Chapter 4
FACILITY REQUIREMENTS
Colorado Springs Airport

INTRODUCTION

This chapter summarizes the facilities and associated land areas required to accommodate the forecast aviation demand presented in Chapter 3. Facility requirements were developed for the airfield (runways, taxiways, and navigational aids), the passenger terminal complex, ground access, air cargo, general aviation, and aviation support facilities.

Planning Activity Levels

Forecasts of enplaned passengers, air cargo tonnage and aircraft operations were developed for the forecast horizon years. However, many variables can affect the achievement of forecasts such as regional, national, and international economic conditions and changes in airline service patterns. For the Master Plan, it is prudent to use a strategic planning approach whereby Planning Activity Levels (PALs) are used to determine the timing for future airport development projects. Table 4-1 depicts the PALs for major forecasted activity components.

PAL 1, PAL 2, PAL 3 correspond to the original baseline aviation demand forecast for 2019, 2029, and 2035.[1] The aviation demand associated with each planning activity level is summarized in Table 4-1.

Future Flight Schedules

Detailed aircraft flight schedules provide a planning-level synopsis of future aviation activity (peak periods, time-of-day, departures and arrivals, fleet mix, etc.) and are used to support analytical and simulation modeling efforts. Flight schedules were developed for this analysis to generate, as appropriate, the facility requirements contained in this report.

A detailed flight schedule representing Airport activity in the base year (2009) was prepared using existing patterns of aviation activity and operational assumptions developed for the Master Plan Update. Future flight schedules for each PAL were derived from the base year flight schedule by applying growth rate factors based on forecast assumptions.

[1] Appendix D to this document provides a summary of the planning implications associated with PAL4. PAL4 is based on an alternate scenario of forecast demand, as described in Appendix D of this master plan.

Table 4-1
SUMMARY OF PLANNING ACTIVITY LEVELS
Colorado Springs Airport

	2009	PAL 1 (2019)	PAL 2 (2029)	PAL 3 (2035)
Enplaned passenger				
Mainline	255,950	306,500	392,000	445,200
Regional affiliate	640,977	849,500	1,141,700	1,308,500
Low cost carrier	32,673	59,200	111,200	156,800
Total	929,600	1,215,200	1,644,900	1,910,500
Passenger airline departures				
Mainline	2,287	2,640	3,310	3,710
Regional affiliate	13,718	16,100	19,400	20,700
Low cost carrier	249	500	930	1,310
Total	16,254	19,240	23,640	25,720
Air cargo tonnage				
Integrated carrier	11,310	13,770	16,470	18,110
Regional feeder	116	120	130	130
Total	11,426	13,890	16,600	18,240
Aircraft operations				
Passenger airline				
Mainline	4,574	5,280	6,620	7,420
Regional affiliate	27,436	32,200	38,800	41,400
Low cost carrier	498	1,000	1,860	2,620
Subtotal	32,508	38,480	47,280	51,440
All-cargo airline	1,652	1,640	1,660	1,660
General aviation				
Itinerant	34,739	39,350	44,870	48,590
Local	33,672	37,630	42,760	46,330
Subtotal	68,411	76,980	87,630	94,920

Note: According to the original baseline forecast, PAL1 would occur around 2019, PAL 2 at 2029 and PAL3 at 2035; based on the 2013 forecast update, PAL1 would occur beyond the end of the planning horizon.
Source: Master Plan Update forecasts—LeighFisher, October 22, 2010.

Summary of Requirements

Facility requirements are organized according to functional areas of the Airport, as summarized in Table 4-2. As shown in Table 4-2, many Airport facilities currently have sufficient capacity to accommodate forecast activity levels throughout the planning period. However, a number of facilities will need to be modified or expanded throughout the planning period to accommodate future activity, improve Airport operational capabilities or levels of service, or meet key design standards. Potential deficiencies in facilities are highlighted in blue on Table 4-2.

Notable requirements over the course of the forecast period include:

- **Airfield –** The existing airfield facilities provide sufficient capacity to accommodate baseline forecast aircraft operations through PAL 3. Existing air traffic control facilities at the Airport are sufficient to effectively support airfield and airspace operations at the Airport through the end of the planning period. The intersection of Runway 17R-35L and Runway 13-31 should also be addressed from a geometrical perspective because the unique layout could lead to potential runway incursions. In addition, an extension to Runway 17R-35L should be considered to better serve the Airport when Runway 17L-35R is unavailable. Analyses of weather data for the Airport indicate a need to enhance the instrument landing systems to Category II/III capability.

- **Passenger terminal –** The existing passenger terminal footprint is adequate to serve the projected needs of the Airport throughout the planning period. Future requirements project the need for targeted improvements to specific functional elements such as the passenger security screening facilities.

- **Ground transportation –** The public parking lot may need to be expanded as PAL2 is realized. In addition, the rental car ready/return lot may need expansion at or around PAL3. Other ground transportation facilities appear to be adequate throughout the planning period.

- **Air cargo –** No cargo expansion is likely to be required for the duration of the planning period. However, to ensure that additional carriers can be accommodated should market demand prove necessary, additional cargo space should be reserved on the Airport.

- **General aviation –** Forecast general aviation demand will not necessitate an increase in total land area dedicated to general aviation, although additional hangar capacity may be needed to accommodate growth in demand, as early as PAL 1. In addition, general aviation administrative space and automobile parking may need to be expanded sequentially at PAL1 and PAL2, respectively.

- **Aviation support –** Aviation support facilities appear to be capable of accommodating PAL 3 demand with only minor improvements over the planning period, as necessary.

Additional facility requirements and more robust discussions of assumptions and findings are provided in each of the following sections. In summary, the Airport is in excellent condition to accommodate PAL 3 demand with selected improvements to be made throughout the planning period.

Table 4-2
FACILITIES REQUIREMENTS SUMMARY
Colorado Springs Airport

	Existing	PAL 1	PAL 2	PAL 3
AIRFIELD				
Critical aircraft—airfield design	B-757-200	B-757-200	B-757-200	B-757-200
Airport Reference Code (ARC)	C-IV	C-IV	C-IV	C-IV
Runway length (lf)	13,500	13,500	13,500	13,500
Instrument approach capability	Category I	Category II/III	Category II/III	Category II/III
PASSENGER TERMINAL				
Terminal processor				
Ticketing check-in positions (ea) *(a)(b)*	30	-	-	29
Ticketing lobby area (sf) *(c)*	7,500	-	-	3,800
Security screening lanes	4	5	7	7
Security screening queue area *(c)*	800	1,600	2,300	2,400
Baggage claim				
Baggage claim circulation area *(c)*	15,500	-	-	5,000
Baggage claim frontage (lf)	600	-	-	350
Passenger concourse				
Aircraft parking active positions *(d)*	12	-	-	12
Remain-overnight aircraft positions	16	-	-	15
Concessions space				
Airside	8,359	8,400	11,400	13,300
Landside	9,863	4,400	5,900	6,800
GROUND TRANSPORTATION				
Public parking spaces *(e)*	4,635	3,600	4,850	5,650
Rental car ready/return spaces	768	545	735	855
Rental car service center area (acres)	22.0	12.9	17.4	20.3
Employee parking spaces	704	450	580	650
Departures curbfront				
Inner curb (lf)	950	365	480	560
Outer curb (lf)	1,065	170	170	170
Arrivals curbfront *(f)*				
Inner curb (lf)	925	345	440	480
Outer curb (lf)	975	290	290	290

Notes: Blue shading highlights potential functional deficiencies; lf = linear feet; sf = square feet; ea = each
(a) Check-in positions include agent desks, electronic kiosks, and baggage drop positions.
(b) Assuming that facilities are dedicated to exclusive use by individual airlines.
(c) Areas based on level of service C.
(d) Twelve gates does not include the 4 aircraft parking positions at the east unit terminal.
(e) Inventory of 4,635 spaces does not include the overflow lot which provides approximately 875 spaces.
(f) Assuming existing dwell times; dwell times could be significantly reduced through curbfront enforcement.

Source: LeighFisher, November 2010.

Table 4-2
FACILITIES REQUIREMENTS SUMMARY *(continued)*
Colorado Springs Airport

	Existing	PAL 1	PAL 2	PAL 3
GENERAL AVIATION				
Itinerant apron (sf)	342,900	104,700	119,400	129,300
Tie-down apron (sf)	237,300	130,000	137,000	140,000
Hangar space				
T-hangars (sf)	264,200	184,000	194,000	198,000
Corporate/community hangars (sf)	200,300	306,000	426,000	541,000
General aviation terminal space	17,000	24,500	31,000	35,600
Automobile parking (sf)	171,000	147,800	186,000	213,600
Fueling apron (sf)	59,000	11,700	12,800	13,500
Land area (acres)	42.3	22.5	27.5	31.0
AIR CARGO				
Aircraft apron (sf)	371,900	115,000	115,000	115,000
Building warehouse (sf)	48,600	20,800	24,900	27,400
Landside area (sf)	90,800	20,800	24,900	27,400
Total cargo area (acres)	13.8	5.8	6.1	6.2
AVIATION SUPPORT				
Ten-day fuel supply				
Storage requirement (gal)	200,000	119,000	148,000	160,000
Land are requirements (acres)	0.50	0.29	0.36	0.38

Notes: Blue shading highlights potential functional deficiencies; sf = square feet; gal = gallons

Source: LeighFisher, November 2010.

AIRFIELD AND AIRSPACE

The assessment of airfield and airspace facility requirements consisted of the following tasks:

- Assessment of the airfield capacity using FAA annual service volume methodology.
- Assessment of the required runway length for the existing and forecast fleet mix of aircraft.
- Assessment of the need for new or modified airfield facilities to meet airport design standards or eliminate existing modifications of standards.
- Evaluation of the potential impacts of technology, airline fleet mix changes, and other industry trends on the need for new or modified airfield facilities.

- Evaluation of Terminal Instrument Procedures (TERPS) and Federal Requirements, per 14 CFR Part 77, for obstacle clearance surfaces and identification of existing objects that penetrate these surfaces.
- Evaluation of the need and timing for additional or enhanced navigational aids, marking, and lighting.

Runway Use

There are two principal runway use configurations that are employed at the Airport—north flow and south flow. North flow runway use involves use of Runways 35L, 35R, and 30 (crosswind permitting). South flow runway use involves use of Runways 17R, 17L, and 12 (crosswind permitting). In accordance with current operating procedures, south flow is the preferred runway use configuration, meaning that it is used when winds are calm (e.g., less than 5 knots).

Airfield Capacity

In long-range airport planning studies, the annual capacity of a particular runway system can be estimated using annual service volume (ASV). ASV expresses the estimated number of aircraft operations that can be accommodated annually on an airport's runway system at reasonable levels of delay. ASV takes into account differences in runway use, weather conditions, and mix of aircraft over a one year period. The ASV was estimated for 2035 based on methodology defined in Chapter 3 of Advisory Circular 150/5060-5, *Airport Capacity and Delay*. ASV is calculated by the following formula:

$$ASV = Cw \times D \times H \text{ , where:}$$

- C^w is the weighted average hourly capacity of the runway usage
- D is the ratio of annual demand to average daily demand during the peak month
- H is the ratio of average daily demand to average peak hour demand during the peak month

The weighted capacity of the airfield was estimated to be 108 operations per hour. The D and H factors were estimated at 298 and 10.5, respectively, based on the aviation activity forecasts for 2035. The D factor is calculated by dividing the annual total of aircraft operations by the number of operations estimated to occur in the average day of the peak month; the H factor is calculated by dividing the average daily demand in the peak month by the average peak hour demand in the peak month.

The capacity of the Airport's runway system is estimated to be approximately 340,000 annual operations, using the PAL 3 fleet mix. Approximately 191,980 aircraft operations are expected at PAL 3; therefore, the existing runway system has sufficient capacity to accommodate the number of aircraft operations forecast through the planning period.

Assessment of Runway Length Requirements

This section summarizes the evaluation of runway length requirements. The evaluation involved (1) assessment of manufacturer's published takeoff and landing length criteria, as reported in aircraft planning manuals and (2) a more detailed evaluation of the aircraft takeoff performance capabilities (measured by takeoff weights and payloads) and the presence of obstacles near the extended runway ends.

Requirements Based on Manufacturer's Published Planning Criteria

The landing and takeoff runway length requirements associated with common commercial jet aircraft were evaluated using planning data published by the aircraft manufacturers. The objectives of this evaluation were to:

- Determine the approximate runway length necessary to serve the current and future fleet mix of aircraft.
- Establish which aircraft types require a more detailed performance analysis.

The aircraft types considered were from the *Aviation Demand Forecasts* prepared for the master plan, as well as the Official Airline Guides (OAG) published flight schedules. The takeoff and landing runway length requirements for the resulting set of aircraft types were evaluated using charts provided in the aircraft planning manuals published by Airbus Industries, the Boeing Company, and Bombardier Aerospace. The analysis of takeoff and landing runway length requirements incorporated the following assumptions:

- Ambient temperatures of 83°F, reflecting the mean maximum temperature of the hottest month.
- Balanced field length, meaning that the takeoff run available (TORA), takeoff distance available (TODA), and accelerate-stop distance available (ASDA) would be identical.
- Use of the most common engine types used by the airlines currently serving or expected to serve the Airport.
- Departure initial climb areas (ICAs) that are free of obstacles that would impose departure climb or payload restrictions.
- Zero wind, unless otherwise noted.
- Existing runway gradients, 0.6% for Runway 17L-35R, and 1.2% for Runway 17R-35L.
- Runway 35L and 35R departures were evaluated for takeoff requirements (as opposed to Runway 17R and 17L departures), due to the runway's uphill gradients and rising terrain to the north of the Airport.

- Both dry and wet conditions were considered when estimating landing runway length requirements.

Landing length requirements. Table 4-3 presents the results of the landing runway length evaluation. Landing runway length requirements are shown for both dry and wet conditions—length required under wet conditions is greater than the length required under dry conditions because surface friction is reduced. FAA Advisory Circular 150/5325-4B, Paragraph 508, specifies that runways be designed for wet landing conditions; therefore, runway landing length requirements for wet runways are presented in Table 4-3. The aircraft listed in Table 4-3 represent a subset of the commercial aircraft fleet mix that were selected based on their aircraft performance characteristics. These aircraft represent the most demanding aircraft in terms of landing length requirements, and therefore, it is unnecessary to evaluate additional aircraft.

The evaluation indicates that the existing landing lengths of between 11,022 (Runway 17L-35R) and 13,501 feet (Runway 17R-35L) are sufficient to accommodate the aircraft fleet mix. Further, takeoff length requirements (as opposed to landing length requirements) would govern any future decisions regarding the provision of additional runway length.

Table 4-3
RUNWAY LANDING LENGTH SUMMARY
Colorado Springs Airport

Aircraft	Landing length requirement (ft) Dry runway	Wet runway	Flap setting (degrees)
CRJ-700ER	5,930	n/a	45
MD-83	6,130	6,980	28
B737-800	6,740	7,780	30
B757-200	5,430	6,330	30

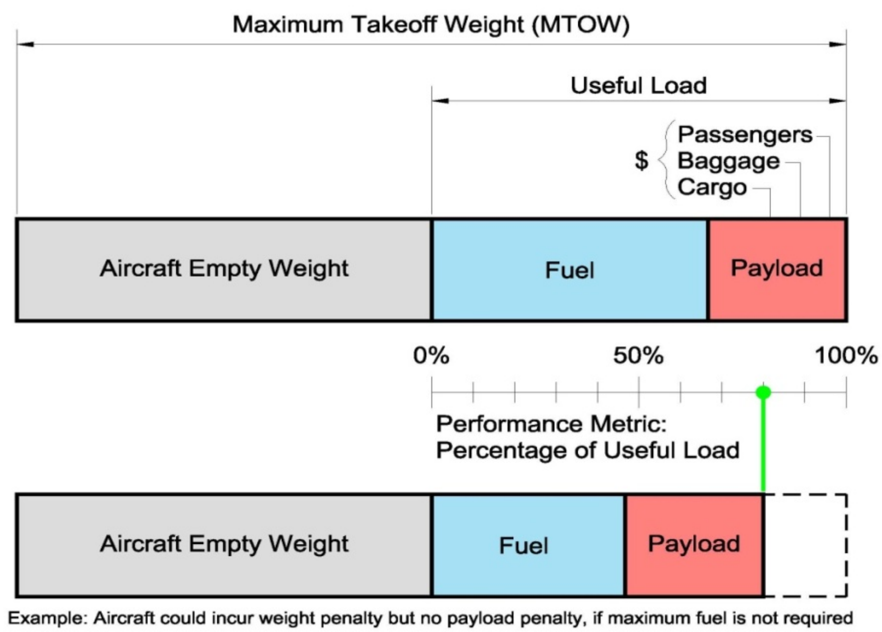
(a) Requirements based on standard day temperature, airport elevation of 6,187 and maximum design landing weight.
(b) Landing length estimated for minimum published flap setting.

Source: Aircraft characteristics for airport planning, published by Boeing and Bombardier.

Takeoff length requirements. Table 4-4 presents the results of the takeoff runway length evaluation. The left side of the table presents the Runway 35R takeoff requirements for the fleet mix assuming a 0.6% runway gradient; the right side presents the same for the 1.2% gradient of Runway 35L. As shown on the left hand side of the table, each of the aircraft analyzed can be accommodated on Runway 35R with its existing length of 13,501 feet. Conversely, Runway 35L with its shorter length of 11,022 feet and gradient cannot accommodate each of their aircraft at 100% of their useful load. On the right side, Table 4-4 shows that each of the aircraft can be accommodated by Runway 35L up to 80% of their "useful load"; whereas at 90% or above, the following aircraft would not be able to depart: the MD80, MD83, B737-800, and the B757-200 (highlighted in blue).

Useful load is defined as the aircraft maximum takeoff weight minus the aircraft empty weight, as shown in Figure 4-1. An aircraft's useful load can be used to transport either fuel or payload (i.e., passengers, baggage, and cargo) and, within certain limits, useful load can be allocated between fuel and passengers. The takeoff lengths that exceed the length of Runway 35L are shaded in blue. Notably, each of these aircraft could takeoff operating at 90% of their useful load from Runway 35R which has both a lesser runway gradient and greater length when compared to Runway 35L.

Figure 4-1
DEFINITION OF USEFUL LOAD



Figures 4-2 and 4-3 presents the takeoff length required for the same aircraft types for Runway 35L and Runway 35R departures. Runway 35R and 35L departures were evaluated in order to be conservative (as opposed to Runways 17L and 17R), as the runway gradient is uphill from south to north. Figure 4-1 includes an adjustment made to account for the existing gradient of 1.2% on Runway 35L, while Figure 4-2 has an adjustment for the 0.6% gradient of Runway 35R. The takeoff lengths required are represented by bars, which are shaded to indicate the length necessary for specific aircraft types to takeoff with different percentages of their maximum useful loads (e.g., 80% to 90%). Because Runway 35R has both a lower runway gradient and greater length than Runway 35L, Runway 35R accommodates more aircraft operating a higher useful loads.

Table 4-4

RUNWAY TAKEOFF LENGTH SUMMARY

Colorado Springs Airport

	Engine type	Takeoff runway length requirement adjusted for gradient of 0.6% (Runway 35R) 70%	80%	90%	100%	Takeoff runway length requirement adjusted for gradient of 1.2% (Runway 35L) 70%	80%	90%	100%
Passenger narrowbody									
MD80	JT8D-217	8,681	10,301	13,341	-	9,154	10,774	13,814	-
MD83	JT8D-219	8,781	10,781	13,341	-	9,254	11,254	13,814	-
A319	CFM56	5,911	6,641	8,111	10,151	6,384	7,114	8,584	10,624
A320	CFM56	6,681	7,341	8,011	9,081	7,154	7,814	8,484	9,554
B737-800	CFM56-7B26	8,901	10,251	13,391	-	9,374	10,724	13,864	-
Passenger regional									
CRJ-200LR	CF34-3B1	8,081	8,951	9,841	-	8,554	9,424	10,314	-
CRJ-700ER	CF34-8C1	6,781	7,831	8,731	-	7,254	8,304	9,204	-
CRJ-900	CF34-8C5	8,251	9,281	10,111	-	8,724	9,754	10,584	-
All-cargo									
B757-200	RB211-535E4	8,201	9,661	11,261	13,341	8,674	10,134	11,734	13,814
A310-200	CF6-80A3	6,551	7,131	7,871	10,441	7,024	7,604	8,344	10,914

Note: the takeoff lengths that exceed the length of Runway 35L are shaded in blue.

(a) Takeoff length requirements are shown for a temperature of 83 degrees F (mean maximum temperature of the hottest month at the Airport) and airport elevation of 6,187 feet. Calm winds assumed.

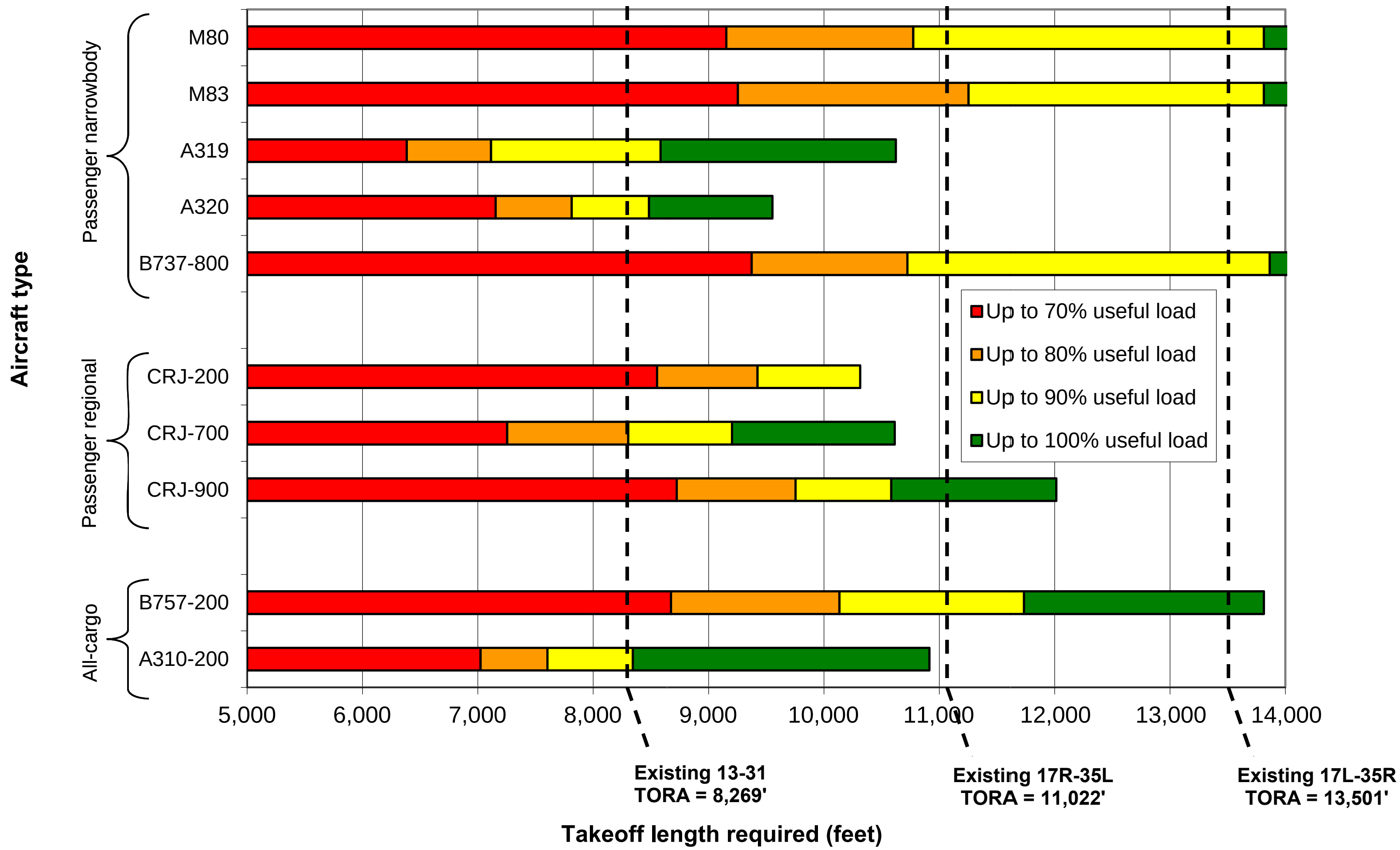
(b) Gradient adjustment per FAA AC 150/5325-B: increase requirement by 10 feet for every 1 foot of difference between high and low points of the runway.

(c) Obstacles which may limit payload are not considered within these results.

(d) Aircraft which reach brake energy limit or tire speed limit before reaching maximum payload are denoted with "-".

Source: Aircraft Characteristics for Airport Planning, Boeing Company, Airbus Industries, and Bombardier; JP Airline-Fleets International, 2007/2007, and FAA Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design.*

Figure 4-2
AIRCRAFT MANUFACTURER'S TAKEOFF LENGTH REQUIREMENTS FOR RUNWAY 35L—ISA+13ºC (83ºF)
Colorado Springs Airport

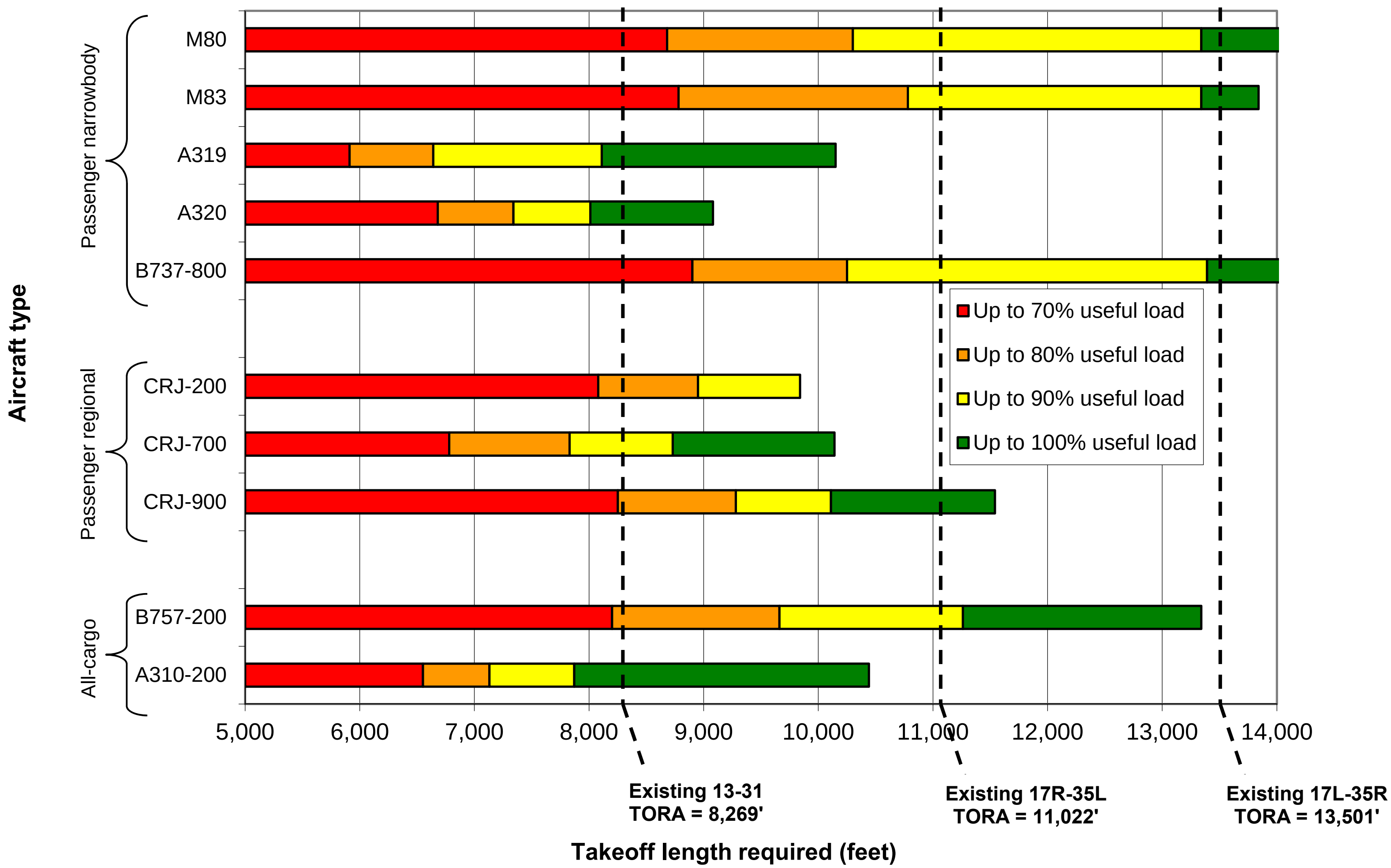


Note: Field limits, such as obstacle limitations, are not reflected in these requirements; dry runway assumed; runway gradient of 1.2% assumed.

Figure 4-3

AIRCRAFT MANUFACTURER'S TAKEOFF LENGTH REQUIREMENTS FOR RUNWAY 35R—ISA+13ºC (83ºF)

Colorado Springs Airport



Note: Field limits, such as obstacle limitations, are not reflected in these requirements; dry runway assumed; runway gradient of 0.6% assumed.

Aircraft do not typically operate at 100% of their useful load for practical reasons: (1) the aircraft may not be accommodating a full passenger load and (2) the aircraft may not be traveling sufficient distance to require a full load of fuel. Accordingly, it is prudent to examine representative aircraft types coupled with potential destinations to determine the percentage of useful load that would be realistic for a typical flight.

Table 4-5 presents runway length requirements for select destinations. As shown, the aircraft would be operating between 45% and 84% of useful load to travel to the destinations shown (based on fuel requirements). For example, the CRJ-200LR traveling to San Francisco would be operating at approximately 84% of its useful load. Using Figures 4-2 and 4-3, it would appear the CRJ-200LR could depart on either runway.

Table 4-5
RUNWAY LENGTH REQUIREMENTS FOR SELECT DESTINATIONS
Colorado Springs Airport

	CRJ-200LR	CRJ-700ER	B737-800	B757-200
Destination	SFO	ORD	ATL	MEM
Range (nm)	837	792	1,029	742
Passenger capacity (ea)	50	66	160	n/a
Maximum takeoff weight (lbs)	53,000	75,000	174,200	255,000
Operating empty weight (OEW) (lbs)	30,500	43,000	91,300	136,940
Total available useful load (lbs) (a)	22,500	32,000	82,900	118,060
Typical fuel (lbs)	10,000	10,700	24,500	27,500
Typical payload (lbs) (b)	9,000	11,880	28,800	25,560
Fuel and payload as percent of useful load	84%	71%	64%	45%
OEW plus payload (lbs)	39,500	54,880	120,100	162,500
Brake release gross weight (lbs)	49,500	65,580	144,600	190,000
Percent of maximum takeoff weight	93%	87%	83%	75%
Takeoff length (lf) (c)	8,570	5,970	7,440	5,470

Notes: SFO – San Francisco International Airport; ORD – O'Hare International Airport (Chicago); ATL – Hartsfield-Jackson Atlanta International Airport; MEM – Memphis International Airport

(a) Useful load is defined as the aircraft maximum takeoff weight minus the operating empty weight.

(b) Assumes 90% load factor, 200 lbs for each passenger plus baggage, and zero belly cargo for CRJ2, CRJ7 and B738. The typical payload used for the B752 is based on a typical cargo load.

(c) Takeoff length requirements are shown for a temperature of 83ºF and airport elevation of 6,187 feet. Takeoff length requirements do not account for obstacle limitations or other field limitations.

Source: Aircraft Characteristics for Airport Planning, Boeing Company and Bombardier.

Detailed Aircraft Takeoff Performance Analysis

Following completion of the preliminary aircraft takeoff and landing length requirements analyses, as summarized in the previous section, a detailed analysis of the takeoff performance capability of critical aircraft at the Airport was conducted. In the detailed analysis, aircraft takeoff weight computation methodologies prescribed in *Airplane Characteristics for Airport Planning* manuals that are used by the airlines for flight planning purposes were used to compute maximum allowable takeoff weights for specific aircraft types.

This analysis, takes into consideration the following factors that can affect aircraft takeoff performance:

- Environmental and physical characteristics, including "hot day" temperature (83 degrees F), runway end elevations, runway gradient, and wind conditions.
- Standard aircraft operating procedures, operating weights, and engine types.
- The effects of close-in obstacles on takeoff performance.

In this analysis, maximum allowable takeoff weights were estimated for three critical aircraft, as shown in Table 4-5. Aircraft types were selected for this analysis based on the following reasons:

- These aircraft types represent important components of the existing and/or future fleets of aircraft that are currently using or can be reasonably expected to use the Airport in the future.
- These aircraft types are prone to be affected by takeoff-related payload restrictions, according to recent experience at the Airport.
- The results of the preliminary runway length analysis described in the previous section indicate that the performance of these aircraft types should be considered at a higher level of detail.

Tables 4-6 and 4-7 also show the engine type assumptions for the aircraft. These assumptions generally reflect engine types that are used most frequently by the airlines that serve the Airport, as determined using airline fleet data reported in *JP Airline-Fleets International*. The maximum structural takeoff weights and maximum useful loads for each the aircraft are also shown in the table.

The final set of assumptions used in this analysis is associated with the location and disposition of close-in obstacles beyond the departure ends of both Runway 35L and Runway 35R. The locations of obstacles that have a potential to adversely affect aircraft takeoff performance were determined using a one-engine inoperable (OEI) procedure that is the representative of the typical OEI procedure used by the airlines operating at the Airport.

As shown in Table 4-6, the takeoff weight of each of the aircraft is limited by the obstacles located in the departure corridor off the end of the runway. For example, using the aircraft performance manuals to estimate the takeoff length required for a CRJ700ER, it would appear that the aircraft could depart operating at 98% of its useful load; however, obstacle limitations reduce performance to 71% of useful load. As shown in Table 4-5, a CRJ-700ER traveling to ORD would be expected to operate at about 71% of its useful load, so that flight could theoretically occur. Conversely, Table 4-5 shows that a B737-800 traveling to ATL would operate at about 64% of its useful load, while Table 4-6 shows that the obstacles limit the aircraft to 56% of its useful load.

Table 4-6
AIRCRAFT TAKEOFF WEIGHT COMPARISON – 35L DEPARTURES
Colorado Springs Airport

	CRJ-200LR	CRJ-700ER	B737-800	B757-200
Engine type	CF34-3B1	CF34-8C1	CFM56-7B26	RB211-535E4
Maximum takeoff weight (lbs)	53,000	75,000	174,200	255,000
Operating empty weight (lbs)	30,500	43,000	91,300	136,940
Maximum useful load (lbs)	22,500	32,000	82,900	118,060
With obstacle limitation (a)				
Allowable takeoff weight (lbs)	46,470	65,800	137,900	209,300
Percent of useful load	71%	71%	56%	61%
Without obstacle limitation (b)(c)				
Allowable takeoff weight (lbs)	50,500	74,500	165,200	243,500
Percent of useful load	89%	98%	89%	90%

Note: Yellow shading denotes a tire speed/brake energy limitation; green shading denotes limitation on takeoff weight based on obstacle limitation.

(a) Assumptions: 83 degrees Fahrenheit; dry runway conditions; 10 knot headwind; and bleeds open/on.

(b) CRJ200, CRJ700 and B737 assumptions: 83 degrees Fahrenheit; dry runway conditions; calm winds; and bleeds closed/off.

(c) B757 assumptions: 82 degrees Fahrenheit; dry runway conditions; 10 knot headwind.

Source: AeroData/FedEx for allowable takeoff weights with obstacle limitation; LeighFisher for allowable takeoff weights without obstacle limitation.

Table 4-7 presents the same data for Runway 35R. Runway 35R, as shown, permits greater takeoff weights. However, the higher takeoff weights are still governed by obstacles for each of the aircraft with the exception of the B757-200 (which is governed by tire speed/

brake energy limits). Given the allowable takeoff weights in Tables 4-6 and 4-7, which account for obstacles, it is apparent that additional runway length may not increase the allowable takeoff weight during hot days.

Table 4-7
AIRCRAFT TAKEOFF WEIGHT COMPARISON – 35R DEPARTURES
Colorado Springs Airport

	CRJ-200LR	CRJ-700ER	B737-800	B757-200
Engine type	CF34-3B1	CF34-8C1	CFM56-7B26	RB211-535E4
Maximum takeoff weight (lbs)	53,000	75,000	174,200	255,000
Operating empty weight (lbs)	30,500	43,000	91,300	136,940
Maximum useful load (lbs)	22,500	32,000	82,900	118,060
With obstacle limitation *(a)*				
Allowable takeoff weight (lbs)	48,240	66,800	142,100	221,300
Percent of useful load	79%	74%	61%	71%
Without obstacle limitation *(b)(c)*				
Allowable takeoff weight (lbs)	50,500	74,500	165,200	243,500
Percent of useful load	89%	98%	89%	90%

Note: Yellow shading denotes a tire speed/brake energy limitation; green shading denotes limitation on takeoff weight based on obstacle limitation.

(a) Assumptions: 83 degrees Fahrenheit; dry runway conditions; 10 knot headwind; and bleeds open/on.
(b) CRJ200, CRJ700 and B737 assumptions: 83 degrees Fahrenheit; dry runway conditions; calm winds; and bleeds closed/off.
(c) B757 assumptions: 82 degrees Fahrenheit; dry runway conditions; 10 knot headwind.

Source: AeroData/FedEx for allowable takeoff weights with obstacle limitation; LeighFisher for allowable takeoff weights without obstacle limitation.

Table 4-8 presents similar data to Tables 4-6 and 4-7; however, the environmental conditions considered are different. For Table 4-8, a temperature of 32 degrees Fahrenheit was evaluated coupled with contaminated runway conditions (in which the runway would be covered by rain, slush, or snow). As Table 4-8 shows, the CRJ-200LR and CRJ-700ER would be limited by the available runway length of Runway 35L. However, the B737-800 and B757-200 would be limited by obstacles. Table 4-8 also shows that the longer Runway 35R would limit only the CRJ-200ER takeoff weight due to available runway length; whereas the other three aircraft would be limited by obstacles.

Table 4-8
AIRCRAFT TAKEOFF WEIGHT COMPARISON – CONTAMINATED RUNWAYS 35L/35R
Colorado Springs Airport

	CRJ-200LR	CRJ-700ER	B737-800	B757-200
Engine type	CF34-3B1	CF34-8C1	CFM56-7B26	RB211-535E4
Maximum takeoff weight (lbs)	53,000	75,000	174,200	255,000
Operating empty weight (lbs)	30,500	43,000	91,300	136,940
Maximum useful load (lbs)	22,500	32,000	82,900	118,060
Runway 35L departures				
Level 1 contamination				
Allowable takeoff weight (lbs)	44,410	68,000	141,900	210,400
Percent of useful load	62%	78%	61%	62%
Runway 35R departures				
Level 1 contamination				
Allowable takeoff weight (lbs)	48,450	69,900	150,500	226,100
Percent of useful load	80%	84%	71%	76%

Notes:
Blue shading denotes a field length limitation.
Green shading denotes limitation on takeoff weight based on obstacle limitation.
Assumptions: 32 degrees Fahrenheit; 10 knot headwind, includes wing and engine anti-ice penalties.

Source: AeroData/FedEx for allowable takeoff weights under contaminated runway conditions.

Runway Length Summary

Based on the assessment of runway length analysis, lengthening Runway 17R-35L could increase the allowable takeoff weights for certain aircraft when operating with contaminated runway conditions in north flow. The analysis also shows that some of the takeoff weight restrictions are governed by obstacles rather than by available runway length for both runways. These obstacles should be identified, and to the extent practical removed to facilitate higher takeoff weights, thereby eliminating potential operating weight penalties. As an additional mitigation tool, further analysis could be conducted to ensure that the one-engine out departure procedures in use by the various airlines are optimized to minimize takeoff weight penalties for north flow operations.

Ideally Runway 17R-35L would be the same length or longer than Runway 17L-35R for the purposes of redundancy (e.g. when Runway 17L-35R is closed for maintenance or snow removal). Although extending 17R-35L to 13,500 feet is not likely to be considered as a feasible solution due to known site constraints, extensions of various lengths should be considered to the extent practical for Runway 17R-35L.

Wind and Weather Analysis

An analysis of Airways Hourly Surface Observations (TD-3280) data from the National Climatic Data Center (NCDC) was conducted to assess the annual percent occurrence of weather conditions and runway use configurations. This weather data is collected using instruments located on the airport, such as the automated weather observation system (AWOS). Weather conditions—namely cloud ceiling and visibility—determine the ATC procedures that can be used at an airport, which in turn affect runway capacity and aircraft delay. Cloud ceiling and visibility levels that govern changes in ATC procedures at the Airport were identified during conversations with representatives from the FAA Airport Traffic Control Tower and Airport staff.

For purposes of the wind and weather analysis, visual meteorological conditions (VMC) and instrument meteorological conditions (IMC) are defined in accordance with FAA guidance, as follows:

- VMC weather is defined as cloud ceilings at least 1,000 feet above ground level (AGL) *and* visibility at least 3 miles.
- IMC weather is defined as cloud ceilings below 1,000 feet AGL *or* visibility less than 3 miles

In addition, varying levels of IMC were analyzed: Category I, Category II, and Category III conditions, defined as follows:

- Category I is defined as cloud ceilings at least 200 feet but less than 1,000 feet above ground level (AGL) *or* visibility at least 1/2 mile but less than 3 miles.
- Category II is defined as cloud ceilings at least 100 feet but less than 200 feet above ground level (AGL) *or* visibility at least 1/4 mile but less than 1/2 mile.
- Category III is defined as cloud ceilings of less than 100 feet above ground level (AGL) *or* visibility less than 1/4 mile.

Weather Conditions

The percent occurrence of weather conditions that would require the use of Category I, Category II, and Category III instrument landing systems (ILS) was examined for a 10-year period ended in October 2009, as summarized in Table 4-9. As shown, it was determined that the provision of a Category II/III ILS would have enabled the Airport to remain open up to 2.6% more of the year (the equivalent of approximately 9.5 days).

Table 4-9
SUMMARY OF WEATHER CONDITIONS
Colorado Springs Airport

Weather condition	Minimums: Cloud ceiling (feet)	Minimums: Visibility (miles)	Ten-year Average Occurrences: 24-hour occurrence	Ten-year Average Occurrences: Daytime occurrence	Ten-year Average Occurrences: Nighttime occurrence
VMC	1,000	3	92.6%	93.6%	91.0%
IMC	<1,000	<3	7.4	6.4	9.0
Category I	200-1,000	½ to 3	4.7	4.3	5.4
Category II	100-200	¼ to ½	2.0	1.5	2.9
Category III	<100	<¼	0.6	0.6	0.7
Additional coverage with Category II/III ILS			2.6	2.1	3.8

Source:
LeighFisher's analysis of Hourly Surface Airways Observations data obtained from the NCDC for the 10-year period November 1, 2000, to October 31, 2009.

Runway Wind Coverage

Runway wind coverage refers to the percent of time that the crosswinds associated with a particular runway orientation are within an acceptable level. Airport wind coverage is determined by considering all runways simultaneously. Crosswinds—which are the components of wind that flow in a direction perpendicular to a runway's orientation—can effectively close a runway for use. The maximum allowable crosswind components for a particular aircraft are determined largely by aircraft size, aircraft weight, and pilot capabilities. In general, larger, heavier air carrier aircraft can land and take off in higher crosswinds than smaller, lighter general aviation aircraft.

The FAA provides the following guidance regarding wind coverage in AC 150/5300-13, *Airport Design*:

> The desirable wind coverage for an airport is 95 percent, based on the total numbers of weather observations. This value of 95 percent takes into account various factors influencing operations and the economics of providing the coverage.[2]

Based on this guidance, wind coverage for the airfield was estimated using the following maximum allowable crosswind component conditions:

[2] Federal Aviation Administration, Advisory Circular 150/5300-13 (Change 11), *Airport Design*, March 28, 2007, p. 87.

- 10.5-knot crosswind component, which represents the crosswind component at which pilots of small, light general aviation aircraft would be unable to use the runway

- 13-knot crosswind component, which represents the crosswind component at which pilots of twin-engine propeller aircraft would be unable to use the runway

- 16-knot crosswind component, which represents the crosswind component at which pilots of larger commuter propeller aircraft and smaller business jet aircraft would be unable to use the runway

- 20-knot crosswind component, which represents the crosswind component at which pilots of regional and air carrier jets would be unable to use the runway

Table 4-10 summarizes the wind coverage of the Airport's runways at these crosswind speeds. In this table, wind data for daytime hours was presented. Separate coverage estimates are provided for visual meteorological conditions (VMC), instrument meteorological conditions (IMC), and all weather conditions.

These results indicate that the Airport's current runway system provides wind coverage in excess of the FAA's 95% coverage criteria for all four crosswind components that were evaluated. In addition, the results of the wind analysis indicate that Airport's primary runway—Runway 17L-35R—could be used 96% of the time with a 10.5-knot crosswind component. For further detail regarding wind coverage at the Airport, including coverage during Category II/III conditions, see Appendix E.

Table 4-10
WIND DATA SUMMARY DAYTIME HOURS (7 AM – 10 PM)
Colorado Springs Airport

	% Calm	10.5	13.0	16.0	20.0
All weather	15.7				
35R/35L - north flow *(a)*		85.54	85.68	86.12	86.50
17L/17R - south flow		11.27	12.01	12.55	12.84
31 - northwest flow		1.92	1.76	1.23	0.47
13 - southeast flow		1.27	0.56	0.10	0.00
Total		100.00	100.00	100.00	99.81
VMC *(b)*					
35R/35L - north flow *(a)*	15.0	85.19	85.30	85.77	86.18
17L/17R - south flow		11.50	12.26	12.81	13.11
31 - northwest flow		1.98	1.82	1.29	0.52
13 - southeast flow		1.33	0.61	0.13	0.00
Total		100.00	100.00	100.00	99.81
IMC *(c)*	25.6				
35R/35L - north flow *(a)*		90.11	90.59	90.95	91.25
17L/17R - south flow		7.70	8.17	8.49	8.65
31 - northwest flow		1.66	1.24	0.57	0.10
13 - southeast flow		0.53	0.00	0.00	0.00
Total		100.00	100.00	100.00	100.00

Notes:
(a) North flow includes the percentage of calm weather. Calm weather includes all winds below 5 knots; analysis assumed 10-knot tailwind component.
(b) VMC (Visual Meteorological Conditions) weather is defined as a cloud ceiling of at least 1,000 feet and reported visibility of at least 3 miles.
(c) IMC (Instrument Meteorological Conditions) weather is defined as a cloud ceiling less than 1,000 feet or reported visibility less than 3 miles.

Source: LeighFisher, January 2010 based on Surface Airways Hourly Data (TD-3280) for November 1, 2000, through October 31, 2009, from the National Climatic Data Center.

Airport Design Standards

As part of the airfield facilities requirements work effort, the Airport's existing airfield facilities were evaluated to assess their compliance with current FAA airport design standards defined in FAA Advisory Circular 150/5300-13 (Change 13), *Airport Design*. The following paragraphs summarize the most important findings of this review.

Runway Safety Areas (RSAs)

RSAs are rectangular areas that encompass runways and the land areas immediately around them. For runways serving Airplane Design Group (ADG) IV aircraft (i.e. the critical aircraft group), standard RSAs are 500 feet wide, centered on the runway, and extend 1,000 feet beyond each of the runway's physical ends. RSAs are required to be cleared, graded, and capable of supporting aircraft without causing damage to them. RSAs are intended to minimize damage to aircraft and injury to passenger and flight crew in the event of an aircraft excursion from the runway. Objects taller than three inches above grade are not permitted within RSAs unless they are (1) fixed by function and (2) mounted on frangible couplings, to the extent practicable, that are no higher than three inches above grade.

At the Airport, localizer antennas serving Runways 17L, 35R, and 35L are all outside of the RSA. All RSAs at the airport meet the current design standards.

Runway Protection Zones (RPZs)

RPZs are trapezoidal areas beyond the ends of runways, centered on the extended runway centerline, intended to protect people and property on the ground. For precision instrument runways serving Airport Design Group IV aircraft with approaches capable of accommodating operations with visibility of less than 0.75 mile, RPZs are 2,500 feet long, 1,000 feet wide at their inner edge (i.e., closest to the runway), and 1,750 feet wide at their outer edge. The RPZs begin 200 feet beyond the physical end of their respective runways.

As stated in Paragraph 212 of *Airport Design*,

> *Land uses prohibited from the RPZ are residences and places of public assembly. (Churches, schools, hospitals, office buildings, shopping centers, and other uses with similar concentrations of persons typify places of public assembly.) Fuel storage facilities may not be located in the RPZ.*

The RPZs associated with each of the Airport's runways meet these land use requirements. However, the RPZ associated with Runway 31 encompasses land located beyond the Airport's property line. The use of this land is subject to local land use controls (Commercial Airport Overlay District, Ordinance 06-89) which effectively prevents incompatible development within the Runway 31 RPZ.

Modifications of Standards

Table 4-11 on the following page includes all published Modifications of Standards (MOS). Each of these MOS is included in the Airport Layout Plan. In addition, there are a number of potentially non-standard conditions that may require correction or additional MOS as shown in Table 4-12. These conditions along with the published MOS are also included in the Airport Layout Plan and should be subject to corrective measures when the pavement is next rehabilitated or the subject of a future MOS submittal to the FAA.

Table 4-11
PUBLISHED MODIFICATIONS OF STANDARDS
Colorado Springs Airport

Item	Standard	Existing	Approved	Notes
Taxiway F longitudinal gradient between Taxiway M and Taxiway B (between Sta. 358+25 and Sta. 352+61.95 and between Sta. 351+18.76 to Sta. 352+61.95)	+/- 1.5%	1.7% to 2.0% between Sta. 358+25 and Sta. 352+61.95 and 1.73% between Sta. 351+18.76 to Sta. 352+61.95	Submitted to FAA 05/22/2012; awaiting approval	
Runway 13 end RSA longitudinal gradient for first 200 feet beyond threshold	0% to -3%	0.75%	Submitted to FAA 11/03/2011; awaiting approval	Update to approved MOS on record; Airspace Case 93-ANM/D-063-NRA
Runway 31 longitudinal gradient and vertical curve length in first quarter of runway	+/- 0.8% longitudinal grade and minimum vertical curve length of 1,000 feet for each 1% of grade change	1.87% longitudinal grade and 500-foot vertical curve at Sta. 82+50	Submitted to FAA 11/03/2011; awaiting approval	Update to approved MOS on record; Airspace Case 93-ANM/D-012-NRA
Taxiway MIL longitudinal grade at Runway 13/31	+/- 1.5%	-2.25%	Submitted to FAA 11/03/2011; awaiting approval	Update to approved MOS on record; Airspace Case 93-ANM/D-063-NRA. Remove Taxiway B4 from approved MOS on record as it now meets longitudinal grade requirements.
Taxiway MIL length of lead-in to fillets at Runway 13/31	250-foot lead-in length to fillets	0-foot lead-in length to fillets	Submitted to FAA 11/03/2011; awaiting approval	
Taxiway G longitudinal gradient from centerline to north edge at Taxiway B (between Sta. 176+00 and 173+75)	+/- 1.5%	-1.9%	FAA approved 09/06/2007.	

Source: Airport Layout Plan data sheet, July 2013.

Table 4-12

ADDITIONAL NON-STANDARD CONDITIONS

Colorado Springs Airport

Item	Standard	Existing	Notes	Source
Taxiway A length of lead-in to fillet at southwest corner of Taxilane south of Taxiway A4	250-foot lead-in length to fillets	0-foot lead-in length to fillets	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R-35L" Project	AIP#19 Engineer's Report
Taxiway A2, A3, and A4 west of Taxiway A fillet width	85-foot fillet radius (cockpit over centerline)	105-foot fillet radius (judgmental oversteering)	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R-35L" Project	AIP #25 Engineer's Report
Runway 17R/35L longitudinal gradient for the last quarter of runway length at both ends	+/- 0.8% longitudinal grade	0.9% to 1.21 % in north quarter 0.7% to 1.36% in south quarter	Reconstruct Runway 17R/35L and eliminate a non-standard gradient whenthe runway is extended.	AIP#32 Engineer's Report
Taxiway A2 longitudinal grade at Runway 17R/35L	+/- 1.5%	1.80%	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R-35L" Project	AIP#32 Engineer's Report
Taxiway A3 longitudinal grade at Runway 17R/35L	+/- 1.5%	1.81%	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R- 35L" Project	AIP#32 Engineer's Report
Taxiway A4 longitudinal grade at Runway 17R/35L	+/- 1.5%	2.21%	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R-35L" Project	AIP#32 Engineer's Report
Taxiway A4 Longitudinal grade break	Minimum vertical curve length of 100 feet for each 1% of grade change	Grade break at the runway edge of 0.71% without a vertical curve	To be addressed in "Realignment of Taxiway "A" to 500' from Runway 17R-35L" Project	AIP#32 Engineer's Report

Table 4-12
ADDITIONAL NON-STANDARD CONDITIONS *(continued)*
Colorado Springs Airport

Item	Standard	Existing	Status	Source
Taxiway H transverse gradient between Taxiway M and Taxiway E (between Sta. 159+00 and 176+00)	Crowned pavement section with 1% to 1.5% cross slope	Transverse pavement section with 1.5% cross slope	Conditions to be re-assessed at the time of next rehabilitation.	AIP#51 Engineer's Report
Taxiway E-1, E-7, and E-8 transverse gradient	Crowned pavement section with 1% to 1.5% cross slope	Transverse pavement section with cross slope	Conditions to be re-assessed at the time of next rehabilitation.	AIP#38/#40 Engineer's Report
Runway 17L/35R and Taxiway E Connectors Lighting	Counterpoise shall not be connected to light fixture base can or mounting stake, except for on fixture bases of runway TDZ lights, runway CL lights, and taxiway CL lights installed in rigid pavement. A safety ground must be installed at each light fixture.	Counterpoise connected to each light fixture base can for all lights. No safety ground wire installed.	Conditions to be re-assessed at the time of next rehabilitation.	AIP#38/#40 Engineer's Report

Source: Airport Layout Plan data sheet, July 2013.

Navigation Aids and Airfield Lighting

A review of navigational and visual aid needs at the Airport was conducted as part of the airfield facility requirements evaluation. Weather and runway use configuration data indicated that it may be prudent to enhance the instrument landing systems that are currently in place. As noted in the Existing Conditions chapter, Runways 17L and 35L are each equipped with Category I instrument landing systems, which enable trained pilots flying equipped aircraft to land when visibility is a low as 0.5 mile and the cloud ceiling is as low as 200 feet. Runways 35R also has an ILS which enables trained pilots flying equipped aircraft to land when visibility is a low as 0.75 mile.

Provision of a Category II/III approach on one (or both) of the parallel runways would be beneficial as it would allow the Airport to remain open for an additional 9.5 days or 228 hours per year. For further detail regarding weather conditions at the Airport, including when Category II/III conditions are most prevalent, see Appendix E.

Obstacle Clearance Surface Assessment

For the obstacle clearance assessment, FAA United States Standard for Terminal Instrument Procedures (TERPS) approach and instrument departure obstacle clearance surfaces (OCSs) were evaluated. The potential obstacles considered in this assessment were taken from the aerial obstruction survey, based on the orthophotography from June 2010, flown by The Sanborn Map Company.

Potential Impact of Future Technologies

Over the 25 year planning period considered in this study, there are a variety of technological advancements and industry changes that could have an impact on the airfield. Key among these are technological improvements to the air traffic control system that are part of FAA's Next Generation Air Transportation System (NextGen) development program. The FAA's NextGen program has been underway since the late 1990s.[3]

One of the central facets of NextGen is the transformation of the U.S. air traffic control system from ground-based navigation aids to satellite-based navigation aids. This transformation, which is currently underway in the en-route airspace and at select airports, promises to increase the accuracy of aircraft navigation and provide more flexible, robust air traffic procedure design. The transformation to satellite-based navigation will also ultimately reduce or eliminate the need for space-consuming ground based navigational aids such as VOR antennas, glide slope antennas, and localizer antennas.

Another planned component of NextGen is increased availability and currency of air traffic data to all users of the air transportation system. This includes providing pilots with in-

[3] A complete and current description of proposed NextGen program improvements, enabling technologies, and implementation timelines is presented in the report, Next Generation Air Transportation System Integrated Work Plan: A Functional Outline, Version 1.0, published by the Joint Planning and Development Office (JPDO), on September 30, 2008.

cockpit displays of air traffic information, so pilots can react to such information directly, and providing air traffic controllers with instantaneous aircraft position information obtained via satellite-based navigation systems, rather than via ground-based radar systems. A technology known as "automated dependent surveillance-broadcast" (ADS-B) is central to this effort. ADS-B utilizes radio transponders which broadcast detailed information regarding aircraft position, speed, altitude, type, and other information to ADS-B receivers. Such receivers can be located aboard aircraft and in air traffic control facilities. As ADS-B use among aircraft operators and within the FAA increases in the coming decade, it is expected to supplement and eventually replace radar systems as the primary source of air traffic information.

A third important facet of NextGen is to automate and optimize traffic flows both in the terminal and en-route airspace environments, enabling pilots and controllers to make more efficient use of the same volume of airspace. This optimization, which relies in part on the other two facets of NextGen that have already been mentioned, is expected to allow controllers to sequence aircraft to arrival and departure runways more effectively, helping to ensure that available airspace and airfield capacity is not wasted because aircraft are not fed through the air traffic system effectively enough to use it.

Other NextGen improvements that may improve the Airport's functionality include the following:

- Satellite-based approach procedures that can facilitate instrument approach procedures in low visibility to runways not currently equipped with CAT II/III instrument landing systems.
- Wake vortex detection and avoidance systems that enable wake-turbulence related in-trail separations and runway dependencies to be reduced when wind and weather conditions are favorable.
- ADS-B-based flight procedures and air traffic control rules that enable pilots to assume responsibility for their own separations from other aircraft, even in instrument meteorological conditions, facilitating "near-visual" operations in poor weather.
- Use of optimized descent profile (ODP) approach procedures to reduce fuel burn, aircraft emissions, and possibly noise impacts associated with Airport arrivals.
- Optimized taxiway routing and taxiway conflict management, utilizing data obtained from the Airport Surface Detection Equipment, Model X (ASDE-X) ground surveillance system.

Some of these improvements will be enabled via facility and equipment improvements. However, many of the improvements will depend on the rate at which aircraft operators equip their aircraft to take advantage of NextGen technology.

Some of the improved flight procedures, associated with NextGen technology, are already in place at the Airport. Specifically, the Airport has four area navigation (RNAV) procedures in place that are designated as Required Navigation Procedures (RNP) for Runways 17L, 35R, 17R, and 35L. These RNP provide a number of benefits over conventional navigation including: (1) lower minimums; (2) improved operational performance including fuel efficiency and time savings; and (3) improved safety with clearly defined and predictable flight paths. In addition to the four RNP, the Airport also has five RNAV global positioning system (GPS) procedures in place. These procedures provide approach minimums similar to those provided by conventional instrument landing system (ILS) approaches. For example, the Runway 17R GPS approach can accommodate operations with visibility as low as 0.75 mile.

To prepare itself for further NextGen flight procedures and operational capabilities, the Airport should develop a comprehensive map of airspace obstructions in the vicinity of the Airport, including obstructions that impact one-engine inoperative departure surfaces. In the long term, it is recommended that the Airport monitor the progress of the FAA's NextGen program and actively collaborate with both the FAA and the air carriers to determine when additional new technologies should be installed at the Airport and who should be responsible for their implementation.

PASSENGER TERMINAL

The following summarizes general planning factors and assumptions used to derive facility requirements for key functional areas of the passenger terminal. Requirements were determined based on a multitude of factors, including Airport staff input, simulation modeling, facilities provided at comparable airports, knowledge of industry-wide trends, airline data, and guidelines published in the International Air Transport Associations (IATA's) *Airport Development Reference Manual*; FAA Advisory Circular (AC) 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*; and FAA AC 150/5300-13, *Airport Design*. Requirements were generated for aircraft gates, parking positions, passenger departure lounges, ticketing and check-in positions, passenger security screening, and baggage handling facilities.

Gates and Aircraft Parking

At present, 12 individual gates are provided on the apron surrounding the primary passenger concourse. Four additional gates are provided on the satellite concourse. Demand for active gate positions is summarized in Table 4-2 and estimated based on the following planning guidelines and assumptions:

- Because the aircraft gates are equivalent in terms of their capability to accommodate the aircraft within the fleet mix, any flight can be placed on any gate. However, preferential use of the gates was assumed to establish an upper bound for aircraft gate requirements.

- Gate occupancy times were set equal to those given in the future flight schedules in order to accurately simulate the duration that a given operation will require use of a gate. Gate occupancy times include schedule buffers to account for variability in the actual arrival and departure times of aircraft operations.

- A maneuver buffer of 5 minutes between aircraft for a particular gate was applied to represent the time required to park or push back from the gate.

Gate requirements are presented above in Table 4-2, Facilities Requirements Summary (see pages 4-5). As shown in Table 4-2, the existing twelve aircraft gates can accommodate the level of activity associated with PAL 3. Eleven of the twelve aircraft gates would be leased by airlines, and one gate would be "common use" serving a mix of airlines throughout the day. With the additional four gates on the satellite concourse, it is not expected that additional aircraft gates will be required within the planning period.

While the number of gates is adequate to accommodate demand, the loading bridges serving the gates may require modification. Analysis of the loading bridges indicates that the slopes are greater than the required standard of 8.3% for most regional jet and propeller aircraft. Alternatives to address the non-standard slopes should be explored.

Passenger Holdrooms

Requirements for holdrooms are directly related to the design aircraft size for each gate. Because each gate has the capability of serving each of the aircraft within the existing and projected fleet mix, each holdroom should be assumed to serve the largest aircraft that would likely serve the Airport. To establish an upper bound for the holdroom requirement, it was assumed that each gate would need to accommodate the Boeing 757-200 aircraft, with approximately 180 seats.

The number of passengers that were assumed to be accommodated in each holdroom is calculated assuming 80% of the design aircraft's passengers, with 65% of them requiring seats, and that standing and seated passengers occupy 10.8 and 16.6 square feet each, respectively. Using these assumptions, a Boeing 757-200 would require approximately 2,100 square feet of space; and a Boeing 737-900 would require approximately 1,700 square feet.

As shown in Table 4-2, the Airport will not require additional holdroom capacity throughout the planning horizon. The total required area for passenger holdrooms is approximately 25,000 square feet.

Ticketing Lobby

Approximately 30 passenger check-in positions are provided in the lobby areas on the upper level of the terminal. Future check-in facility requirements were based on the following assumptions and guidelines:

- Check-in positions will continue to be allocated on an exclusive-use basis to individual airlines (i.e. no sharing of facilities).

- Check-in positions process passengers at different rates. The rate at which passengers are processed with an agent or at kiosk when checking baggage is assumed to be 23.1 passengers per hour. The rate for passengers checking in at a kiosk without checking baggage is assumed to be 32.7 passengers per hour. Process rates are assumed to remain constant over the planning period, which is a conservative assumption given recent trends to separate check-in and boarding pass retrieval from baggage check. However, because of ongoing changes in airline check-in procedures and use of electronic kiosks, conservative assumptions are used to develop check-in requirements.

- Approximately 60% of passengers will require check-in facilities at the Airport at PAL 3 and beyond. The remaining 40% are assumed to check-in online or off-site.

- To maintain current passenger service levels, it was assumed that passengers can wait a maximum of ten minutes for check-in. Passengers will occupy 19.35 square feet per person at a level of service A.

As shown in Table 4-2, the Airport currently provides a total of 30 check-in positions, which is sufficient for activity levels up to PAL 3. The ticketing lobby has sufficient area to meet the spatial requirements for queues of passengers waiting to check-in for departing flights, provided that the EDS machines currently located in the lobby are removed when checked baggage security improvements are completed.

Passenger Security Screening

At present the security checkpoints provides four lanes for screening of passengers and their carry-on baggage. Future passenger security screening checkpoint requirements are based on the following planning guidelines and assumptions:

- Based on observations at the Airport, an average throughput of 135 persons per lane per hour was assumed. While technological improvements have the potential to increase passenger throughput over the planning period, enhanced security measures have also decreased passenger screening throughput (e.g. millimeter wave technology imaging versus the traditional magnetometer).

- Employee/crew screening demand was added to the passenger volumes at all checkpoints and was assumed to be 10% of daily enplanements.

- To provide desired levels of passenger service, it was assumed that passengers would wait a maximum of ten minutes for security screening. Passengers will occupy between approximately 14 and 19 square feet per person of space while waiting in the queue.

Table 4-13 shows that under these assumptions the existing capacity of the checkpoint is sufficient to meet the existing demand in terms of the number of lanes provided.[4] Approximately 800 square feet of space was provided for passenger queuing area at the front of the checkpoint at the time this analysis was completed. While the number of lanes may be adequate, the queue space is inadequate for the existing condition with four lanes. An expansion of the security screening checkpoint was since constructed that provides approximately 1,800 square feet of total queue space, as well as additional space for additional lanes.

With regard to future lane requirements, Table 4-13 shows that up to four additional lanes would be required over the planning horizon, with the first coming online at PAL 1, and the remaining three being required as early as PAL 2. At both PAL 2 and PAL 3, the model demonstrated that for nearly the entire day three additional lanes would satisfy demand; the fourth additional lane was only required to maintain the maximum ten minute wait time for approximately 30 minutes during the peak hour. It is important to note, however, that screening requirements vary depending on the prevailing security requirements enforced at any given time by the TSA. To that end, it is recommended that passenger checkpoints be reassessed regularly.

With regard to queue space, Table 4-13 provides requirements based on two levels of service (LOS A and C). The requirements are rooted in the International Air Transport Association (IATA) spatial requirements for ticketing and check-in. Table 4-13 also references the TSA's *Checkpoint Design Guide* which recommends a minimum of 300 square feet of queue per lane.

To better understand how the security checkpoint would function if it were constrained to a certain number of lanes, an additional model run was completed. The model applied the PAL 3 schedule to a security checkpoint limited to 6 lanes, which resulted in a maximum wait time of 25 minutes, with a queue of 337 passengers requiring about 4,700 square feet of queue space (at a level of service C). Typical wait time throughout the day (outside of the morning departure peak) was less than 10 minutes.

[4] Note: in the existing condition, the wait time occasionally exceeds 10 minutes, especially during peak periods. When the wait times exceed 10 minutes, the queue length is longer than optimal given the space allocated to queuing passengers.

Table 4-13
SECURITY CHECKPOINT REQUIREMENTS
Colorado Springs Airport

	Existing	Requirements PAL1	PAL2	PAL3
Forecast demand				
Annual enplaned passengers	929,600	1,215,200	1,644,900	1,910,500
ADPM passengers *(a)*	3,089	4,038	5,465	6,348
Peak hour passengers	617	760	994	1,269
Requirements				
Security lanes (ea)	4	5	7 - 8	7 - 8
Max queue (passengers)	170	115	166	173
Queue area (sf) *(b)*				
Level of service A	800	2,200	3,200	3,400
Level of service C	800	1,600	2,300	2,400
TSA CDG *(c)*	-	1,500	2,400	2,400

Notes: Blue shading highlights potential deficiencies.

(a) ADPM = average day, peak month
(b) Queue areas based on International Air Transport Association (IATA) levels of service (LOS) for ticketing and check-in queue: LOS A: 19.4 sf / passenger; LOS C: 14.0 sf / passenger
(c) TSA CDG recommends a minimum of 300 square feet per lane for passenger queuing.

Baggage Handling Systems

The four components of baggage handling systems assessed included: checked baggage security screening system, outbound baggage makeup, inbound baggage handling, and baggage claim lobby.

Checked Baggage Security Screening System

The Airport is currently designing a new checked baggage conveyance system which will replace the existing system. The explosive detection system (EDS) equipment currently in the ticketing lobby will be removed from the lobby, and the explosive detection procedures will be completed after baggage is checked. This system will be fully operational in late 2012. The system provides four zones, each with two EDS. Each EDS has the capacity to screen approximately 225 bags per hour. Using the TSA's methodology, it was determined that the system should be capable of serving the PAL 3 demand.

Outbound Baggage Makeup

As part of the checked baggage system, upgrades to the outbound baggage makeup capability were made. Most notably, the belt frontage for baggage carts is provided by four make-up units with a total linear frontage of 332 feet. With each baggage cart being approximately 12 feet in length, the new frontage provides for approximately 27 baggage carts at any one time. Assuming narrowbody aircraft require approximately 3 carts per departure, the system accommodates as many as 9 simultaneous departures. Notably, the forecast for PAL 3 estimates approximately 7 departures in the peak hour by a mix of narrowbody and regional jet aircraft.

Inbound Baggage Handling

The requirements for this functional element focused on identifying the linear frontage of belt required for offloading inbound baggage by airline baggage handlers. The existing baggage claim devices are direct feed devices. Therefore, a section of frontage of each device is exposed to the public (i.e. presentation frontage) and a non-public section is exposed to baggage handlers (i.e. offload frontage). Requirements were estimated using a planning ratio of 0.30 linear foot of offload frontage for every foot of presentation frontage. The existing offload frontage of over 200 feet is sufficient for the total presentation frontage of approximately 600 feet (a ratio of approximately 0.33).

Baggage Claim Lobby

Baggage claim facilities currently occupy approximately 15,000 square feet of space on the lower level of the terminal, providing approximately 600 linear feet of retrieval frontage on 6 different devices. Requirements for total baggage claim area and claim frontage were estimated based on the following guidelines and assumptions:

- Each baggage claim device would be allocated on a common use basis.
- Passengers unload from the aircraft at a rate of 6.3 seconds per passenger and the walk from the gate to the claim is approximately 7 minutes.
- Bags would be unloaded at a rate of 6.9 seconds per bag and take 10 minutes to reach the claim device for regional jets, and 15 minutes for narrowbody aircraft.
- Passengers that arrive ahead of their bags would accumulate around the claim device.
- Approximately 70% of passengers in the claim area would approach the device and the remaining 30% would be set back from the device.
- Each person in the baggage claim area requires 21.50 square feet of space in the claim area and two linear feet of the claim device.

Table 4-2 summarizes the requirements for baggage claim area. As shown, there is abundant device frontage and claim area provided throughout the planning period.

Concessions Space

Concessions space in the terminal totals approximately 18,100 square feet. Of the 18,100 square feet, 8,300 is airside (post-security) and 9,800 is landside (pre-security). At a small hub airport such as Colorado Springs, it is preferable to have the split between airside and landside at 65 percent airside and 35 percent landside in accordance with *ACRP Report 54: Resource Manual for Airport In-Terminal Concessions.* Concessions space should grow with passengers, and a planning factor of eight square feet per 1000 passengers, specific to the Airport was used to estimate future requirements. As shown in Table 4-2, the landside concessions space is adequately sized through PAL3. However, the airside concessions will require expansion after PAL1, growing to over 13,000 square feet by PAL3.

GROUND TRANSPORTATION AND PARKING

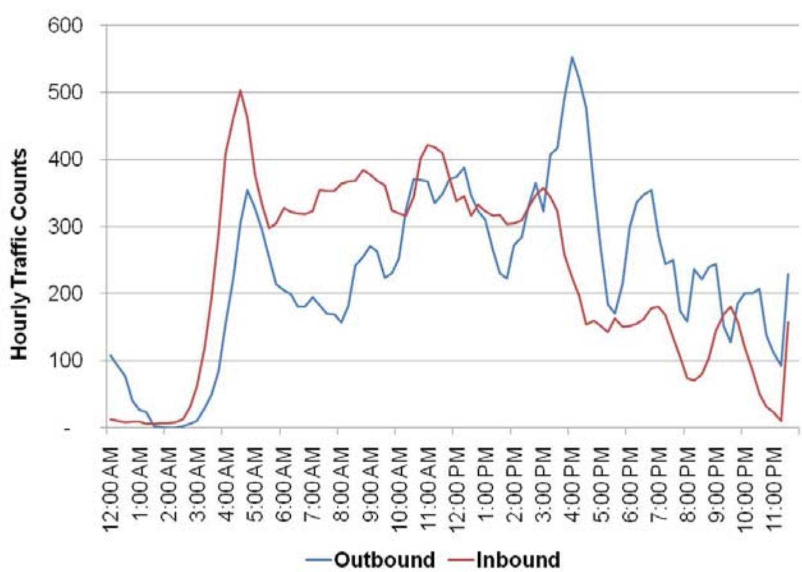
This section summarizes estimated requirements for ground transportation facilities including airport access roadways, curbsides, parking, and rental car facilities at the Airport. These requirements were developed based on data collected as part of the Airport's on-going data collection program, surveys conducted specifically for this Master Plan, anecdotal information from Airport staff, experience at comparable airports, and assumptions regarding desired service levels throughout the planning period.

Airport Access

Access roadway requirements are based on an analysis of current and projected design-hour traffic volumes for Milton E. Proby Boulevard. The projected design-hour volume was compared to the assumed hourly capacity to determine whether an acceptable level-of-service is and will continue to be provided. Using traffic counts obtained during June and July 2010, a peak hour demand was established recognizing that while a limited number of hours during the year may experience higher volumes, the selected hour is representative of traffic volumes experienced during a typical busy, but not holiday, period.

Figure 4-4 depicts the typical traffic volumes observed during the July 2010 traffic counts.

Figure 4-4
HOURLY TRAFFIC COUNTS FOR MILTON E. PROBY
Colorado Springs Airport



Source: LeighFisher analysis of Airport data from July 2010.

Projected traffic volumes for future PALs were calculated assuming that roadway traffic on Milton E. Proby Boulevard would increase at the same growth rate as average day peak month passengers. The future volumes were compared to the existing capacity to calculate a volume/capacity ratio that is indicative of level-of-service. A volume/capacity ratio of 0.6 or lower would indicate that roadways are performing at an acceptable level-of-service—during peak periods, traffic flows smoothly but vehicles are traveling close together and individual motorists find it more difficult to change lanes without other motorists' cooperation in providing a gap. This volume/capacity ratio threshold reflects a more-stringent standard than may be used for typical urban transportation planning because for roadways used by airline passengers, the potential result of congestion is that passengers may miss time-certain flights, whereas delays on regional roads are more likely to be merely an inconvenience.

As shown in Table 4-14, the current number of lanes on Milton E. Proby Boulevard (2 in each direction) is sufficient to accommodate peak hour demands at an acceptable level-of-service through PAL 3.

Table 4-14
ROADWAY REQUIREMENTS: MILTON E. PROBY BOULEVARD
Colorado Springs Airport

	Existing conditions	Future requirements		
		PAL 1	PAL 2	PAL 3
Demand				
Average day peak month passengers	3,089	4,038	5,465	6,348
Inbound peak hour volume (morning peak)	500	650	885	1,025
Outbound peak hour volume (afternoon peak)	515	675	910	1,060
Facility requirements				
Traffic lanes				
Inbound (morning peak)	2	2	2	2
Outbound (afternoon peak)	2	2	2	2

Source: LeighFisher, September 2010.

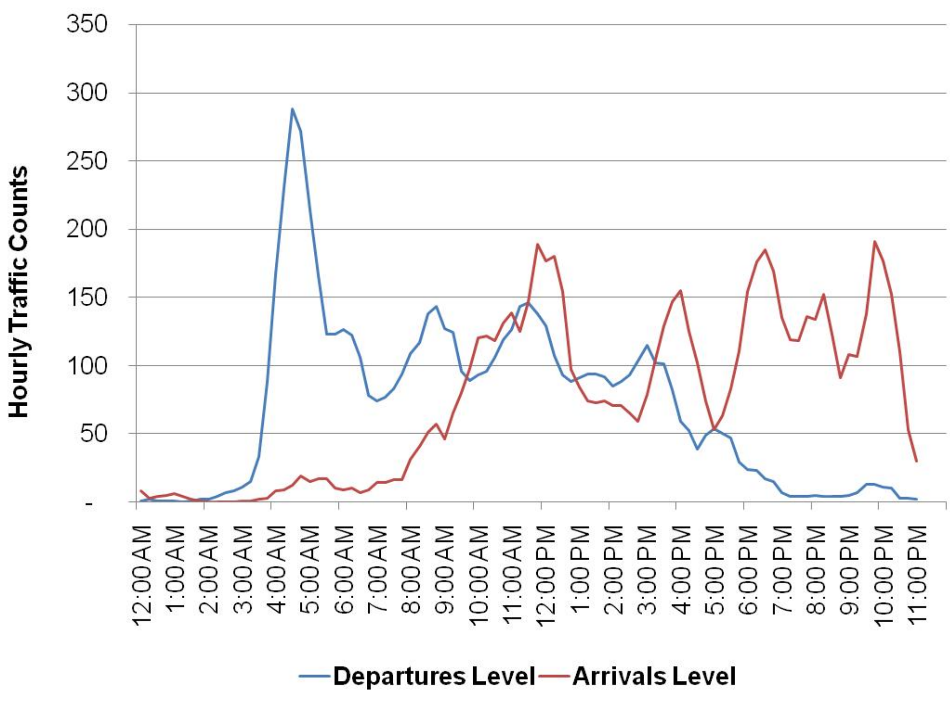
Curbside Facilities

The terminal curbside is configured in a two-level arrangement, with departing passengers dropped off on the departures level outside the ticketing lobby and arriving passengers picked up on the arrivals level. On both levels, the curbside area consists of an inner roadway predominately used by private vehicles and an outer roadway reserved for commercial vehicles.

Peak period demands for the departures and arrivals levels were determined using (a) traffic counts collected in June 2010, (b) vehicle classification surveys that estimated the portion of the volume comprised of different vehicle modes (e.g. private vehicles, taxicabs, courtesy vehicles), (c) commercial vehicle volume data collected by the Airport's automatic vehicle identification (AVI) system, and (d) surveys of dwell times for each mode.

Figure 4-5 summarizes the hourly volumes observed using the curbsides during busy days during the survey period. As shown, the departure level experienced one pronounced peak of 288 hourly vehicles from 4:30 a.m. to 5:30 a.m. while the arrivals level experienced several peak periods of similar magnitude (the highest peak, with an hourly volume of 191, occurred from 9:45 p.m. to 10:45 p.m.).

Figure 4-5
ROLLING 60-MINUTE CURBSIDE VOLUMES, TYPICAL BUSY DAY
Colorado Springs Airport



Source: LeighFisher analysis of Airport data from June 2010.

Table 4-15 summarizes the vehicle classification observed during the surveys. The results shown for the arrivals level reflect adjustments made to incorporate data provided by the

AVI system (which provided monthly volumes for all commercial vehicles, by service type). Given that the AVI data supporting the arrivals level classification provided a significantly larger sample size (and thus, a more reliable result) than the visual survey conducted for both levels (which was conducted over a limited number of hours over four days), it was determined that the arrivals level vehicle classification should be applied to the departures level as well.

Table 4-15

VEHICLE CLASSIFICATION SURVEY RESULTS

Colorado Springs Airport

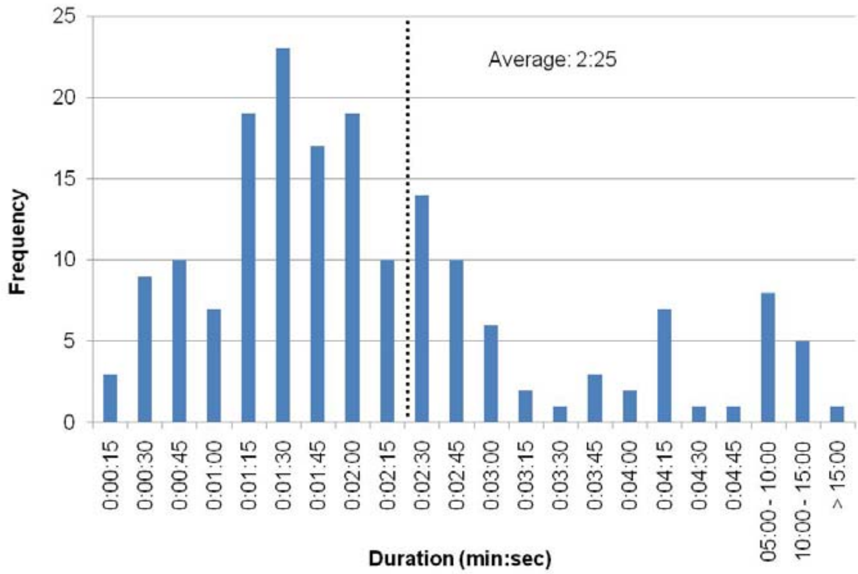
	Upper Level	Lower Level
Private vehicles *(a)*	89.3%	84.3%
Taxicab	4.2%	10.4%
Limousine	0.6%	0.5%
Hotel van	4.5%	3.2%
Rental car van	< 0.1%	< 0.1%
Scheduled	0.3%	1.0%
Military	0.3%	0.5%
Charter van/bus	0.3%	0.1%
Airport vehicle	0.3%	0.1%
Total	100.0%	100.0%

(a) Includes rental cars.

Source: LeighFisher analysis; data provided by Colorado Springs Airport.

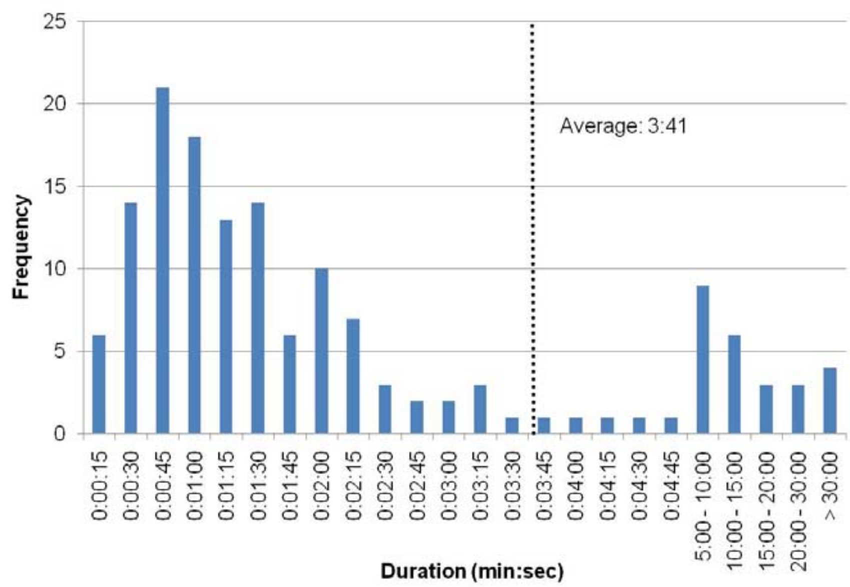
Figures 4-6 and 4-7 summarize the distribution of dwell times observed on the curbsides during the surveys conducted in May 2010. As shown, the average dwell times for private vehicles on the departures and arrivals levels were 2.25 minutes and 3.41 minutes, respectively. Average surveyed dwell times for commercial vehicles on the departures level were 2.18 minutes for taxicabs and 1.32 minutes for hotel/motel courtesy vehicles. On the arrivals level, dwell times were measured for hotel/motel courtesy vehicles and large buses. On-demand services, such as taxicabs, were not surveyed because these vehicles are expected to be stationed at the curbside waiting for passengers. The average arrivals level dwell time for hotel/motel courtesy vehicles was 6.43 minutes.

Figure 4-6
DWELL TIME DISTRIBUTION—PRIVATE VEHICLES UPPER DRIVE (n-178)
Colorado Springs Airport



Source: LeighFisher analysis of Airport data from March 2010 – May 2010.

Figure 4-7
DWELL TIME DISTRIBUTION—PRIVATE VEHICLES LOWER DRIVE (n=150)
Colorado Springs Airport



Source: LeighFisher analysis of Airport data from March 2010 – May 2010.

Based on the passenger forecasts provided in Chapter 3, curbside traffic volumes for the future PALs were calculated assuming that volumes would increase at the same growth rate as average day peak month (ADPM) passengers. Curbside requirements were then calculated as follows:

- Volumes were combined with the average dwell times and vehicle classification information to determine the average number (50th percentile) of vehicles stopped simultaneously on each curb during the busy hours.
- The curbside requirement was then estimated using a Poisson distribution to determine the amount of curbside needed to meet the demand with a 95th percentile confidence.
- For the inner lanes of the upper and ground level, the requirement was adjusted to assume approximately 30% double-parking. On the outer lanes where curbside space is reserved for specific commercial vehicle modes, no double-parking was assumed.
- For the arrivals level, curbside requirements were recalculated assuming a shorter dwell time recognizing that (a) 3.41 minutes is excessive compared to dwell times observed at other airports and (b) shorter dwell times can be achieved through active and visible enforcement of curbside rules.

Table 4-16 summarizes the required curbside length throughout the planning period. The departures level provides approximately 950 linear feet of curbside on the inner lanes and 1,065 feet of curbside on the outer lanes. The arrivals level provides approximately 925 linear feet of curbside on the inner lanes and 975 feet of curbside on the outer lanes. As shown, the existing curbsides have sufficient capacity to meet demand through PAL 3. However, on both levels, almost all curbside activity occurs in a 300-foot-long area immediately in front of the building. As demand exceeds 300 feet, congestion will increase in front of the terminal and drivers will increasingly pick up and drop off passenger further from the building.

Table 4-16
ESTIMATED CURBFRONT REQUIREMENTS
Colorado Springs Airport

	Existing	PAL1	PAL2	PAL3	Dwell time assumption (minutes)
Departures curbfront					
Inner curb (private vehicles, taxis)	290	365	480	560	2:25
Outer curb (courtesy vehicles)	85	170	170	170	varies
Arrivals curbfront					
Inner curb (private vehicles)	270	345	440	480	3:40
Outer curb (commercial vehicles) *(a)*	290	290	290	290	varies
Arrivals curbfront reduced dwell times					
Inner curb (private vehicles)	190	210	290	345	2:25
Outer curb (commerical vehicles) *(a)*	290	290	290	290	varies

(a) Requirements for outer arrivals curb is governed by functional needs of commercial operators as opposed to peak period demand.

Source: LeighFisher analysis; data provided by Colorado Springs Airport.

Parking

The Airport operates parking facilities on-Airport for both the traveling public and Airport employees. The following paragraphs describe future requirements for vehicular parking throughout the planning period.

Public parking

The Airport currently provides a total of 4,635 public parking spaces: 716 in the short term surface lot, and 3,919 in the long term surface lot. The Airport currently does not offer covered parking on-Airport.

Table 4-17 presents the estimated public parking requirements throughout the planning levels. Public parking requirements are presented for:

- Design day demand – Used to estimate future needs for permanent parking facilities, the two on-Airport surface lot, "design day" parking demand is based on the observed peak parking occupancy on an average peak day (Thursday) in a busy month (June). Parking demand is expected to increase at a rate proportional to the increase in peak month passenger level. Design day parking requirements also include a 10% circulation factor to account for a typical parker's ability to locate the last available spaces in a parking facility.

- Holiday/overflow demand – Used to estimate future needs during particularly busy holiday travel periods, holiday/overflow demand is based on the highest observed occupancy in 2009 and is expected to increase at a rate proportional to the increase in peak month passenger level. Holiday/ overflow demand does not include a circulation factor. Often, holiday/overflow demand that cannot be accommodated in the permanent parking facilities can be accommodated in temporary surface lots or within parking facilities usually reserved for other uses (such as employee parking).

As shown in Table 4-17, the existing parking facilities are adequate for the current parking demand. Parking demand during the "design day" is expected to grow from 2,750 to 5,650 at PAL 3. The existing parking facilities will provide sufficient public parking spaces until just prior to PAL 2. Holiday parking demand will exceed public parking capacity beyond PAL 1.

Table 4-17
ESTIMATED PUBLIC PARKING REQUIREMENTS
Colorado Springs Airport

		Estimated requirements (number of spaces)		
	Existing *(c)*	PAL 1	PAL 2	PAL 3
Demand				
Annual enplaned passengers	929,600	1,215,200	1,644,900	1,910,500
Average day, peak month passengers	3,089	4,038	5,465	6,348
Requirements				
Design day parking *(a)*	2,750	3,600	4,850	5,650
Holiday period long-duration parking *(b)*	3,200	4,200	5,650	6,550

(a) Design day requirements include a 10% surplus to account for a parker's inability to locate the last parking space.
(b) Does not include 10% surplus.
(c) The existing design day requirement of 2,750 parking spaces and holiday requirement of 3,200 parking spaces is less than provided at the Airport today (4,635).

Notes: Public parking requirements based on 2009 activity.
Holiday period long-duration parking requirements based on 2009 Christmas season peak occupancies in the public parking facilities.
Requirements were assumed to increase at the same rate as the number of enplaned passengers.

Source: LeighFisher, July 2010.

Employee parking

The Airport currently provides a combined 704 employee parking spaces in the East Manager Lot, the West Manager Lot, the West Auxiliary Lot, and the Far West Employee Overflow Lot. Employee parking requirements were calculated as follows:

- Surveys conducted by Airport staff during August 2010 indicated that during typical busy periods of the week, approximately 340 vehicles were parked in the Airport's employee parking facilities.

- It was assumed that future employee parking demand would increase in direct proportion to the combined growth rate of annual passengers and annual aircraft operations.

- Requirements were calculated by adding 5% to the anticipated peak demand recognizing a driver's difficulty in locating the last available spaces in a parking facility approaching capacity.

Table 4-18 presents the estimated employee parking requirements through PAL 3. As shown, existing facility capacity is expected to be sufficient to meet future requirements beyond PAL 3.

Table 4-18
ESTIMATED EMPLOYEE PARKING REQUIREMENTS
Colorado Springs Airport

	Existing *(a)*	PAL 1	PAL 2	PAL 3
Annual enplaned passengers	929,600	1,215,200	1,644,900	1,910,500
Annual aircraft operations	32,508	38,500	47,300	51,400
Blended growth rate from prior PAL		24.6%	29.1%	12.4%
Employee parking requirements	360	450	580	650

(a) Requirements based on 2009 activity; requirements include a 5% surplus to account for a parker's inability to locate the last parking space. The existing requirement of 360 parking spaces is less than provided today at the Airport (704).

Source: LeighFisher, July 2010.

Rental Car Facilities

Rental car facility requirements are based on (1) existing activity of the rental car companies serving the Airport, (2) interviews with Airport management and rental car company staff conducted as part of rental car analyses conducted in prior years for the Airport, and (3) industry standards and observations of rental car operations at comparative airports, including recently completed operating models. Requirements for future PALs are based on the projected growth of enplaned passengers.

At present, seven rental car companies operate from on-Airport property with their ready/return facility next to the short term parking lot and one brand operates from off-Airport site. Future rental car requirements assume (1) the on-Airport companies will continue to operate from counters inside the terminal and ready/return facilities in the same location throughout the planning period and (2) space is reserved for the off-Airport operator to move on-Airport.

Table 4-19 summarizes the rental car requirements and details the size and timing of growth in future facilities. Approximately 545 spaces are required at PAL 1, with 855 spaces required at PAL 3. The capacity of the existing ready/return facilities is 768 spaces, which would provide adequate spaces through PAL 2. The current 22 acres reserved for services centers is sufficient to meet service center demand beyond PAL 3.

Table 4-19
RENTAL CAR REQUIREMENTS
Colorado Springs Airport

	Existing	PAL 1	PAL 2	PAL 3
Ready/return stalls	768	545	735	855
Service centers (acres) *(a)*	22.00	12.88	17.40	20.27

Note: Blue shading highlights potential functional deficiencies.
(a) Includes fuel, wash, support, storage, and administration facilities.

Source: LeighFisher, July 2010.

AIR CARGO AND GENERAL AVIATION

This section provides an overview of airport facilities required to accommodate air cargo and general aviation aircraft operations at the Airport throughout the 25-year planning period.

Air Cargo

Estimated requirements are provided for cargo warehousing, aircraft parking, and land. Estimates are based on industry best practices related to cargo planning. The following assumptions were developed to identify general aviation spatial requirements:

- The aircraft cargo apron should be capable of accommodating the total number of average daily departures;
- To be conservative, mainline aircraft were assumed to require 50,000 square feet of apron; and feeder aircraft were assumed to require 15,000 square feet of apron;
- A cargo warehouse space utilization factor of 1.5 square feet per ton was used for future warehouse requirements;
- Total land required for cargo use is equivalent to the apron, landside, and warehouse spatial requirements with a 15 percent factor applied.

As shown Table 4-20, the existing land allocation of 13.8 acres is sufficient to accommodate the increased demand. This finding is consistent with expectations, as cargo aircraft operations are not expected to grow over the planning horizon. While cargo tonnage is expected to grow over the planning horizon, aircraft operations are not expected to grow as there is additional lift capacity to ship additional cargo tonnage on the aircraft currently operating in the market, and the cargo airlines would likely up-gauge the aircraft before adding flights. In addition, warehouse space currently available on the airport appears to be capable of accommodating the increase in cargo tonnage.

Table 4-20
CARGO FACILITY REQUIREMENTS
Colorado Springs Airport

	Existing	PAL 1	PAL 2	PAL 3
Demand				
Annual cargo tonnage				
All-cargo	11,426	13,890	16,600	18,240
Belly cargo	58	78	86	91
Total	11,484	13,968	16,686	18,331
Annual departures				
Mainline aircraft	491	480	490	490
Feeder aircraft	335	340	340	340
Total	826	820	830	830
Average daily departures				
Mainline aircraft	2	2	2	2
Feeder aircraft	1	1	1	1
Total	3	3	3	3
Facility Requirements				
Belly cargo				
Aircraft apron *(a)*	15,200	15,200	15,200	15,200
Building warehouse *(b)*	10,300	10,300	10,300	10,300
Landside area *(c)*	39,300	39,300	39,300	39,300
All-cargo (Other) *(d)*				
Aircraft apron *(a)*	79,400	15,000	15,000	15,000
Building warehouse *(b)*	18,700	1,000	1,200	1,400
Landside area *(c)*	27,500	1,000	1,200	1,400
All-cargo (FDX)				
Aircraft apron *(a)*	292,500	100,000	100,000	100,000
Building warehouse *(b)*	29,900	19,800	23,700	26,000
Landside area *(c)*	63,300	19,800	23,700	26,000
Total all-cargo				
Aircraft apron *(a)*	371,900	115,000	115,000	115,000
Building warehouse *(b)*	48,600	20,800	24,900	27,400
Landside area *(c)*	90,800	20,800	24,900	27,400
Total cargo area (acres) *(e)*	13.8	5.8	6.1	6.2

(a) Mainline aircraft assumed to require 50,000 square feet of apron and feeder aircraft, 15,000 square feet.
(b) A cargo warehouse building utilization of 1.5 square foot per ton was assumed.
(c) Landside area is considered to be approximately equivalent to building warehouse area required.
(d) Cargo carriers, other than Fedex, would be accommodated at "Other" all facilities.
(e) Total cargo area = apron + warehouse + landside areas with a 15% factor applied.

Source: LeighFisher, October 2010.

General Aviation

General aviation requirements are expressed in terms of the total land area and the location/site needs that will be required over the planning period. The following assumptions were developed to identify general aviation spatial requirements:

- For itinerant aircraft parking, fifty percent of the average day, peak month departures should be accommodate simultaneously.
- For based aircraft parking, hangar storage should be provided in accordance with the forecast of based aircraft.

General aviation facilities and future total land area requirements are summarized in Table 4-21. As presented, forecast demand does not necessitate an increase in total land area dedicated to general aviation beyond the existing 42 total acres; however, there is a need to provide additional hangars for the projected increase in the high-end general aviation turbojet fleet mix.

Table 4-21

GENERAL AVIATION REQUIREMENTS

Colorado Springs Airport

	Existing	PAL1	PAL2	PAL3
Demand (itinerant aircraft operations)				
Annual total	34,739	39,350	44,870	48,590
Peak month	3,821	4,329	4,936	5,345
Average day, peak month (ADPM)	123.27	139.63	159.22	172.42
ADPM departures	62	70	80	86
Facility requirements				
Itinerant aircraft apron requirement (sf)*(a)*	342,900	104,722	119,412	129,312
Based aircraft storage (sf)				
Tie-down *(b)*	237,300	130,000	137,000	140,000
T-hangar *(c)*	264,200	184,000	194,000	198,000
Corporate/community hangar *(d)*	200,300	306,000	426,000	514,000
Subtotal hangar space	464,500	490,000	620,000	712,000
Total aircraft storage space	701,800	620,000	757,000	852,000
GA terminal/administrative space (sf)*(e)*	17,000	24,500	31,000	35,600
Automobile parking (sf) *(f)*	171,000	147,000	186,000	213,600
Fuel storage (sf) *(g)*	59,000	11,700	12,800	13,500
Land (acres) *(h)*	42.3	20.8	25.4	28.6

Note: Blue shading highlights potential functional deficiencies.

(a) Assumed 3,000 square feet per aircraft and 50% of ADPM aircraft simultaneously at airport.

(b) Assumed 2,700 sf for single-engine, multi-engine and helicopters.

(c) Assumed 1,500 sf per single-engine aircraft; 2,500 sf for multi-engine aircraft.

(d) Assumed 2,500 sf per multi-engine aircraft, turboprops, and helicopters; 5,100 sf per jet engine aircraft.

(e) Terminal and administrative space estimated at 5% of the total hangar space.

(f) Automobile parking based on existing ratio between parking and hangar space, approximately 30%.

(g) Fuel storage estimated at 5% of total apron requirement (itinerant and storage).

(h) Total acreage estimated by adding apron space, buildings, parking, and fuel storage.

Source: LeighFisher, October 2010.

AVIATION SUPPORT FACILITIES

The following identifies the size, general configuration, and approximate location of land areas that should be reserved for aviation support functions, including aircraft rescue and fire fighting facilities (ARFF); Airport administration facilities; Airport maintenance; aircraft maintenance facilities; and glycol and deicing fluid storage; and fuel storage facilities.

Aircraft Rescue and Fire Fighting

The Airport is certificated by the FAA to serve certain air carrier operations, under 14 CFR Part 139, Certification of Airports. Part 139 requires airport operators comply with safety and emergency response requirements, including aircraft rescue and firefighting (ARFF) services. ARFF requirements are grouped into indexes and the type of ARFF services required for each index depends on the type of air carrier aircraft serving the airport. As the largest air carrier aircraft the Airport services is less 158 feet long, FAA requires the Airport to comply with Index C ARFF requirements. Based on the projected fleet mix and existing ARFF services provided, it is not expected that additional ARFF facilities or equipment will be required throughout the planning period. In addition, the ARFF stations currently are sited so that emergency response times meet FAA requirements.

Airport Administration

Airport management offices encompass a total of approximately 16,000 square feet, and are located among the three levels of the passenger terminal building. The Airport staff comprises approximately 120 employees. The administration space requirements are well understood, and the administrative space on the third level of the terminal building (approximately 10,000 square feet) is to be reconfigured and expanded to provide more efficient space in 2012. No additional space is needed over the planning period.

Airport Equipment and Maintenance

Airport maintenance equipment is housed on a ten-acre site with five buildings used for the storage and maintenance of airfield and airport maintenance equipment. Airport and airfield maintenance facilities needs do not necessarily increase proportionally to activity but are more a function of the overall pavement and grassy areas requiring maintenance and climatic conditions (for snow/ice removal). In addition, the condition of airside facilities dictates maintenance requirements, as pavements in poor condition require more maintenance equipment and personnel than do those in good condition.

The current facility is in good condition and adequately sized to accommodate the existing maintenance fleet; however, the facility is located on the southwest corner of the Airport immediately west of the Runway 35L end. Based on anecdotal information from Airport staff and an inventory of existing facilities, an additional maintenance facility may be warranted to house snow removal equipment (SRE) on the east side of the airport. The goal of constructing additional SRE is to achieve increased efficiency for snow removal operations that occur on the east side of the Airport. Due to its length and the fact that Runway 17L-35R is equipped with an ILS on both ends, it is most capable of handling aircraft during inclement weather. However, the existing SRE facility is located on the southwest side of the airport and results in time-consuming preparation and travel to the Airport's primary runway.

Aircraft Maintenance

Requirement for facilities that are leased by or directly support airline operations are typically established based on airline business decisions. Nevertheless, the following provides a general overview of future airline support requirements.

Skywest Airlines, a United Airlines regional/commuter affiliate, operates from a 100,000 square-foot maintenance facility located off Taxiway A. This facility is sized for the maintenance of multiple commuter and regional aircraft. To provide the potential for long-term airline maintenance requirements, a site of similar size should be reserved that would be capable of accommodating an aircraft maintenance facility for a new generation Boeing 737 or equivalent narrowbody aircraft. In addition, the former Western Pacific maintenance hangar (building number 24 on Figure 2-10 in Chapter 2) provides additional capacity for aircraft maintenance. The facility, currently leased to the Colorado jetCenter FBO, is approximately 23,000 square-feet with a 120 foot door span.

De-icing Fluid Storage and Processing

During the spring and summer months when deicing is typically not required, the runoff from the terminal apron is collected via the apron drainage system and discharged directly into the storm sewer system. During the winter months, deicing fluid is recovered by the apron drainage system surrounding the deicing areas and diverted from the storm sewer system to a glycol solution holding pond, located west of the passenger terminal area and east of the Runway 35L end. The holding pond has a capacity of 16 acre-feet. When the holding pond is approximately two-thirds full, the glycol solution is pumped to a pretreatment pond with a capacity of 4 acre-feet. This transfer is typically completed once per year. Once the glycol solution is treated in accordance with the wastewater discharge permit, the solution can be discharged into the sanitary sewer.

De-icing fluid is stored on the west ramp in four storage tanks and approximately 19 glycol totes with a total capacity of approximately 47,190 gallons (based on data from 2010). The deicing fluid consists of Propylene glycol Type I (mixture of water and glycol) and Propylene glycol Type IV (100% glycol). Over the last ten-years, the average number of glycol solution gallons used annually was approximately 75,000 gallons with a maximum of 114,000 gallons, which correspond to approximately 6% and 9% of the 4 acre-foot pretreatment pond. The peak usage would only require about 2% of the holding pond's capacity, and the holding pond could be emptied more than once a year, should circumstances require as much. Even if glycol solution usage doubled from its peak of 114,000 gallons to 228,000, only 17% of the capacity of the pretreatment pond would be required. Accordingly, no additional capacity is expected to be required throughout the planning period.

Airport Beacon

The Airport Rotating Beacon is planned to be relocated in the near future. Currently, it is mounted on top of Peterson Air Force Base Building 979. The existing beacon has reached the end of its useful life and does not meet current clearance requirements that are outlined in the FAA Advisory Circular 150/5300-13A, *Airport Design*. Additionally, it is shadowed by multiple obstructions and is not visible from certain parts of the airfield and air in the vicinity of the Airport.

PAFB Building 979 has been designated as a Colorado State historical structure and cannot be modified to raise the elevation of the beacon, so the Airport must designate a new location. A site survey will be completed to determine a suitable location and the Airport will work with a selected contractor to develop specifications and plans to have a new beacon procured and installed.

Fuel Storage and Distribution

The following paragraphs describe the requirements for Airport fuel storage facilities. Fuel storage requirements are not addressed for the military, since the Air Force assumes responsibility for their own fueling. For the passenger airlines, fuel storage requirements are expressed both in terms of gross tank storage volume and land area required.

Passenger Terminal Fuel Farm

Jet fuel used by the airlines is stored in four 50,000-gallon tanks located directly east of the passenger terminal building. Requirements for fuel storage are based on historical analysis of fuel flowage and aircraft operations data from 2010, as well as the following planning guidelines and assumptions:

- In 2010, an average of 10,512 gallons of jet fuel per day was dispensed from the passenger terminal fuel farm for approximately 52 daily aircraft departures. On average, each departure uploaded 202 gallons of fuel.
- Historical aviation fuel reserves (in days' supply) were estimated by dividing the net usable storage capacity by the average daily fuel dispensed.[5] The net usable storage capacity was assumed to be 90% of the gross storage capacity of the tanks and equals 180,000 gallons. The farm typically had over 17 days' supply of reserve fuel during 2010.
- Future jet fuel requirements are estimated by applying average jet fuel dispensed per aircraft departure to the forecast average day peak month (ADPM) commercial operations forecast. As described in the Aviation Demand Forecasts chapter, APDM activity accounts for 9.5% of the annual total.
- At present, approximately 200,000 gallons of jet fuel are stored on a 0.5 acre site that includes areas for storage tanks and facilities to support the fueling operation.

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[5] The number of days' worth of fuel stored on-site in reserve is an airline business decision and it is difficult to estimate which reserve period is most appropriate in determining fuel storage requirements. In addition, the number and configuration of the tanks provided are ultimately determined by the airlines based on operating considerations, such as the tank filling and fuel settling process, as well as the reserve supply desired.

This amounts to a planning factor of 0.104 square feet of land per gallon of storage, which is assumed to remain constant over the planning period. While conservative, this assumption ensures the sufficient area for ancillary facilities relating to fuel storage (load racks, truck parking, etc) is preserved.

Table 4-22 summarizes the gross volumetric storage and land area requirements for future fueling facilities. As shown, the existing fuel farm easily exceeds the demand throughout the planning period. At PAL 3, storage requirements range from approximately 112,000 gallons for a 7-day reserve supply to 160,000 gallons for a 10-day reserve supply, occupying land areas between approximately 0.27 and 0.38 acres. Given the size of the site and the amount of storage available, no fuel farm improvements are warranted over the planning period.

Table 4-22
PASSENGER TERMINAL FUEL FARM STORAGE REQUIREMENTS
Colorado Springs Airport

	Estimated requirement			
	Baseline	PAL 1	PAL 2	PAL 3
7-day reserve supply				
Storage requirement (gal)	74,000	83,000	103,000	112,000
Land are requirements (acres)	0.18	0.20	0.25	0.27
10-day reserve supply				
Storage requirement (gal)	105,000	119,000	148,000	160,000
Land are requirements (acres)	0.25	0.29	0.36	0.38

Notes: The number and configuration of fuel tanks are a business and operations decision, determined by the airlines or fuel farm operator.

Source: LeighFisher, February 2010.

General Aviation Fuel Farms

Cutter Aviation, Colorado jetCenter, and JHW each store and provide aviation fuels at their facilities. In addition to serving general aviation aircraft, Colorado jetCenter provides fuel to commercial and transient military aircraft. It is not expected that additional general aviation fuel storage capacity will be required during the planning period because:

- None of the three FBOs expressed concern regarding fuel storage capacities during discussions regarding future needs.

- Growth in operations by smaller general aviation aircraft that are fueled by AvGas is expected to be minimal as overall general aviation operations are expected to grow at 1.1% per year with much of the growth in the business general aviation aircraft fueled by Jet A fuel.

- The existing capacity for AvGas of 44,000 gallons is likely sufficient to accommodate the modest growth, as the peak month required approximately 22,000 gallons in 2009 and 16,000 gallons in 2010.

- Finally, the existing area dedicated to general aviation fuel storage is likely adequate to accommodate additional AvGas or Jet A tanks if the FBOs desired additional storage capacity.

Table 4-23 provides a summary of the estimated future demand and existing capacity of the general aviation fuel storage tanks.

Table 4-23
GENERAL AVIATION FUEL STORAGE
Colorado Springs Airport

	Average day, peak month demand *(a)*	Cutter Aviation	Colorado jetCenter	JHW	Total
Jet A					
Number of tanks	-	1	4	2	7
Tank capacities (gallons)	-	12,000	50,000	10,000/12,000	-
Total storage capacity	15,203	12,000	200,000	22,000	234,000
AvGas					
Number of tanks	-	1	1	1	3
Tank capacities (gallons)	-	12,000	20,000	12,000	-
Total storage capacity	719	12,000	20,000	12,000	44,000

Source: Colorado Springs Airport records.

SUMMARY

In summary, most Airport facilities currently have sufficient capacity to accommodate forecast activity levels throughout the planning period. However, a number of facilities will need to be modified or expanded throughout the planning period to accommodate future activity, improve Airport operational capabilities or levels of service, or meet key design standards. Notable requirements over the course of the forecast period include:

- **Airfield –** The existing airfield facilities provide sufficient capacity to accommodate baseline forecast aircraft operations through PAL 3. Existing air traffic control facilities at the Airport are sufficient to effectively support airfield and airspace operations at the Airport through the end of the planning period. The intersection of Runway 17R-35L and Runway 13-31 should also be addressed from a geometrical perspective because the unique layout could lead to potential runway incursions. In addition, an extension to Runway 17R-35L should be considered to better serve the Airport when Runway 17L-35R is unavailable. Analyses of weather data for the

Airport indicate a need to enhance the instrument landing systems to Category II/III capability.

- **Passenger terminal –** The existing passenger terminal footprint is adequate to serve the projected needs of the Airport throughout the planning period. Future requirements project the need for targeted improvements to specific functional elements such as the passenger screening facilities.
- **Ground transportation –** The public parking lot may need to be expanded as PAL2 is realized. In addition, the rental car ready/return lot may need expansion at or around PAL3. Other ground transportation facilities appear to be adequate throughout the planning period.
- **Air cargo –** No cargo expansion is likely to be required for the duration of the planning period. However, to ensure that additional carriers can be accommodated should market demand prove necessary, additional cargo space should be reserved on the Airport.
- **General aviation –** Forecast general aviation demand will not necessitate an increase in total land area dedicated to general aviation, although additional hangar capacity may be needed to accommodate growth in demand, as early as PAL 1. In addition, general aviation administrative space and automobile parking may need to be expanded sequentially at PAL1 and PAL2, respectively.
- **Aviation support –** Aviation support facilities appear to be capable of accommodating PAL 3 demand with only minor improvements over the planning period, as necessary.

In summary, the Airport is in excellent condition to accommodate PAL 3 demand with selected improvements to be made throughout the planning period.