul length of 1,000 miles, the required runway length was calculated at 6,080 feet. The *Runway Extension and Exit Taxiway Analysis* (October 2003) concluded and recommended that primary Runway 5-23 could be extended from 5,220 feet to a maximum length of 6,000 feet. Runway 5-23 should be developed to a length of 6,000 feet to accommodate current and future aircraft use. The length of Runway 12-30 is adequate for both current and forecast operations.

Both runway widths meet standards and are adequate to serve all aircraft projected to use FDK on a regular basis throughout the study period. Runway 5-23 will accommodate the Design Aircraft, a Gulfstream V, which is in Approach Category C (i.e., approach speed of 121 knots or more but less than 141 knots) and Airplane Design Group III (i.e., wingspan of 79 feet up to but not including 118 feet). Runway 120-30 is a secondary runway, that will serve aircraft in Approach Category B (i.e., 91 knots or more but less than 120 knots) and Design Group II (i.e., wingspan of 49 feet up to but not including 79 feet).

The pavement strength of Runway 5-23 is sufficient to accommodate regular use by the Design Aircraft, a Gulfstream V.

The current runway markings are adequate for the existing non-precision and precision runway approaches.

All taxiways serving an ultimate C-III Runway 5-23 would need to be widened to a width of 50 feet, and the length of lead-ins increased to 150 feet.

Two new aircraft holding aprons would be required in conjunction with the extensions of Runway 5-23.

The existing navigation and visual aids are sufficient to support current and future operations at FDK. Installation of new or additional navigation aids will not improve the current minimums until the critical approach surfaces are clear of obstructions. Once the controlling obstructions are removed, the existing ODALS should be removed and replaced with a MALSF.

The existing VOR site should be retained as the preferred site during planning of future airfield alternatives.

3.5.2 Terminal Area

A section of the terminal area encompassing the Delaplaine building and the Frederick Flight Center building should be designated for redevelopment as an aviation-related use.

The existing airport administrative offices and restaurant should remain in the terminal area, and be retained with other aviation-related tenant uses in a future building designed with an aviation "signature", serving as a gateway to the airport.

Terminal area vehicle parking capacity is not sufficient for peak demand and should be increased by an additional 46 spaces over the study period.

The near-term (Year 2010) demand for additional T-hangar buildings is six 12-unit buildings. The current (Year 2005) demand will increase from two to four, and displacement of two existing T-hangar buildings (i.e., two T-hangars with 22 spaces south of Frederick Community College facility) for runway development will increase the demand by two additional T-hangar buildings.

The current demand for 10,000 square feet of additional open-bay hangar space for high performance aircraft will increase to 70,000 square feet over the study period.

The existing apron areas allocated to based aircraft parking are sufficient to meet future demands.

Transient aircraft parking apron area should be increased by approximately 12,700 square yards, including three rotorcraft positions.

3.5.3 Surface Transportation

The regional access to the airport is sufficient for the 20-year planning period.

3.5.4 Support Facilities

The two preferred locations for a future Airport Traffic Control Tower, analyzed under the 2003 ALP should be incorporated into the alternative plans and evaluated further.

The response time of the off-airport ARFF services is sufficient for the current airfield. Evaluations of future airfield alternatives should include accessibility by emergency response vehicles.

Aviation fuel storage capacity for Avgas (i.e., ten day supply) is sufficient for the 20-year period. However, the current storage capacity (including a combination of underground storage tanks and mobile refueler truck storage) is not sufficient for the 10 year projected growth (i.e., 35%) in based turbine aircraft alone. Accordingly, the FBO's plan to increase the existing fixed and mobile jet fuel storage capacity by 58 percent (i.e., 14,800 gallons) is sensible and, in the short term, will increase the on-site supply to about 6 days.

A future Airport Maintenance Vehicle and Equipment Storage building with approximately 4,000 square feet and a parking apron should be sited on the airport.

Perimeter security fencing and an access control system for the airfield and selected landside facilities should be installed.