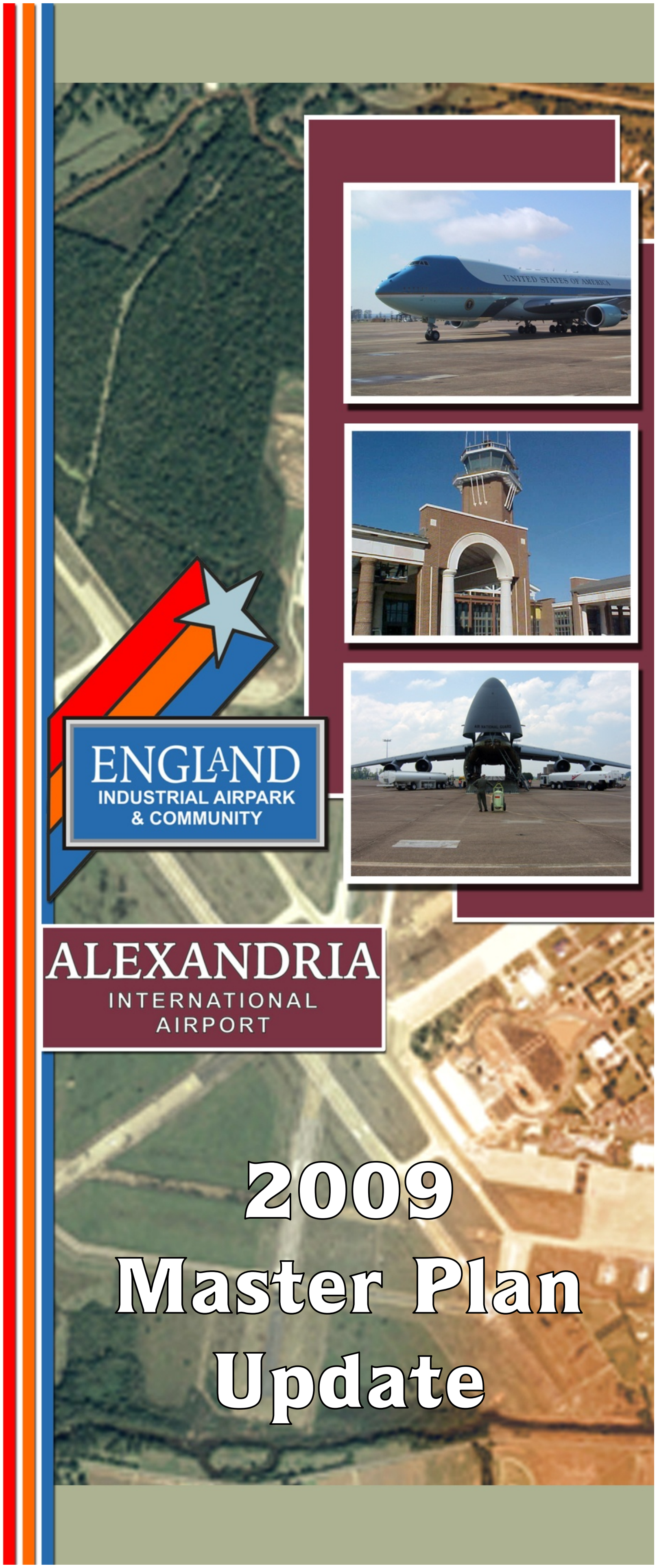


Appendix B
Runway Length Analysis

Appendix B
Runway Length Justification

Airplanes today operate in a variety of different environments and available field lengths. However, the suitability of those runway lengths is governed by the existing and forecast fleet mix, critical aircraft operational requirements, and the following variables:

- Airport elevation above mean sea level
- Mean maximum temperature
- Wind velocity
- Aircraft operating weights
- Takeoff and landing flap settings
- Effective runway gradient
- Runway surface conditions (dry, wet, contaminated, etc.)
- V_1 Engine-Out procedures
- Operational use
- Presence of obstructions within the vicinity of the approach and departure path, and
- Locally imposed noise abatement restrictions and/or other prohibitions

Further, according to FAA guidance, **Advisory Circular 150/5325-4B**, *Runway Length Requirements for Airport Design*, the "design objective for a primary runway is to provide a runway length for all airplanes that will regularly (approximately 500 annual operations) use it without causing operational weight restrictions".[1] The suitability of available runway length at AEX was previously evaluated in the FAA approved *1998 Master Plan Update*. Based upon the critical aircraft at the time, Boeing 747-200, a runway length of 12,000 feet was determined. As a result, a 2,648 foot extension of Runway 14 was illustrated on the FAA approved airport layout plan set.

AEX is equipped with two primary runways according to the criteria outlined in Table 1-2 of **AC 150/5325-4B**. Typically, when 95% wind coverage cannot be captured by the primary runway alone, a secondary or crosswind runway is required. However, in the case of AEX, Runways 14-32 and 18-36 each can accommodate 95 percent wind coverage under 10.5, 13, 16 and 20 knot crosswind conditions. Therefore for airports with two primary runways, typically the operational objectives are to:

- "Better manage the existing traffic volume;
- Accommodate forecast growth, and
- Mitigate noise impacts associated with the existing primary runway".

[1] Section 103, Primary Runways, FAA Advisory Circular 150/5325-4B, Runway Length Requirements for Airport Design, July 1, 2005, page 3.

Again, FAA guidance recommends that the "secondary" primary runway be constructed to the same length, pavement strength and design standards as the primary runway. If, however, the "secondary" primary runway cannot be built to meet Airport critical aircraft dimensional requirements, it should be designed to accommodate the runway length of the most demanding aircraft regularly using it without causing operational weight restrictions. In reviewing the terrain surrounding Runway 18-36, it was considered unrealistic based upon anticipated land acquisition and construction impacts that a runway length of 12,000 feet on Runway 18-36 could be constructed. As a result, runway length requirements for Runway 18-36 were based upon the most demanding aircraft, Boeing 737-700/800 series, which regularly uses this runway.

Although Congress has already appropriated $750 thousand for construction of the extension of Runway 14-32, it was necessary to determine the future aircraft's critical runway length requirements in the absence of weight restrictions based upon updated FAA runway design criteria as outlined in **FAA AC 150/5325-4B**. Therefore, the five step process outlined in the Advisory Circular was utilized to determine the runway length requirements for both Runways 14-32 and 18-36.

B.1 RUNWAY LENGTH REQUIREMENTS FOR AIRPORT DESIGN

The following five-step program was utilized to determine runway length requirements associated with the airport's existing and future critical aircraft. The five steps include:

1. Identify the list of critical design airplanes that will make regular use of the proposed runway for an established period of at least five years.
2. Identify airplanes or family of airplanes that will require the longest runway lengths at maximum certified takeoff weight (MTOW).
3. Using Table 1-1 of **AC 150/5325-4B** and the airplanes identified in Step #2, determine the method that will be used for establishing the recommended runway length based upon useful load and service needs of critical design aircraft or family of aircraft.
4. Select the recommended runway length from among the various runway lengths generated in Step 3 using the process identified in Chapters 2, 3 or 4 of the Advisory Circular, as applicable.
5. Apply any necessary adjustment (i.e. pavement gradient, pavement conditions, etc.).

Based upon this methodology, runway length requirements for both Runways 14-32 and 18-36 were determined.

B.2 STEP 1 – IDENTIFICATION OF CRITICAL DESIGN AIRPLANE(S)

The AC provides the definition of critical design airplanes as the "listing of airplanes (or a single airplane) that would result in the longest recommended runway length".[2] Therefore, to complete Step 1, forecasts of activity associated with specific aircraft and operations were identified for the twenty-year planning period.

[2] AC 150/5325-4B, Chapter 1, page 2, paragraph 102.b.2)

For the purpose of this analysis, the following assumptions were made based upon information obtained from users and historic data:

1. The airport will continue to provide commercial service, and, therefore, remain a Commercial Service Primary Airport, as identified by the NPIAS.
2. The airport will continue to accommodate heavy commercial, cargo and military[3] transport aircraft because of its role as an intermediate staging base for the US Military and regional disaster relief staging area.
3. According to national and international aircraft forecasts (EADS, Honeywell, General Electric (GE), and NBAA), operators are shifting to larger commercial aircraft to offset personnel and fuel costs and obtain greater economies of scale (i.e. revenue per seat and seat mile). Further older jet aircraft models, such as the B747-200, B737-100/200/300, etc. are no longer in production replaced by larger and more efficient models. Examples of this trend are as follows:
    - L1011 aircraft with B767-400ER and A330-300 aircraft
    - B727-100/200/300 and DC-10s with B757-200, A319, A320 and CRJ200 aircraft.
    - MD80s/737-classic models (100/200/300) with A320s and 737-600/700/800 & 900 series, and
    - B767, A310, A300 & DC10s replaced by B787, A330, A350 and B777 aircraft.
4. AEX's historic fleet mix for 2007 provided the baseline data for the types and frequency of operations (**Table B-1**).
5. The more demanding airplane models currently operating at AEX incur operational penalties. For example, some aircraft operate only during cooler temperatures and/or others carry less than desirable fuel, passengers, payload etc. to effectively operate on the shorter runway.
6. Each category of aircraft was projected outward based upon a combination of historical data, local and global trends, discussions with users, data provided in the FAA approved *FAR Part 150 Study*, information from AEX ATC and FAA Enhanced Traffic Management System, as well as DOT Form 41 data for the years 2000 through August 2008 as shown in **Table B-1**.

[3] The US Army has a commercial lease with the England Authority, and the airport is designated as an intermediate staging base (ISB) for Joint Readiness Training Center (JRTC) operations as well as regional disaster relief staging area according to the LaDOTD.

TABLE B-1
FLEET MIX BREAKDOWN BY AIRCRAFT TYPE

Aircraft	ARC	Years			
		2007	2012	2017	2027
A124 - Antonov AN-124 Russian	C-VI	2	2	2	2
Airbus A320/321-300 series	C-III	0	346	424	470
Airbus 330-300/340-500 series	D-V	8	43	75	98
B703 - Boeing 707-300	C-III	2	0	0	0
Boeing 737-200/300/400	C-III	869	356	120	9
Boeing 737-600/700/800	C-III	501	613	712	770
B744 - Boeing 747-400	D-V	47	256	444	575
Boeing 757-200/300	C-III	2	0	0	0
B763 - Boeing 767-300	D-IV	89	53	0	0
DC10 - Boeing (Douglas) DC 10-10/30/40	D-IV	22	12	0	0
DC9	C-III	12	10	3	0
MD80 - Boeing (Douglas) MD 80 Series	C-III	114	89	0	0
L101 - Lockheed L-1011 Tristar	D-IV	10	0	0	0
MD11 - Boeing (Douglas) MD 11	D-IV	17	0	0	0
Subtotal Air Charter		**1,695**	**1,780**	**1,780**	**1,924**
E135 - Embraer ERJ 135/140/Legacy	C-II	530	426	206	0
E145 - Embraer ERJ-145	C-II	1,439	1,276	1,026	555
E45X - Embraer ERJ 145 EX	C-II	81	6	205	370
SF34 - Saab SF 340	C-II	5,466	4,259	3,592	1,850
CRJ2 - Bombardier CRJ-200/Challenger 800	C-II	3,230	2,662	1,681	925
Embraer ERJ 170*	C-II	0	852	1,500	2,775
CRJ-700/701/702*	C-II	7	1,065	2,052	2,775
Subtotal Air Taxi		**10,753**	**10,646**	**10,262**	**9,250**
B732 - Boeing 737-200/VC96	C-III	10	11	12	14
MD10	C-III	2	2	2	3
BE99 - Beech Airliner 99	B-II	6	7	7	8
GA Jet (Gulfstreams II/III/IV/V & Learjet 35/45/60)	C&D-II/III	7,195	9,151	15,986	22,814
GA Turbine	Various	7,244	7,886	8,529	9,506
GA Piston	Various	13,581	13,465	8,469	5,704
Subtotal Freight and General Aviation		**28,038**	**30,522**	**33,004**	**38,049**
Military Helicopter	Various	121	501	528	528
Military Jet (T1,37,38, 45, TEX, Tornado, etc)	C-I & II	4,955	6,978	7,234	7,234
Military Piston	A-I & II	150	619	652	652
Military Turbine	Various	71	296	312	312
C130	C-IV	4,532	4,738	4,880	4,880
C5	D-VI	88	363	382	382
SH330/360	B-II	73	302	318	318
C17A[1]	C-IV	142	29,114	29,984	29,984
Subtotal Military		**10,132**	**42,911**	**44,290**	**44,290**
Total[2]		**50,618**	**85,859**	**89,336**	**93,513**

**Notes:*
[1]According to data provided in FAA approved Part 150 Study and from military personnel, C17 training operations are anticipated to increase to approximately 37,440 over current operations. This is expected throughout the planning period.
[2]May not exactly sum due to rounding.
Sources: FAA Air Traffic Enhanced Management System, 2000, 2007 and 2008; 259th ATC 2007 and 2008 data, AEX Comparative Traffic Data, JP Airline Fleets International, Individual Airline/Carrier aircraft on order, and The LPA Group Incorporated, 2009

Both the FAA approved *1998 Master Plan* and current master plan update confirmed that the airport reference code is and will remain a D-V due to regular operations of the Boeing 747 and other similarly sized aircraft. Further, since significant military transport and training operations regularly occur at AEX as a result of a commercial lease with the England Authority, the runway length analysis, although based upon commercial aircraft operations, must consider the airfield's use by military aircraft.

B.3 STEP 2 – AIRCRAFT REQUIRING THE LONGEST RUNWAY LENGTH AT MTOW

Step 2 of **FAA AC 150/5325-4B** states: "identify the airplanes that will require the longest runway length at maximum certificated takeoff weight (MTOW). This will be used to determine the method for establishing the recommended runway length".[4] When the MTOW of listed airplanes is over 60,000 pounds, the recommended runway length is determined according to individual airplanes. The recommended runway length is a function of the most critical individual airplane's takeoff and landing operating weights, which depend on wing flap settings, airport elevation and temperature, runway surface conditions and effective runway gradient. The procedure assumes that there are no obstructions that would preclude use of the full runway length. Therefore, in accordance with FAA guidance, the critical individual aircraft takeoff and landing operating weights for the B747-400, B737-300 and B747-700 were obtained from Boeing's *Airplane Characteristics for Airport Planning* manuals associated with these specific aircraft (**Table B-2**).

TABLE B-2
CRITICAL AIRCRAFT OPERATING WEIGHTS

Aircraft	Maximum Design Landing Weight (Pounds)	Maximum Design Takeoff Weight (Pounds)
B747-400 (PW4056)	574,000	875,000
B737-300 (CFM56-3B-2 Engines at 22,000 lbs)	114,000	139,500
B737-700 (CFM56-7B24 Engines at 24,200 lbs Standard Load at Standard Thrust (SLST))	129,200	154,500

Source: Boeing Industries Airplane Characteristics for Airport Planning, Boeing 747-400, 737-300 & 737-700

Since the Boeing 747-400 is the most demanding commercial aircraft which regularly uses the airport, it was designated as the critical aircraft for determining the primary runway (Runway 14-32) length requirements. As noted earlier, when an airport is equipped with two primary runways, it is recommended by FAA that they both be designed to accommodate the most demanding aircraft that regularly uses the airport. However, in the case of Runway 18-36, it is unlikely because of land acquisition requirements, environmental impacts, etc. that the 12,000 foot length, as recommended in the FAA approved *1994 Base Reuse Plan* and FAA approved

[4] AC 150/5325-4B, Chapter 1, Page 2, Paragraph 102.b.2

1998 Master Plan, could be accommodated. Therefore, the B737 was established as the critical aircraft for runway length requirements on Runway 18-36.

B.4 STEP 3 – METHOD NEEDED FOR RECOMMENDED RUNWAY LENGTH ANALYSIS

Step 3 of **FAA AC 150/5325-4B** (Chapter 1, Pg 2, Paragraph 102.b.3) states: "Use Table 1.1 (found in **AC 150/5325-4B**) and the airplanes identified in Step 2 (**Table B-2**) to determine the method that will be used for establishing the recommended runway length".

For reference, **Table B-3** reflects the information contained in Table 1.1 of the AC (Chapter 1, Pg. 3). All of the critical design airplanes previously presented in **Tables B-2** have a MTOW greater than 60,000 lbs. Since the critical aircraft (B747 and B737) fall into the family of aircraft greater than 60,000 lbs, then the procedures outlined in **Chapter 4**, Runway *Lengths for Regional Jets and those Airplanes with a Maximum Certified Takeoff Weight of more than 60,000 lbs (27,200 KG),* were used to determine the recommended runway length requirements. Aircraft performance tables associated with the B747-400 series and B737-300 and 700 series were obtained from Boeing Commercial Aircraft's FAR/JAR performance manuals.

TABLE B-3
AIRPLANE WEIGHT CATEGORIZATION FOR RUNWAY LENGTH REQUIREMENTS

<table>
<tr><th colspan="3">Airplane Weight Category
Maximum Certificated Takeoff Weight (MTOW)</th><th>Design Approach</th><th>Location of Design Guidelines</th></tr>
<tr><td rowspan="4">12,500 pounds or less</td><td colspan="2">Approach Speed less than 20 knots</td><td>Family Grouping of Small Airplanes</td><td>Chapter 2; Paragraph 203</td></tr>
<tr><td colspan="2">Approach Speeds of at least 30 knots but less than 50 knots</td><td>Family Grouping of Small Airplanes</td><td>Chapter 2; Paragraph 204</td></tr>
<tr><td rowspan="2">Approach Speeds of 50 knots or more</td><td>With Less than 10 Passengers</td><td>Family Grouping of Small Airplanes</td><td>Chapter 2; Paragraph 205; Figure 2-1</td></tr>
<tr><td>With More than 10 Passengers</td><td>Family Grouping of Small Airplanes</td><td>Chapter 2; Paragraph 205; Figure 2-2</td></tr>
<tr><td colspan="3">Over 12,500 pounds but less than 60,000 pounds</td><td>Family Grouping of Large Airplanes</td><td>Chapter 3; Figure 3-1 or 3-2[a] and Tables 3-1 or 3-2</td></tr>
<tr><td colspan="3">60,000 pounds or more or Regional Jets
(Selected Category)</td><td>Individual Large Airplane</td><td>Chapter 4; Airplane Manufacturer Websites (Appendix 1)</td></tr>
</table>

Source: FAA AC 150/5325-4B.
Notes:
a) When the design airplane's airport planning manual (APM) shows a longer runway length than what is shown in Figure 3-2 (AC 150/5325-4B), use the airplane manufacturer's APM. However, users of an APM are to adhere to the design guidelines found in Chapter 4 (AC 150/5325-4B).

B.5 STEPS 4 AND 5 – DETERMINE RECOMMENDED RUNWAY LENGTH

The recommended runway length for this weight category is based upon the specific aircraft performance charts published by airplane manufacturers. Both takeoff and landing length requirements must be determined with applicable length adjustments in order to determine the recommended runway length. The longest of the takeoff and landing runway length requirements for the critical design airplanes under evaluation becomes the recommended runway length.

B.5.1 Runway 14-32 Runway Length Requirements

Using the guidance outlined in Chapter 4, *Runway Lengths for Regional Jets and Those Airplanes with Maximum Certificated Takeoff Weight of more than 60,000 Pounds (27,200 KG)* of **AC 150/5325-4B**, it was necessary to determine both the most demanding takeoff and landing runway length requirements and then apply any runway length adjustments associated with Alexandria International Airport (i.e. temperature, airport pressure, airport elevation, pavement condition, grade changes, etc). Since the B747-400 is anticipated to be the most widely used and demanding aircraft over the planning period, this aircraft was used to determine both the critical runway takeoff and landing length requirements.

<u>Takeoff Length Requirements</u>

To accurately determine takeoff length requirements, the takeoff chart for the B747-400 (PW4056 engines) with dry runway, zero wind, and zero effective runway gradient conditions within the airport's mean daily maximum temperature of the hottest month at the airport was used. Then the operating takeoff weight equal to maximum certificated takeoff weight was identified on the chart (**Exhibit B-1**). Note for Federally funded projects, "the airport designer must take into account the length of haul (range) that is flown by airplanes on a *substantial* use basis. The length of haul range will determine the operating takeoff weight for the design airplanes under evaluation."[5] For long-haul routes, the operating takeoff weight should equal maximum takeoff weight (MTOW). Also, for length of haul ranges that equal or exceed the Payload Break point, the operating takeoff weight is set to equal MTOW.

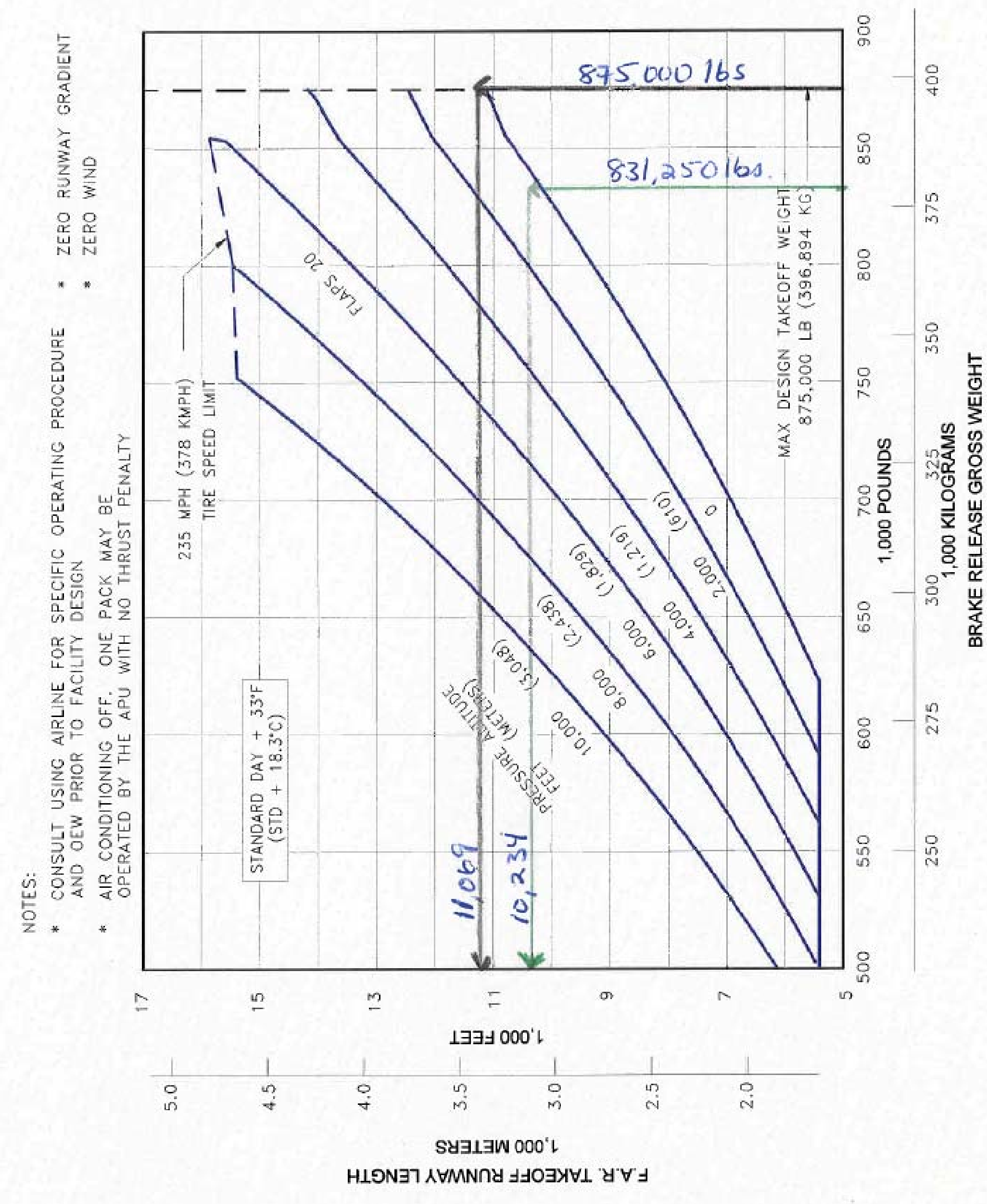
Based upon these criteria, 100 percent and 95 percent useful load factors were evaluated. This is specifically because AEX is not only a commercial service airport but is a military intermediate staging facility for national and international operations and disaster relief staging area for the southeast United States. **Table B-4** and **Exhibit B-1** illustrate the takeoff length requirements associated with Runway 14-32.

[5] Page 19 (2) – FAA Advisory Circular 150/5325-4B

TABLE B-4 FAR TAKEOFF FIELD LENGTH REQUIREMENTS B747-400	
Design Condition	**Data**
Airplane	747-400 (PW4056)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	574,000 pounds
Maximum design takeoff weight[3]	875,000 pounds
95% design takeoff weight[3]	831,250 pounds
Maximum difference in runway centerline elevations[2]	4.2 feet (Rwy 32 = 88.5 ft; Rwy 14 = 84.3 ft)
FAR Takeoff Field Length Requirements 100% Useful Load	
Takeoff Length with 20 degree flap setting @ 92°F[3]	11,000 feet
Adjusted Takeoff Length for Elevation (dry pavement)[4]	11,069 feet
Adjusted Takeoff Length for runway grade change	11,111 feet
Adjusted Takeoff Length for wet pavement[5]	12,778 feet
FAR Takeoff Field Length Requirements 95% Useful Load	
Takeoff Length with 20 degree flap setting @ 92°F[3]	10,171 feet
Adjusted Takeoff Length for Elevation (dry pavement)[4]	10,234 feet
Adjusted Takeoff Length for runway grade change	10,275 feet
Adjusted Takeoff Length for wet pavement[5]	11,816 feet
Recommended Takeoff Length Required	**12,000 feet**

Notes:
[1] Obtained from 10+Years of NOAA Temperature Data (1996-2007)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B747-400 Airplane Characteristics for Airport Planning
[4] Graphic FAR Takeoff Runway Length Requirements – Standard Day + 33°F
*[5]Wet pavement conditions = 1.15 * Dry Pavement requirements.*
Sources: Boeing Industries B747-400 Airplane Characteristics for Airport Planning AC (December 2002), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Exhibit B-1
JAR/FAR Takeoff Length Requirements Graphic
Boeing 747-400



3.3.4 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY +33°F (STD + 18.3°C)

MODEL 747-400 (PW4056 ENGINES)

Sources: Boeing Airplane Design Manual for Planning, B747 Aircraft, December 2002 and The LPA Group Incorporated, 2008

Landing Length Requirements

Landing length requirements were determined by obtaining the landing chart for the B747-400 with the highest flap setting (30 degrees), zero wind, and zero effective runway gradients. The maximum certificated landing weight was entered onto the horizontal weight axis, and a vertical line was drawn to the airport elevation curve. The point where it intersects the runway length was used as the "dry runway" curve. Note that runway length requirements associated with "wet" conditions are required for turbojet-powered airplanes. Since a "wet runway" curve did not exist, the dry landing length was adjusted upward by 15 percent.

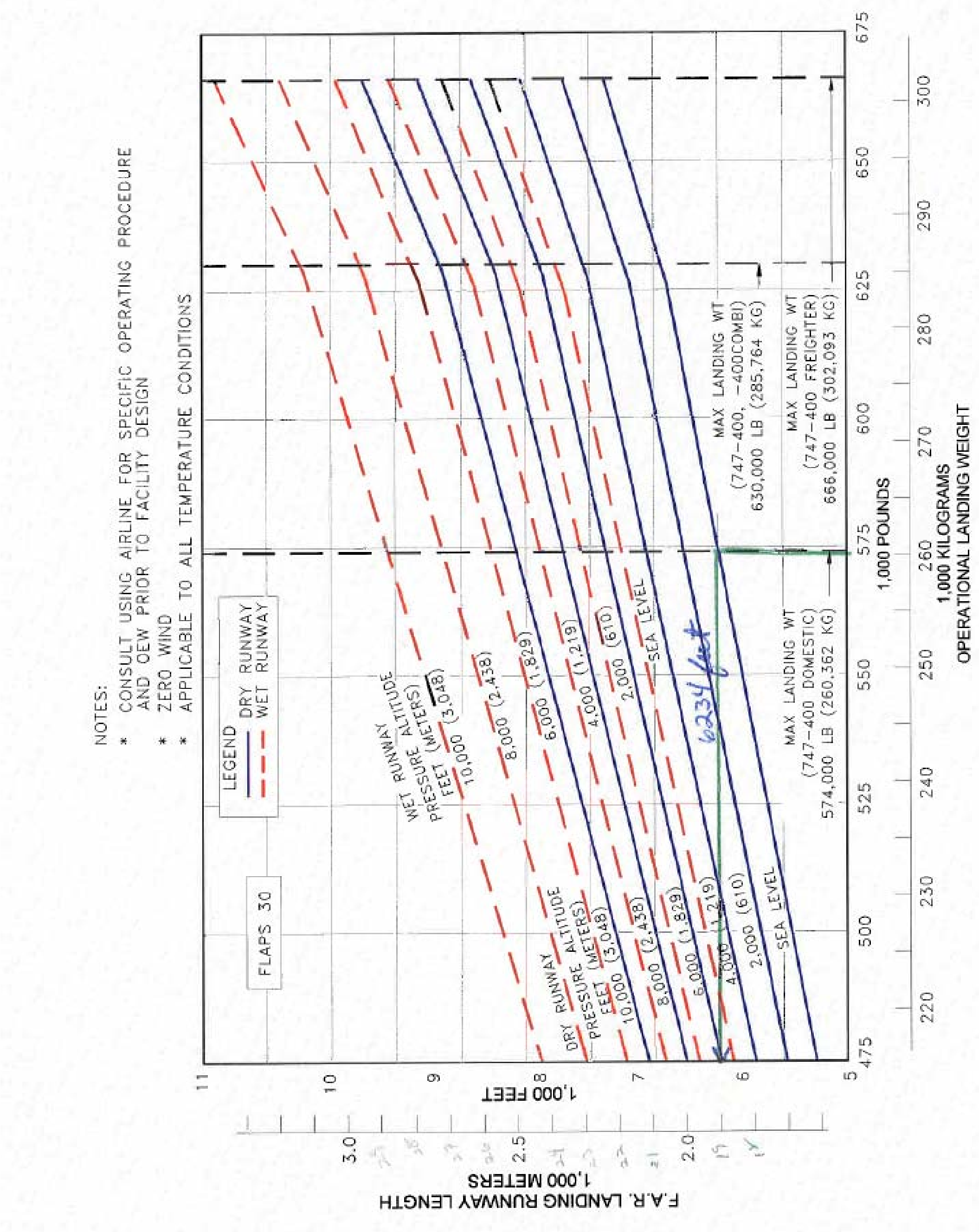
The landing length requirements for the Boeing 747-400 for both dry and wet pavement are denoted in **Table B-5** and illustrated in **Exhibit B-2**.

TABLE B-5
FAR LANDING FIELD LENGTH REQUIREMENTS B747-400

Design Condition	Data
Airplane	747-400 (PW4056)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	574,000 pounds
Maximum design takeoff weight[3]	875,000 pounds
95% design takeoff weight[3]	831,250 pounds
Maximum difference in runway centerline elevations[2]	4.2 feet (Rwy 32 = 88.5 ft; Rwy 14 = 84.3 ft)
FAR Landing Field Length Requirements	
ISO FAR Landing Field Length Requirements[3] flaps at 30 degrees[4]	6,234 feet
Adjusted Length for Elevation (dry pavement)[5]	6,273 feet
Adjusted Length for wet pavement conditions[6]	7,214 feet
Recommended Landing Length Required	**7,200 feet**

Notes:
[1] Obtained from 10+Years of NOAA Temperature Data (1996-2007)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B747-400 Airplane Characteristics for Airport Planning and already includes 60 percent landing length requirement per FAR Part 121.
[4] Graphic FAR Landing Length Requirements – Flaps 30
[5] Adjusted length for elevation based upon following formula (FAA Central Region, 2005):
Adjusted length for elevation = 7% per 1000 feet above sea level (L_1=((.07*E/1000)*L)+L)
Do not have to adjust for temperature since FAA Headquarters recommends using Maximum Landing Weight for runway length calculations.[6] Wet pavement conditions = 1.15 * Dry Pavement requirements.
Sources: Boeing Industries B747-400 Airplane Characteristics for Airport Planning AC (December 2002), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Exhibit B-2
JAR/FAR Landing Length Requirements Graphic
Boeing 747-400



3.4.2 F.A.R. LANDING RUNWAY LENGTH REQUIREMENTS - FLAPS 30
MODEL 747-400, -400 COMBI, -400 DOMESTIC, -400 FREIGHTER

Sources: Boeing Airplane Design Manual for Planning, B747 Aircraft, December 2002 and The LPA Group Incorporated, 2008

Applying FAA runway length guidance, manufacturer FAR Takeoff and Landing Length requirements, and adjusting for temperature, maximum difference in runway centerline elevations, airport elevation, wet pavement, etc., a runway length of 11,816 feet is required at 95 useful load, which would be rounded to **12,000 feet** since it is exceeds the 300-foot threshold required in the AC. Thus, the FAA approved runway length of 12,000 feet is warranted to support critical aircraft operations at AEX.

B.5.2 Runway 18-36 Runway Length Requirements

As discussed in **Chapter 4**, Runway 18-36 is designated, according to FAA guidelines outlined in **FAA AC 150/5325-4B,** as an additional primary runway. As summarized in the AC, the following runway length guidelines are suggested for determining the runway length of additional primary runways:

RUNWAY LENGTH FOR ADDITIONAL PRIMARY RUNWAYS

Runway Service Type, User	Runway Length for Additional Primary Runway Equals
Capacity Justification, Noise Mitigation, Regional Jet Service	100% of the Primary Runway
Separating Airplane Classes – Commuter, Turboprop, General Aviation, Air Taxis, etc.	Recommended runway length for the less demanding airplane design group or individual design airplane.

Source: Table 1-2, Runway Length for Additional Primary Runway, FAA AC 150/5325-4B, 07/01/2005

Based upon the airport's various roles, FAA previously approved *1998 Airport Master Plan*, and discussions with 259th ATC personnel, Runway 18-36 is primarily used to separate aircraft classes especially during peak period and disaster relief efforts. The FAA approved *1998 Master Plan* designated the critical design aircraft for Runway 18-36 as the DC-10 (ARC D-IV). In reviewing historic data, the DC-10 aircraft, which went out of production in 1989, have been replaced by the B737 and the A320 models. Further, as discussed within the Demand/Capacity section of Chapter 4, the use of Runway 18-36 by both corporate general aviation and military operations, specifically the C-130, are forecast to increase in the short-term.

Currently, the B737-300 model is the critical aircraft for runway length associated with Runway 18-36, which has an ARC of C-III. However, the design requirements for Runway 18-36 will remain a D-IV because of its continued substantive use by C-130, C-17 and GA/corporate aircraft, specifically the Learjet 60 and Gulfstream II, IV and V aircraft.

Takeoff Length Requirements

Runway takeoff and landing lengths for both the B737-300 and B737-700 aircraft were evaluated. The B737-300 aircraft are no longer in production and are slowly being phased out and replaced by the newer B737-700. In reviewing charter operations from 2002 through August 2008, the number of B737-100/200 and 300 model aircraft have slowly been declining and replaced by the new 737-700/800 and 900 models. It was, therefore, anticipated based upon discussions with existing users of the older model aircraft including Ryan Air, Miami Air International and the U.S. Marshals service that over the twenty-year planning period operations will continue to shift to the newer Boeing models. As of 2007, the B737-700 model represents approximately 30 percent of current air charter operations. Since it is anticipated that any extension of Runway 18-36 will not occur before the mid-term (2012-2017) timeframe, it is recommended that runway length requirements be based upon the newer Boeing 737 models.

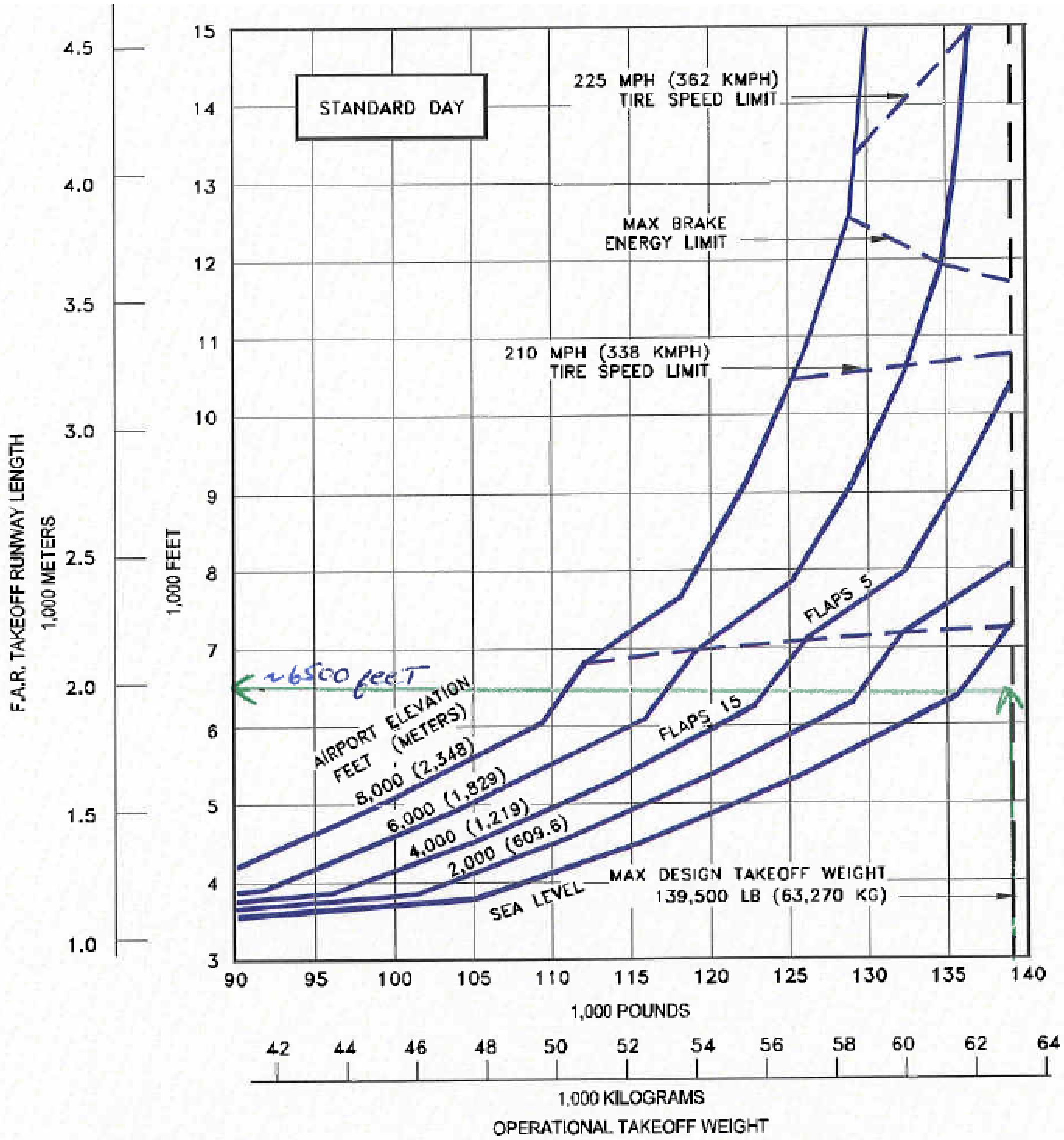
Utilizing the takeoff charts for the B737-300 (CFM56 B-2 Engines at 22,000 lbs) and the B737-700 (CFM56-7B24 Engines at 24,200 lb SLST), the adjusted takeoff lengths for both aircraft were determined as summarized in **Tables B-6 and B-7** and supported by **Exhibits B-3 and B-4**, respectively.

TABLE B-6
FAR TAKEOFF FIELD LENGTH REQUIREMENTS B737-300

Design Condition	Data
Airplane	737-300 (CFM56-3B-2 Engines@ 22,000 lbs)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	114,000 lbs[2]
Maximum design takeoff weight[3]	139,500 lbs[2]
Maximum difference in runway centerline elevations[2]	3.3 feet
Recommended Takeoff Length Requirements	
ISO Takeoff Length at 15° Flap[3]	~6,500 feet
Adjusted Takeoff Length for Temperature and Elevation (dry pavement)	7,627 feet
Adjusted Takeoff Length for runway grade change	7,660 feet
Adjusted Takeoff Length for wet pavement[4]	8,808 feet

Notes:
[1] Obtained from 10 Years of NOAA Temperature Data (1996-2007)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B737Airplane Characteristics for Airport Planning, December 2005
[4]Wet pavement conditions = 1.15 * Dry Pavement requirements.
Sources: [1]*National Oceanic and Atmospheric Administration, 1996-2007*
[2]*Boeing 737Design Manual, and airport survey data, 2007*
Boeing Industries, 737-100/200/300/400/500/600/700/800 and 900 Airplane Characteristics for Airport Planning AC (December 2005), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Exhibit B-3
JAR/FAR Takeoff Length Requirements Graphic
Boeing 737-300



3.3.13 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS
STANDARD DAY
MODEL 737-300 (CFM56—3B-2 ENGINES AT 22,000 LB SLST)

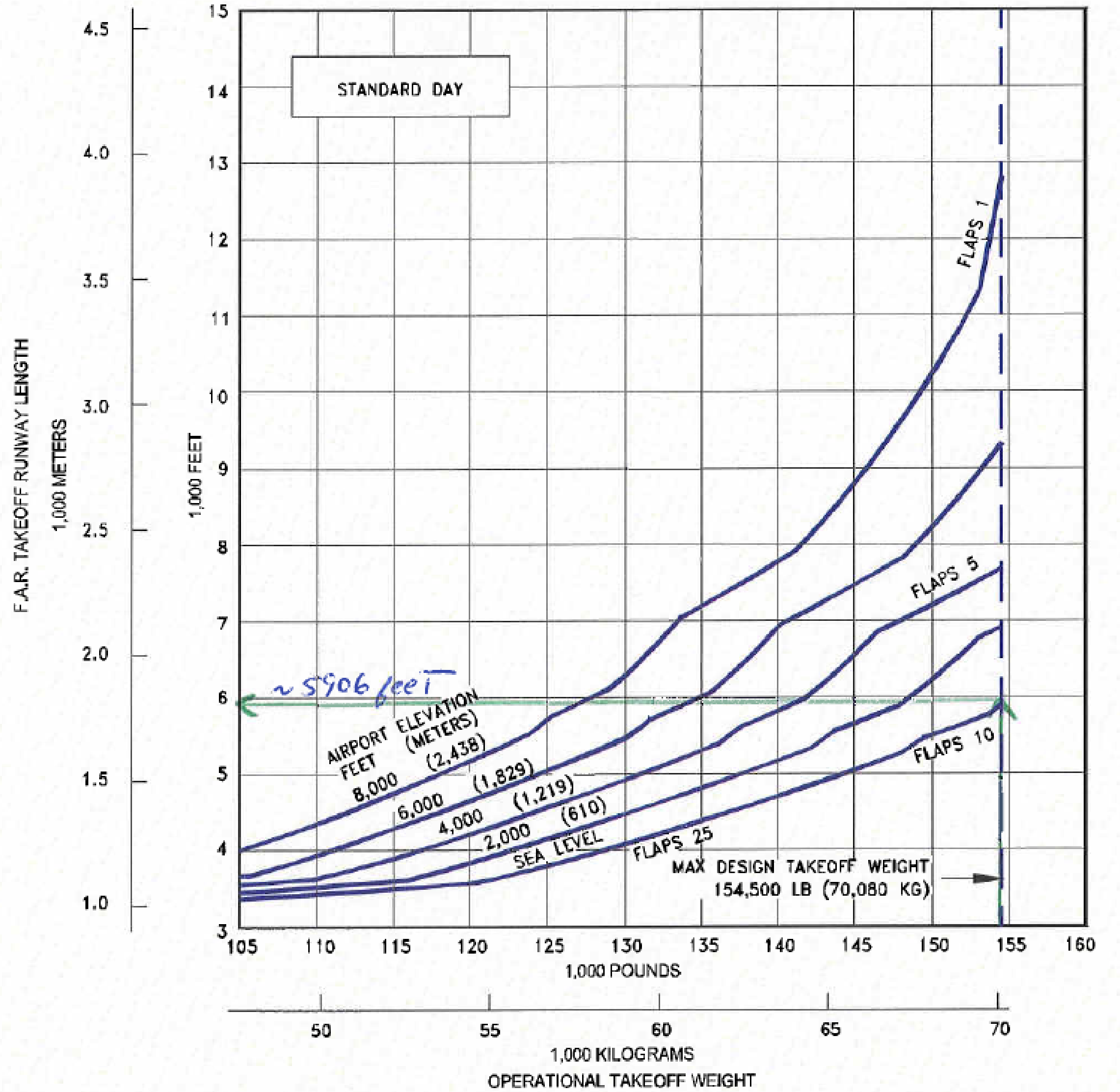
Sources: Boeing Airplane Design Manual for Planning, B737 Aircraft, October 2005 and The LPA Group Incorporated, 2008

TABLE B-7 FAR TAKEOFF FIELD LENGTH REQUIREMENTS B737-700	
Design Condition	**Data**
Airplane	737-700 (CFM56-7B24 Engines at 24,200 lb SLST)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	129,200 lbs[2]
Maximum design takeoff weight[3]	154,500 lbs[2]
Maximum difference in runway centerline elevations[2]	3.3 feet
Recommended Takeoff Length Requirements	
ISO Takeoff Length[3]	5,906 feet
Adjusted Takeoff Length for Temperature and Elevation (dry pavement)*	6,930 feet
Adjusted Takeoff Length for runway grade change	6,963 feet
Adjusted Takeoff Length for wet pavement[4]	8,008 feet
Recommended Takeoff Length Required	**8,008 feet**

Notes:
[1] Obtained from 10 Years of NOAA Temperature Data (1997-2008)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B737-700 Airplane Characteristics for Airport Planning
* ISO landing length according to manual was for all temperatures, so no adjustment needed
[4]Wet pavement conditions = 1.15 * Dry Pavement requirements.
Sources: [1]*National Oceanic and Atmospheric Administration, 1996-2007*
[2]*Boeing 737 Design Manual, and airport survey data, 2007*
Boeing Industries, 737-100/200/300/400/500/600/700/800 and 900 Airplane Characteristics for Airport Planning AC (December 2005), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Although the FAA recommends that the aircraft with the longer length requirement be utilized to determine the effective runway length, in the case of Runway 18-36, a length of 8,008 feet is recommended. This is supported by the continuing trend toward newer and more efficient aircraft in conjunction with the planned timing for the extension.

Exhibit B-4
JAR/FAR Takeoff Length Requirements Graphic
Boeing 737-700



3.3.51 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS
STANDARD DAY, DRY RUNWAY
MODE L 737-700 (CFM56-7B24 ENGINES AT 24,200 LB SLST)

Sources: Boeing Airplane Design Manual for Planning, B737 Aircraft, October 2005 and The LPA Group Incorporated, 2008

Landing Length Requirements

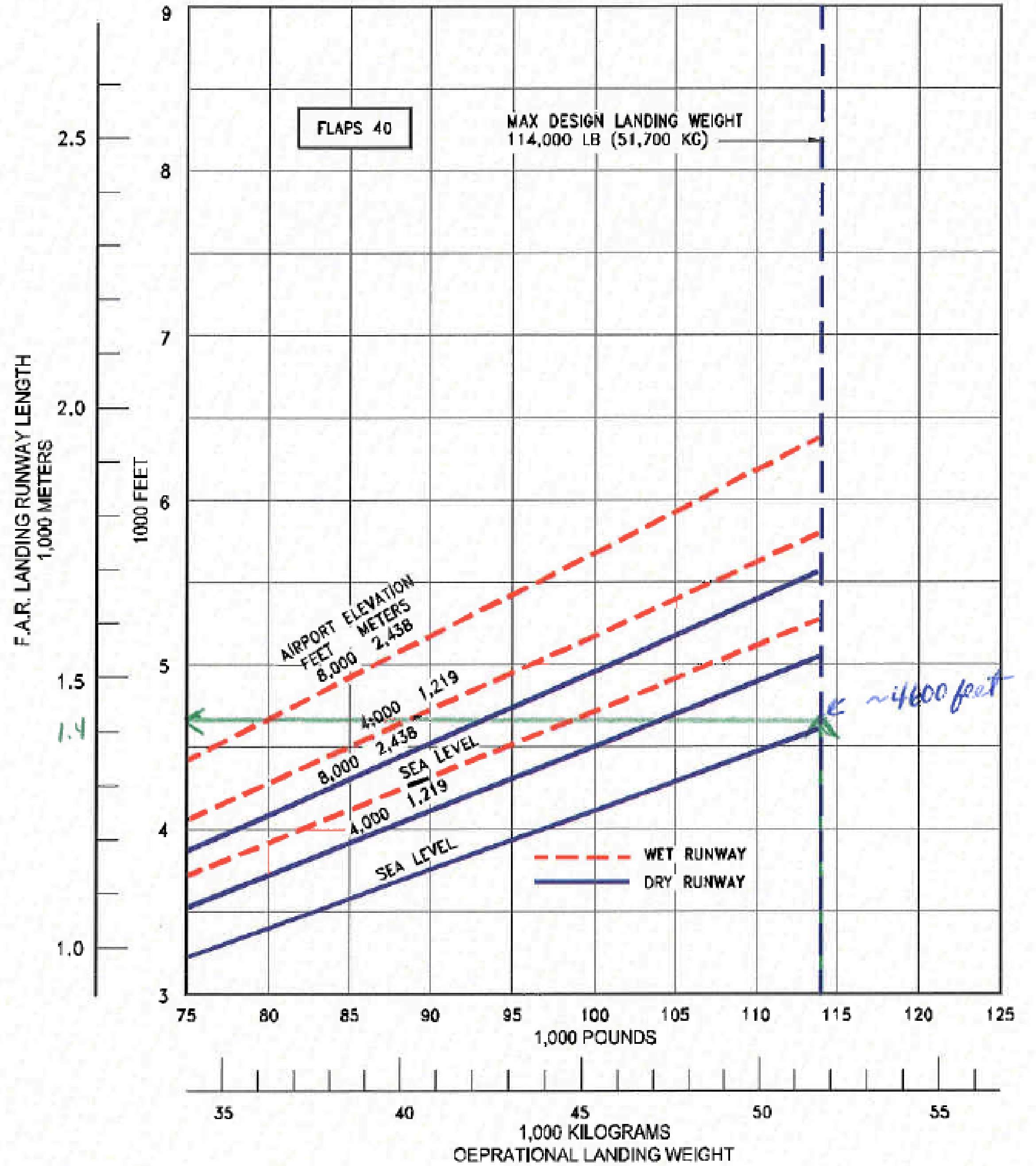
The landing length requirements for both the B737-300 and B737-700 were evaluated to determine the critical runway landing length associated with both aircraft. In applying the elevation, runway grade change and wet pavement requirements to the Landing Length Airplane Characteristics graphs for each aircraft, the B737-700 requires approximately 100 feet more length for landing than the older B737-300. This can be directly traced to the higher certificated landing weight on the B737-700 as compared to the B737-300. However, due to runway lighting separation requirements, it was determined that a 5,400 foot runway could support operations of both aircraft. The landing length requirements and supporting graphics are provided in **Tables B-8 and B-9** and **Exhibits B-5 and B-6**, respectively.

TABLE B-8
FAR LANDING FIELD LENGTH REQUIREMENTS B737-300

Design Condition	Data
Airplane	737-300 (CFM56-3B-2 Engines@ 22,000 lbs)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	114,000 lbs[2]
Maximum design takeoff weight[3]	139,500 lbs[2]
Maximum difference in runway centerline elevations[2]	3.3 feet
Recommended Landing Length Requirements	
ISO FAR Landing Field Length Requirements at Flaps 40[3]	4,600 feet
Adjusted Length for Elevation (dry pavement)[4]	4,629 feet
Adjusted Length for wet pavement conditions[5]	5,323 feet
Recommended Landing Length Required	**5,400 feet**

Notes:
[1] Obtained from 10 Years of NOAA Temperature Data (1996-2007)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B737Airplane Characteristics for Airport Planning, December 2005
[4]Landing Length adjusted for elevation only since FAA Headquarters recommends using maximum design landing weight for calculating length. With higher temperatures, landing operating weights would decrease. Therefore, this is the more conservative method.
[5]Wet pavement conditions = 1.15 * Dry Pavement requirements.
Sources: [1]*National Oceanic and Atmospheric Administration, 1996-2007*
[2]*Boeing 737Design Manual, and airport survey data, 2007*
Boeing Industries, 737-100/200/300/400/500/600/700/800 and 900 Airplane Characteristics for Airport Planning AC (December 2005), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Exhibit B-5
JAR/FAR Landing Length Requirements Graphic
Boeing 737-300



3.4.10 F.A.R. LANDING RUNWAY LENGTH REQUIREMENTS - FLAPS 40
MODEL 737-300

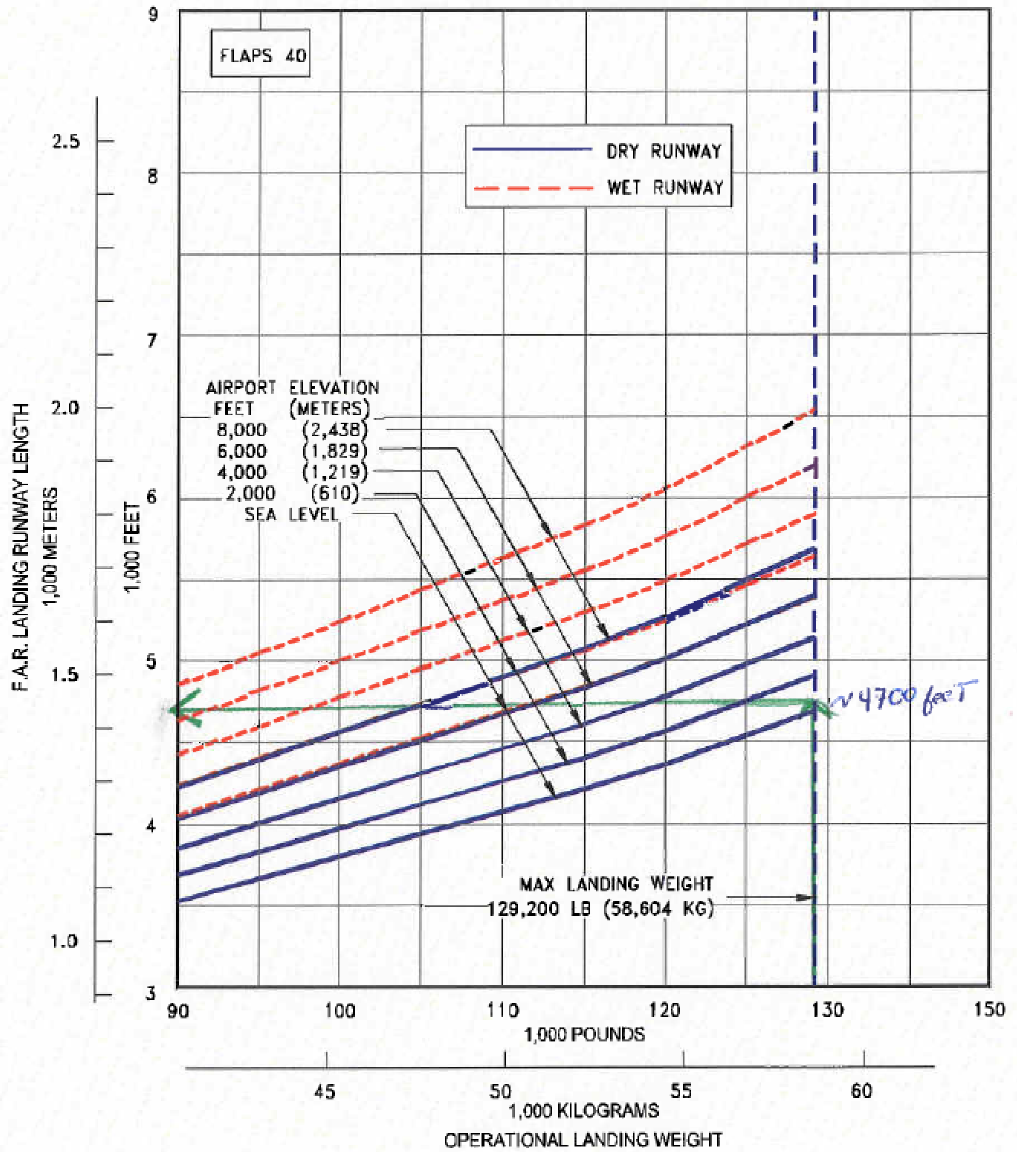
Sources: Boeing Airplane Design Manual for Planning, B737 Aircraft, October 2005 and The LPA Group Incorporated, 2008

TABLE B-8 FAR LANDING FIELD LENGTH REQUIREMENTS B737-700	
Design Condition	**Data**
Airplane	737-700 (CFM56-7B24 Engines at 24,200 lb SLST)
Mean daily maximum temperature of hottest month at airport[1]	91.9° Fahrenheit (33.27° C) [1]
Airport Elevation[2]	89 feet above MSL
Maximum design landing weight[3]	129,200 lbs[2]
Maximum design takeoff weight[3]	154,500 lbs[2]
Maximum difference in runway centerline elevations[2]	3.3 feet
Recommended Landing Length Requirements	
ISO FAR Landing Field Length Requirements – Flaps 40[3]	4,700 feet
Adjusted Length for Elevation (dry pavement)[4]	4,729 feet
Adjusted Length for wet pavement conditions[5]	5,438 feet
Recommended Landing Length Required	**5,400 feet**

Notes:
[1] Obtained from 10 Years of NOAA Temperature Data (1997-2008)
[2] Obtained from 1998 Airport Layout Plan and Survey Data
[3] Data obtained from B737-700 Airplane Characteristics for Airport Planning
* ISO landing length according to manual was for all temperatures, so no adjustment needed
[4]Landing Length adjusted for elevation only since FAA Headquarters recommends using maximum design landing weight for calculating length. With higher temperatures, landing operating weights would decrease. Therefore, this is the more conservative method.
[5]Wet pavement conditions = 1.15 * Dry Pavement requirements.

Sources: [1]*National Oceanic and Atmospheric Administration, 1996-2007*
[2]*Boeing 737 Design Manual, and airport survey data, 2007*
Boeing Industries, 737-100/200/300/400/500/600/700/800 and 900 Airplane Characteristics for Airport Planning AC (December 2005), National Oceanic and Atmospheric Administration, 2007, FAA AC 150/5325-4B, 1998 Airport Layout Plan, URS Greiner, AirNav.com and The LPA Group Incorporated, 2008

Exhibit B-6
JAR/FAR Landing Length Requirements Graphic
Boeing 737-700



3.4.22 F.A.R. LANDING RUNWAY LENGTH REQUIREMENTS - FLAPS 40
MODEL 737-700

Sources: Boeing Airplane Design Manual for Planning, B737 Aircraft, October 2005 and The LPA Group Incorporated, 2008

B.6 SUMMARY

The results of the runway length analyses supports the findings and recommendations delineated in the FAA approved *1994 Base Reuse Plan*, FAA approved *1998 Master Plan*, and FAA approved *2007 FAR Part 150 Study*. Utilizing the manufacturer runway length data associated with the Boeing 747-400, Boeing 737-300 and Boeing 737-700 aircraft, the extension of Runway 14-32 as previously recommended in FAA approved reports is still valid based upon forecast aircraft operations and the requirements outlined in **FAA Advisory Circular 150/5325-4B**.

An extension of Runway 18-36 is also recommended. First, to accommodate aircraft which regularly use the runway and that require a length of 8,008 feet. Second, because of the airport's unique roles as a commercial aviation center, disaster relief and military intermediate staging area, Runway 18-36 must support operations when Runway 14-32 is inoperable either due to accident, maintenance or construction. Further, by providing a longer runway on Runway 18-36 allows ATC greater flexibility during various operational conditions, which increases the overall airfield capacity and operational safety.

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