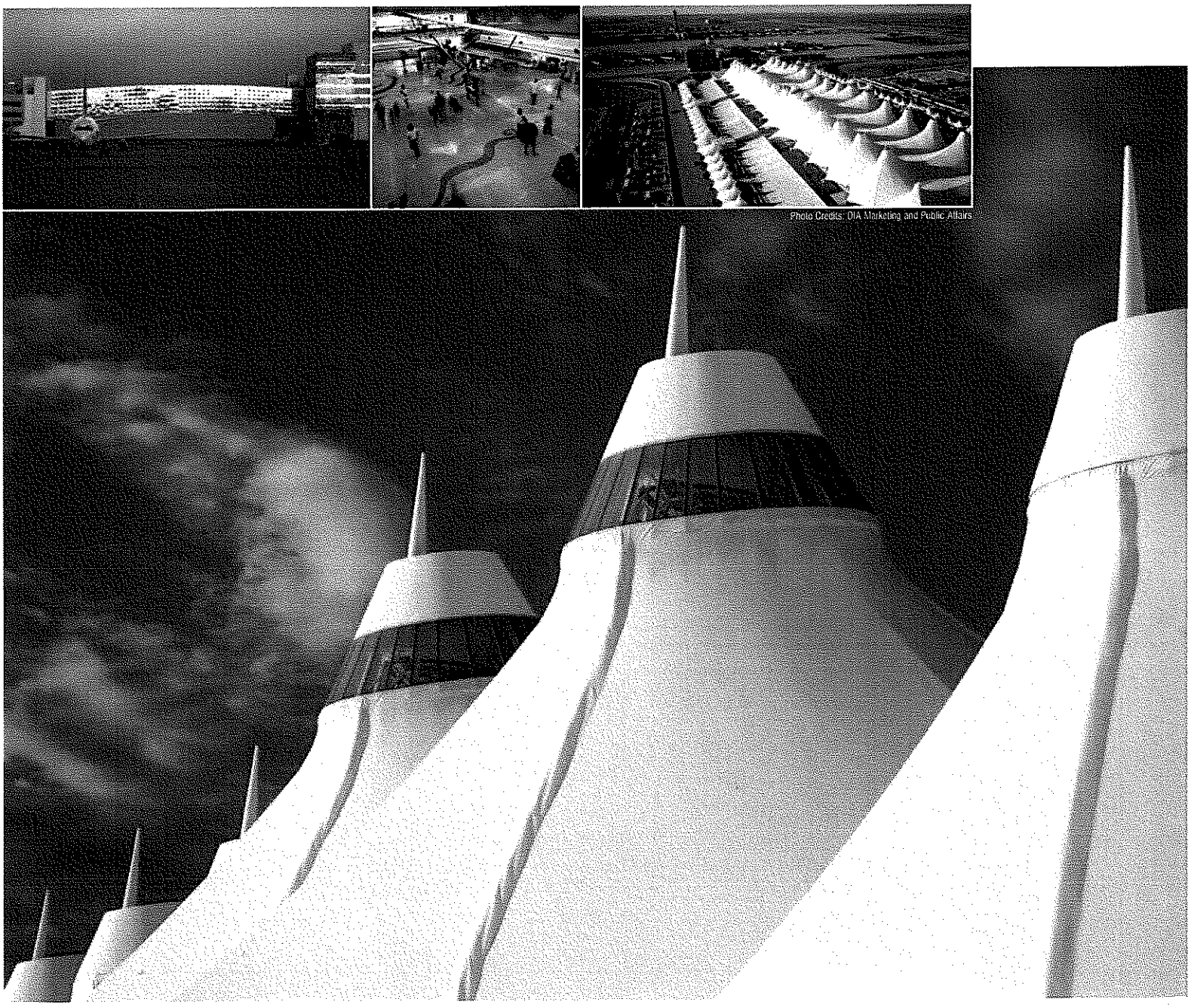
Denver International Airport
City and County of Denver
Department of Aviation

DENVER INTERNATIONAL AIRPORT

Airport Layout Plan Narrative Report

October 7, 2004



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1. Introduction

Denver International Airport (DIA or "the Airport") opened on February 28, 1995, replacing Stapleton International Airport, which had served Denver's air carrier airport needs for over 65 years. The new Airport was designed with the capability to be expanded to meet the Denver metropolitan area's commercial air transportation needs for at least the next 50 years with planned development of 12 runways, five concourses, and 300 narrowbody aircraft gates. Special emphasis was placed on designing the airfield to maximize capacity (and thus minimize delays) during low visibility and/or snow conditions. Passenger enplanements, aircraft operations, and air cargo processing have all increased since the opening of the Airport. In 2003, the Airport handled 37.5 million passengers, 510,000 aircraft operations, and more than 65.3 million pounds of air cargo.[1]

At opening, initial development consisted of five 12,000-foot runways (three north-south runways and two east-west runways), a terminal complex with three concourses, the 14-mile Peña Boulevard and associated supporting roadways and parking facilities, cargo facilities, aircraft maintenance facilities, general aviation and flight catering/kitchen facilities, and several city and Federal Aviation Administration (FAA) buildings. Phase 1 originally included several additional projects that were not initially constructed due to financing considerations. These projects included an additional 16,000-foot runway (Runway 16C-34C), several taxiways, and a third lane in each direction on Peña Boulevard.[2] These facilities were deferred into "Phase 1-A," which was anticipated to be implemented within five years after opening. The final Federal Environmental Impact Statement (EIS), approved on September 27, 1989, considered both Phase 1 and Long-Range facility development.

The purpose of this document is to provide general information about the future development of the Airport and to provide a narrative supplement to the Airport Layout Plan (ALP) that is being filed with the FAA.[3]

The remainder of the document is divided into four major sections. The following section, Section 2, summarizes the aviation activity forecasts that were completed in 2001. The section also compares the forecast with the most recent Terminal Area Forecast prepared by the FAA. Section 3 provides an overview of the Airport and its land uses, identifies the design standards applied at the Airport, and discusses modifications to those design standards. It also outlines airport land use, the ultimate airfield plan, and airport development issues. Section 4 summarizes the basis for future development of the Airport and identifies the projects that will occur in the near- and long-term future. Section 5 discusses the community involvement and agency coordination programs that have been in place at the Airport since its opening.

[1] DIA Airport Business – Traffic Reports, December 2003

[2] Runway 16C/34C was opened in September 2003 and is initially named Runway 16R/34L. This designation will be used throughout the document.

[3] As a federally obligated airport, development at DIA needs to be accomplished in accordance with an FAA-approved Airport Layout Plan (ALP), which must be accompanied by a narrative that explains a systematic rationale for development and associated analyses.

2. Summary of Aeronautical Forecasts

2.1 Overview

Aviation activity projections play an important role in defining airport improvement projects and strategies for developing new facilities. Among other things, aviation activity forecasts are used to:

- Project the future role of an airport by identifying the type of aircraft that will need to be accommodated at an airport and the type of aviation demand that will be served over the foreseeable life of an airport,
- Evaluate the capacity of existing airport facilities and their ability to absorb projected aviation demand, and
- Identify the extent to which existing facilities should be improved to ensure that airport growth is not constrained or estimate the type and size of additional airside and landside facilities that need to be provided at an airport in future years.

Two different forecasts have been prepared for the Airport in recent years. The first forecast is the 2004 Terminal Area Forecast (TAF) prepared by the FAA's Aviation Policy and Plans Office (APO). The second forecast was developed in support of the Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Study by Ricondo & Associates, Inc. (R&A) in 2001, prior to the events of September 11, 2001.

2.2 Terminal Area Forecast

The first forecast is the 2004 TAF prepared by the FAA. These forecasts are prepared each year for all commercial airports in the United States. This forecast was released February 2004 and accounts for the impact of the events of September 11, 2001 and the recent economic downturn.

As shown in **Exhibit 2-1**, the 2004 TAF projects that total aircraft operations at the Airport will increase from 549,843 operations in calendar year 2004 to almost 815,732 operations in calendar year 2020, a net increase of 48 percent and an average annual growth of 2.5 percent.[4] The number of enplanements is forecasted to increase from 18.8 million in 2004 to almost 32.6 million in 2020, a net increase of 3.5 percent. **Table 2-1** presents operations and enplanements projections under the Terminal Area Forecast.

[4] The TAF was normalized from federal government fiscal years (October to September) to calendar years for this report.

Table 2-1

Terminal Area Forecast - 2004

Calendar Year	Itinerant Operations: Air Carrier	Air Taxi & Commuter	General Aviation	Military	Total	Instrument Approaches[5]	Enplanements	Based Aircraft[6]
Historical								
1995	312,154	134,526	28,129	1,123	475,932	513,919	15,533,749	0
1996	322,023	107,816	22,486	791	453,116	473,671	16,148,087	0
1997	341,879	128,271	22,394	770	493,314	481,306	17,484,919	0
1998	341,074	111,467	19,736	1,055	473,332	491,991	18,415,700	0
1999	362,824	119,799	16,846	982	500,451	502,265	19,017,009	2
2000	370,072	142,662	14,855	920	528,509	522,502	19,375,844	2
2001	352,033	139,538	14,614	1,551	507,736	531,551	18,046,403	2
2002	338,049	157,777	12,416	987	509,229	516,019	17,825,549	2
2003	323,610	174,092	11,228	1,345	510,275	516,828	18,752,569	2
Projected								
2003[7]	329,129	162,484	11,769	1,463	504,845	511,461	17,454,657	1
2004	340,665	196,273	11,495	1,411	549,843	556,569	18,799,319	2
2005	354,431	212,122	11,648	1,411	579,612	582,415	19,961,023	2
2006	365,886	218,992	11,804	1,411	598,093	598,574	20,859,306	2
2007	377,387	224,070	11,962	1,411	614,830	614,733	21,727,092	2
2008	388,117	228,710	12,122	1,411	630,361	630,893	22,535,877	2
2009	398,633	233,350	12,284	1,411	645,678	647,052	23,329,668	2
2010	409,517	237,990	12,448	1,411	661,366	663,211	24,149,166	2
2011	420,675	242,630	12,615	1,411	677,330	679,371	24,991,858	2
2012	431,478	247,270	12,783	1,411	692,943	695,531	25,827,282	2
2013	442,515	251,911	12,955	1,411	708,792	711,689	26,683,524	2
2014	453,517	256,551	13,128	1,411	724,607	727,849	27,546,909	2
2015	464,089	261,191	13,304	1,411	739,994	744,008	28,389,335	2
2016	474,646	265,830	13,481	1,411	755,368	760,168	29,236,835	2
2017	484,809	270,470	13,661	1,411	770,351	776,327	30,070,733	2
2018	494,879	275,109	13,844	1,411	785,243	792,486	30,906,692	2
2019	505,310	279,749	14,029	1,411	800,499	808,645	31,770,494	2
2020	515,716	284,389	14,217	1,411	815,732	824,805	32,641,421	2

Source: Federal Aviation Administration – 2004 Terminal Area Forecast
Prepared by: Ricondo & Associates, Inc., September 2004

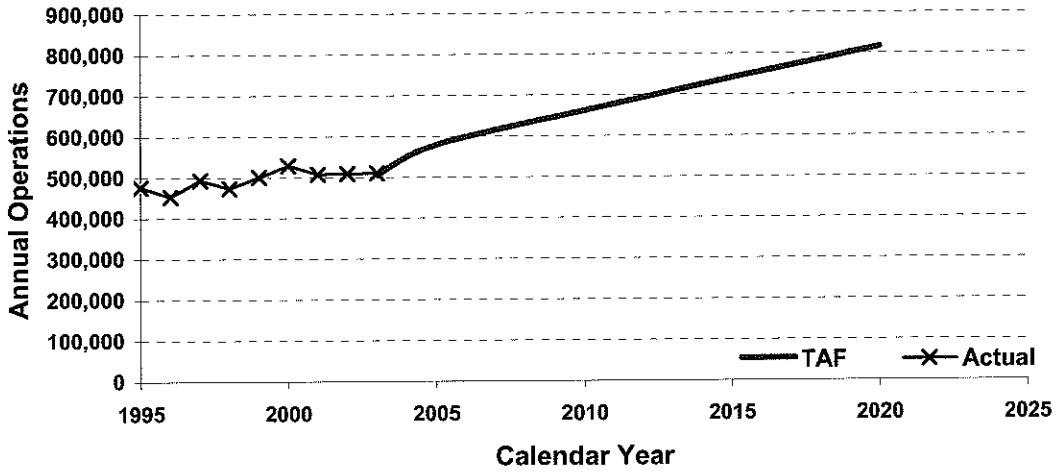
[5] Instrument operations exceed total airport operations because the radar control facility at the Airport provides service to secondary airports.

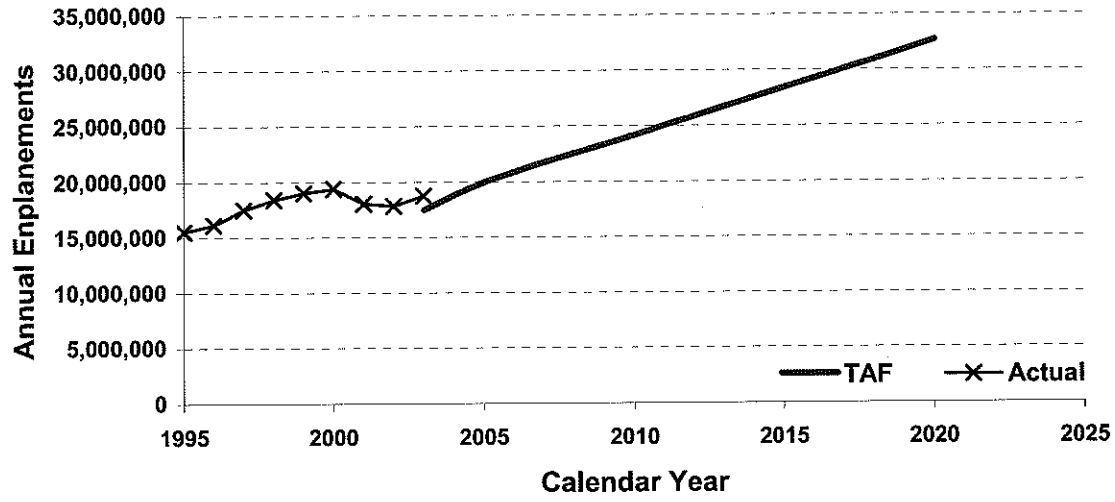
[6] Most based aircraft were shifted to reliever airports in the Denver area after the movement from Stapleton International Airport to DIA.

[7] The TAF was published in February 2004 and included projections for the years 2003 – 2020. The actual statistics for 2003 reflect actual activity that occurred after the forecast was prepared.

Exhibit 2-1

Terminal Area Forecast – 2004





Source: Federal Aviation Administration – 2004 Terminal Area Forecast
Prepared by: Ricondo & Associates, Inc., September 2004

2.3 Baseline Forecast – Aviation Activity Forecast

The second forecast was prepared by R&A in support of the FAR Part 150 Noise Compatibility Study that was initiated by DIA in mid-2001. This forecast is hereafter referred to as the Baseline Forecast.

This forecast was prepared based on historical growth trends at DIA and Denver Stapleton International Airport and expected growth both at DIA and nationwide in the aviation industry. Several methodologies were utilized in preparing this forecast including a market share approach and socioeconomic regression analysis approach. More thorough details of the forecast methodology can be viewed in the document *Aviation Activity Forecast* published May 16, 2001.

Table 2-2 presents operations and enplanement projections under the Baseline Forecast. As shown, the number of operations is expected to grow from 548,350 in 2001 to 888,250 in 2021 for an increase of 62 percent and an average annual growth of 2.4 percent. Enplanements are projected to increase 95 percent from 20 million in 2001 to 38.9 million in 2021. These projections can be viewed graphically in **Exhibit 2-2**.

Table 2-2

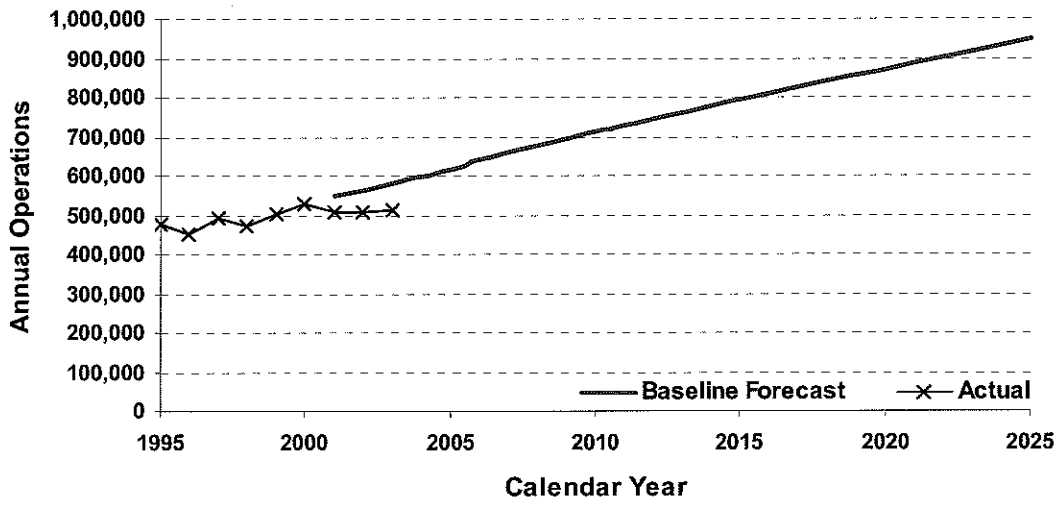
Baseline Forecast – Aviation Activity Forecast

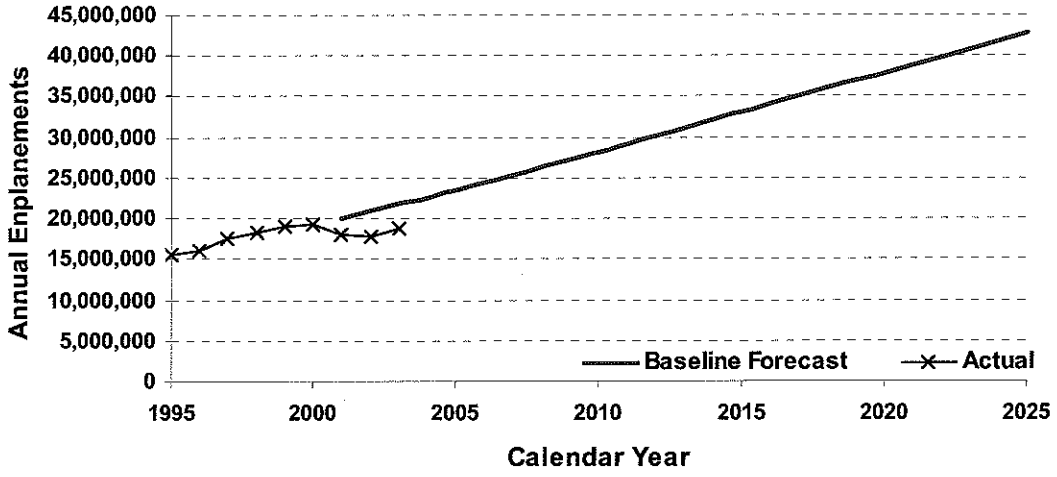
	Operations									
Calendar Year	Majors / Nationals	Regionals / Commuters	General Aviation	All Cargo	Other Air Taxi	Military	Total	Instrument Approaches	Enplanements	Based Aircraft
Historical										
1995	302,960	107,686	28,129	25,120	10,914	1,123	475,932	13,162	15,533,749	0
1996	305,022	89,586	22,489	26,684	8,547	791	453,119	13,662	16,148,087	0
1997	331,556	97,104	22,394	27,876	13,614	770	493,314	41,502	17,484,919	0
1998	331,070	81,932	19,736	30,250	9,289	1,055	473,332	32,928	18,415,700	0
1999	344,266	100,746	16,846	27,192	10,419	982	500,451	44,803	19,017,009	2
2000	353,242	116,284	14,855	25,416	17,792	920	528,509	44,803	19,375,844	2
2001	337,907	108,004	14,614	20,228	25,432	1,551	507,736	35,527	18,046,403	2
2002	325,581	127,384	12,416	16,934	25,927	987	509,229	34,488	17,825,549	2
2003	309,854	144,616	11,228	20,922	22,310	1,345	510,275	34,233	18,752,569	2
Projected										
2001	367,800	120,000	15,100	26,600	17,900	950	548,350	46,500	20,019,000	2
2005	418,400	133,200	15,800	30,800	18,300	950	617,450	52,300	23,398,700	2
2006	434,800	137,000	15,900	32,000	18,400	950	639,050	54,200	24,481,800	2
2010	487,600	150,200	16,600	36,300	18,800	950	710,450	60,200	28,199,000	2
2011	501,200	153,000	16,700	37,500	18,900	950	728,250	61,700	29,175,900	2
2016	567,000	163,200	17,400	43,000	19,400	950	810,950	68,700	34,041,100	2
2021	629,000	171,600	18,000	48,800	19,900	950	888,250	75,300	38,911,200	2
2025	676,800	176,600	18,400	53,700	20,300	950	946,750	80,300	42,843,400	2

Sources: Ricondo & Associates, Inc.
DIA Aviation Activity Forecast, May 2001
Prepared by: Ricondo & Associates, Inc., September 2004

Exhibit 2-2

Baseline Forecast – Aviation Activity Forecast





Sources: Ricondo & Associates, Inc.
DIA Aviation Activity Forecast, May 2001
Prepared by: Ricondo & Associates, Inc., September 2004

2.4 Forecast Comparison

The two forecasts are illustrated in **Exhibit 2-3** and summarized by operations and enplanements in **Table 2-3** and **Table 2-4,** respectively. The FAA projects that total aircraft operations at the Airport will increase from 549,843 operations in 2004 to almost 815,732 operations in calendar year 2020, a net increase of 48 percent and an average annual growth of 2.5 percent. According to the baseline forecast, aircraft operations will increase from 548,350 operations in calendar year 2001 to 888,250 operations in calendar year 2021, a net increase of 62 percent and an average annual growth of 2.6 percent. These results are shown in Table 2-3.

In terms of passenger enplanements, the 2004 TAF projects that enplanements will increase from 18.8 million in 2004 to 32.6 million in 2020, a net increase of 74 percent and an average annual growth of 3.5 percent. These results are shown in Table 2-4. Similarly, according to the baseline forecast, annual enplanements will increase from 20 million in 2001 to 38.9 million in 2021, a net increase of 94 percent and an average annual growth of 3.6 percent.

2.5 Design and Critical Aircraft

The critical aircraft using the Airport on a regular basis has changed from Airplane Design Group (ADG) IV to ADG V. Currently, there are 15 daily (5,475 annual) scheduled departures by ADG V aircraft (Airbus 340, Boeing 777 and 747).[8] This well exceeds the FAA frequency criteria of 500 operations per year used to define the critical aircraft for the Airport. Additionally, there are also limited operations (1.5 departures per month) of Antonov 124 (ADG VI) aircraft at the Airport and seasonal activity by Boeing 747 (ADG V) cargo aircraft.

As summarized in the *Aviation Activity Forecast* report, it is conservatively estimated that operations by ADG V aircraft will double by the year 2011. The extent of future use by aircraft in ADG VI at DIA is uncertain. Lufthansa is the only passenger airline currently serving the Airport that has committed to purchases of these aircraft, but the airline currently has no plans to use these aircraft at DIA. Federal Express has ordered cargo versions, but initial use at the Airport will probably be sporadic. Because concepts being marketed for passenger and cargo versions of these aircraft are primarily intended for international service, it is unlikely the Airport will see more than one or two daily departures by 2011. The Airport will closely monitor potential activity by ADG VI, and care will be taken to ensure that the capability and flexibility to accommodate these aircraft is maintained.

[8] Official Airline Guide, February 2004

Table 2-3

Forecast Comparison - Operations

Calendar Year	Actual Annual Ops	2004 TAF Annual Ops	2001 Forecast - Baseline Annual Ops	2001 Forecast - Baseline Departure from TAF
Historical				
1995	475,932			
1996	453,116			
1997	493,314			
1998	473,332			
1999	500,451			
2000	528,509			
2001	507,736			
2002	509,229			
2003	510,275			
Projected				
2001			548,350	
2004		549,843		
2005		579,612	617,450	6%
2006		598,093	639,050	6%
2010		661,366	710,450	7%
2011		677,330	728,250	7%
2015		739,994	793,750	7%
2016		755,368	810,950	7%
2020[9]		815,732	872,790	7%
2021			888,250	
2025			946,750	

Sources: Ricondo & Associates, Inc.
Federal Aviation Administration – 2004 Terminal Area Forecast
DIA Aviation Activity Forecast, May 2001
Prepared by: Ricondo & Associates, Inc., September 2004

[9] The baseline forecast for 2020 is interpolated from the 2016 and 2021 forecast numbers.

Table 2-4

Forecast Comparison – Enplanements

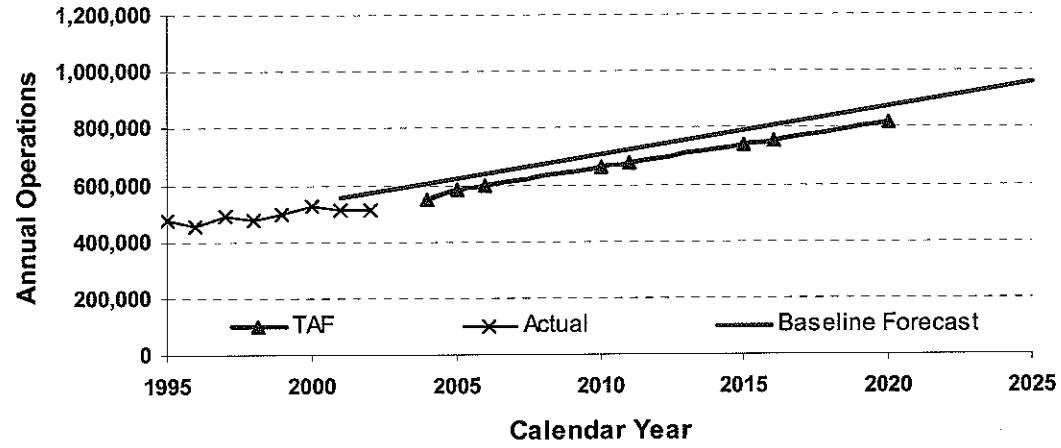
Calendar Year	Actual Annual Enp.	2004 TAF Annual Enp.	2001 Forecast - Baseline Annual Enp.	Departure from TAF
Historical				
1995	15,533,749			
1996	16,148,087			
1997	17,484,919			
1998	18,415,700			
1999	19,017,009			
2000	19,375,844			
2001	18,046,403			
2002	17,825,549			
2003	18,752,569			
Projected				
2001			20,019,000	
2004		18,799,319		
2005		19,961,023	23,398,700	15%
2006		20,859,306	24,481,800	15%
2010		24,149,166	28,199,000	14%
2011		24,991,858	29,175,900	14%
2015		28,389,335	33,005,000	14%
2016		29,236,835	34,041,100	14%
2020[10]		32,641,421	37,937,180	14%
2021			38,911,200	
2025			42,843,400	

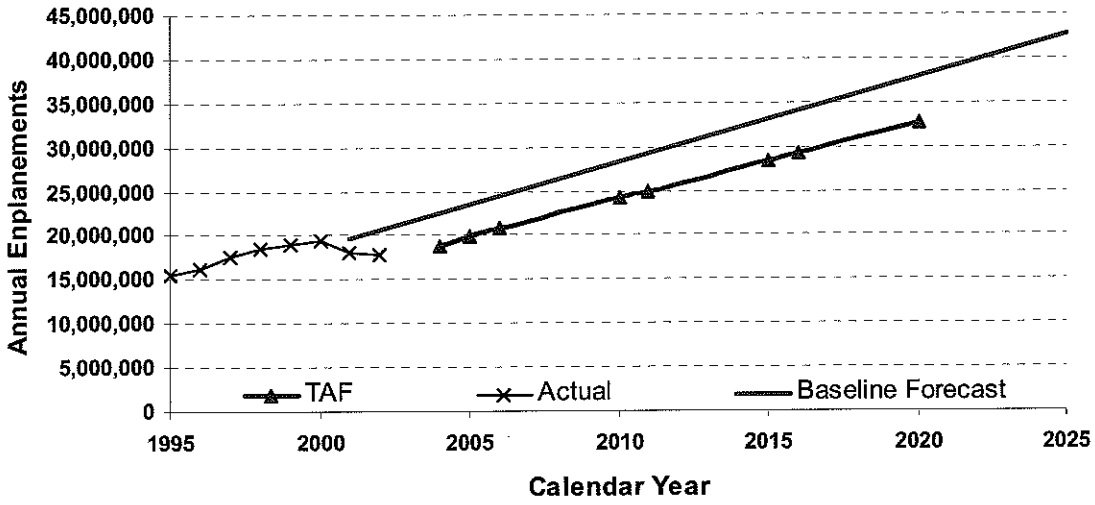
Sources: Ricondo & Associates, Inc.
Federal Aviation Administration – 2004 Terminal Area Forecast
DIA Aviation Activity Forecast, May 2001
Prepared by: Ricondo & Associates, Inc., September 2004

[10] The baseline forecast for 2020 is interpolated from the 2016 and 2021 forecast numbers.

Exhibit 2-3

Forecast Comparison





Sources: Ricondo & Associates, Inc.
Federal Aviation Administration – 2004 Terminal Area Forecast
DIA Aviation Activity Forecast, May 2001

Prepared by: Ricondo & Associates, Inc., September 2004

3. Existing and Future Conditions

Denver International Airport is located 23 miles northeast of Denver's central business district. As mentioned in Section 1 of this report, it was opened in February 1995 to replace Stapleton International Airport. With Stapleton's subsequent closure, DIA is the only airport with scheduled passenger service in the Denver Regional Aviation System that has been defined by the Denver Regional Council of Governments. According to 2003 data, the Airport was the tenth busiest airport in the world based on the number of passenger enplanements and aircraft operations. Nationally, the Airport ranks ninth for aircraft operations and fifth for passenger enplanements.[11]

In terms of air cargo activity, 359,000 tons of air cargo were handled in the year 2003. Other sources of aviation activity at the Airport include general aviation activity, which has been declining approximately nine percent each year for the last five years. Such activity did, however, account for almost 11,200 operations in 2003, or 2.2 percent of the annual operations. Military activity accounted for almost 1,345 operations in 2003, or 0.3 percent of the annual operations.

3.1 Airport Overview

The FAA approved the latest version of the ALP on September 24, 2004. A copy of this drawing accompanies this document. As illustrated in this drawing and summarized in **Table 3-1**, the Airport currently has six concrete runways (four north/south and two east/west). Five of these runways are 12,000 feet long and, with the exception of runway shoulders that are slated to be upgraded, are designed to accommodate aircraft within ADG V. The sixth runway is 16,000 feet long and 200 feet wide and is designed to accommodate aircraft within ADG VI. All runways are designed to accommodate Aircraft Approach Category D operations.

Runways 7, 8, 16L, 16R, 17L, 17R, 25, and 26 are equipped with Instrument Landing Systems (ILS) and allow for ILS Category I approaches, while Runways 34L, 34R, 35L, and 35R support ILS Category III approaches.

Parallel Runways 17R-35L and 17L-35R are separated by 5,280 feet and Runways 16L-34R and 17R-35L are separated by 7,600 feet. According to FAA requirements, separations greater than 4,300 feet allow for simultaneous precision instrument approaches and the FAA has approved established triple independent simultaneous instrument approaches to these three runways. The 2,600-foot separation between Runways 16R-34L and 16L-34R allow for staggered Instrument Flight Rules (IFR) operations, with aircraft arriving on Runway 16R and 16L in a south flow configuration. This separation also meets wake turbulence requirements allowing simultaneous operations involving heavy aircraft.

The terminal and concourses are located in the center of the airfield. The Elrey B. Jeppesen Terminal is located between two sets of parking garages and is accessible from both sides. It has approximately 1.5 million square feet of space, including a central atrium that is walled by glass and covered by a translucent tensile membrane roof.

[11] Airports Council International, final data for 2003.

Table 3-1

Existing Runway Characteristics

General Airport Data

Airport Category	Transport
Airport Reference Code	D-V
Airport Elevation (MSL)	5,430.7'
Airport Reference Point	lat.: N 39° 51' 41.986"; long.: W 104° 40' 23.040"
Mean Max. Temp. of Hottest Month	87°F

Runway Data

Item	Runway 7	Runway 25	Runway 8	Runway 26	Runway 16L	Runway 34R	Runway 16R	Runway 34L	Runway 17L	Runway 35R	Runway 17R	Runway 35L
Physical Length	12,000'	12,000'	12,000' (TODA 13,000')	12,000' (TODA 13,000')	12,000'	12,000' (TODA 13,000')	16,000'	16,000'	12,000'	12,000'	12,000'	12,000'
Width	150'	150'	150'	150'	150'	150'	200'	200'	150'	150'	150'	150'
Runway End Coordination	lat.: N 39°50'27.404" long: W 104°43'35.965"	lat.: N 39°50'26.363" long: W 104°41'02.170"	lat.: N 39°52'39.201" long: W 104°39'44.025"	lat.: N 39°52'38.077" long: W 104°37'10.148"	lat.: N 39°53'49.329" long: W 104°41'12.498"	lat.: N 39°51'50.775" long: W 104°41'13.877"	lat.: N 39°53'44.913" long: W 104°41'44.010"	lat.: N 39°51'06.836" long: W 104°41'45.826"	lat.: N 39°51'53.827" long: W 104°38'28.697"	lat.: N 39°49'55.271" long: W 104°38'30.155"	lat.: N 39°51'40.483" long: W 104°39'36.556"	lat.: N 39°49'41.927" long: W 104°39'37.985"
Runway End Elevation (MSL)	5,347.1'	5,351.8'	5,351.3'	5,291.3'	5,347.1'	5,350.5'	5318.6'	5323.8'	5,325.0'	5,367.0'	5,374.6'	5,430.7'
Touchdown Zone Elevation (MSL)	5,348.0'	5,351.8'	5,351.2'	5,306.2'	5,353.6'	5,350.7'	5322.0'	5324.0'	5,335.2'	5,366.7'	5,388.4'	5,430.5'
Effective Gradient	0.04%	-0.04%	- 0.50%	0.50%	0.03%	-0.03%	0.03%	-0.03%	0.35%	-0.35%	0.47%	-0.47%
Pavement Type	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete	Grooved Concrete
Pavement Strength												
Single:	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs	100,000 lbs
Dual Gear:	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs	200,000 lbs
Dual Tandem:	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs	380,000 lbs
Double Dual Tandem:	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs	850,000 lbs
Runway Lighting	HIRL, CL, TDZL	HIRL, CL	HIRL, CL	HIRL, CL, TDZL	HIRL, CL, TDZL	HIRL, CL, TDZL	HIRL, CL, TDZL	HIRL, CL, TDZL	HIRL, CL	HIRL, CL, TDZL	HIRL, CL, TDZL	HIRL, CL, TDZL
Runway Marking	Precision	Precision	Precision	Precision	Precision	Precision	Precision	Precision	Precision	Precision	Precision	Precision
ILS Category	I	I	I	I	I	III	I	III	I	III	I	III
Approach Slope	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1
Approach Lighting Aids	MALSR, PAPI	MALSR, PAPI	MALSR, PAPI	MALSR, PAPI	MALSR, PAPI	ALSF-2, PAPI	MALSR, PAPI	ALSF-2, PAPI	ALSF-2, PAPI	ALSF-2, PAPI	MALSR, PAPI	ALSF-2, PAPI
NAVAIDs	LOC, GS, OM, MM, RVR	LOC, GS, OM, MM, RVR	LOC, GS, OM, MM, RVR	LOC, GS, OM, MM, RVR	LOC, GS, OM, MM, RVR	LOC/DME, GS, OM, MM, IM, RVR	LOC, GS, OM, MM, RVR	LOC/DME, GS, OM, MM, IM, RVR	LOC, GS, OM, MM, RVR	LOC/DME, GS, OM, MM, IM, RVR	LOC, GS, OM, MM, RVR	LOC/DME, GS, OM, MM, IM, RVR
Critical Aircraft	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400	A380	A380	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400	MD-11 / 747-400
Runway Design Category	D-V	D-V	D-V	D-V	D-V	D-V	D-VI	D-VI	D-V	D-V	D-V	D-V

Source: DIA Airport Layout Plan, September 24, 2004
Prepared by: Ricondo & Associates, Inc., April 2003

Concourse A has 30 gates with jetways, 29 of which are narrowbody and one of which is dedicated for widebody aircraft. Concourse B has 42 gates, including two dedicated widebody gates, and Concourse C has 20 narrowbody gates.[12] The Airport also has 56 apron parking positions for regional jets and turboprop aircraft. The three concourses are linked to the terminal by an underground automated transit system. Passengers can also walk between Concourse A and the terminal via a two-level glass-enclosed bridge.

The FAA Terminal Radar Approach Control (TRACON) facility is located on the Airport about three miles south of the terminal. The Airport Traffic Control Tower, which stands 327 feet tall, is located adjacent to Concourse C on the center of its south side. The Airport is equipped with Final Monitor Aids (FMA), one Airport Surveillance Radar (ASR-9), 29 wind speed and direction sensors, two Airport Surface Detection Equipment (ASDE-III) radars, and other weather and navigational equipment.

Five cargo-handling facilities are located west of the approach end of Runway 35L, on the Airport's south side. The largest facility is the Passenger Airlines Cargo facility, in which several commercial airlines process, store, and ship airfreight. The United Airlines cargo building accommodates inbound and outbound bulk storage for domestic and international freight, container storage, and cooler storage. All-cargo carriers, primarily FedEx, UPS, and DHL, occupy the remaining three facilities. These are located on a common aircraft parking apron with 33 narrowbody aircraft parking positions that can be reconfigured to accommodate different combinations of narrowbody, widebody, regional jet, and propeller aircraft.

The major components of the ground transportation system at the Airport include an airport roadway system and arterial roadways. Peña Boulevard provides access to the terminal, air cargo complex, public and employee parking facilities, rental car agencies, and other airport facilities. This road is accessible from Interstate 70, E-470, and various arterial roadways. As of mid-2004 there are approximately 41,000 parking spaces at the Airport, of which 34,000 are for public use and 6,700 for airport employees.

3.2 Airport Reference Code

Advisory Circular (AC) 150/5300-13 establishes airport design standards by Airport Reference Codes (ARC). The ARC is directly correlated to the width of the runways and taxiways as well as the width of the pavement shoulders. Runway and Taxiway Safety Areas, Object Free Areas, and minimum separations between parallel taxiways and runways are also dependent on the ARC.

The ARC is composed of two components: Aircraft Approach Category and Airplane Design Group (ADG). The Aircraft Approach Category relates to the operational approach speed characteristics of the aircraft, while the ADG designation relates to wingspan dimensions. The ARC is based on the most demanding group of aircraft utilizing an airport on a regular basis, which is defined by the FAA as 500 or more annual operations.

The Airport was originally designed and built to meet or exceed Approach Category D and ADG IV (D-IV) standards. The Airport remained this classification for approximately one

[12] Certain gates have the ability to accommodate widebody aircraft, which reduce capacity to adjacent gates.

year until an increase in Boeing 777 (ADG V) operations warranted a change from ADG IV to ADG V, giving DIA its current ARC of D-V.

The current ALP illustrates that six new runways are planned for construction in the future, which will be constructed according to D-V or D-VI standards. The newly constructed Runway 16R-34L was designed according to D-VI standards in order to accommodate the eventual emergence of new large aircraft at the Airport such as the Airbus A380. It is believed that there will be a limited number of these aircraft operating at the Airport, making it important to consider their potential presence when designing and constructing facilities. A plan is in development to create taxiway routes for ADG VI aircraft from Runway 16R-34L to the terminal and cargo areas.

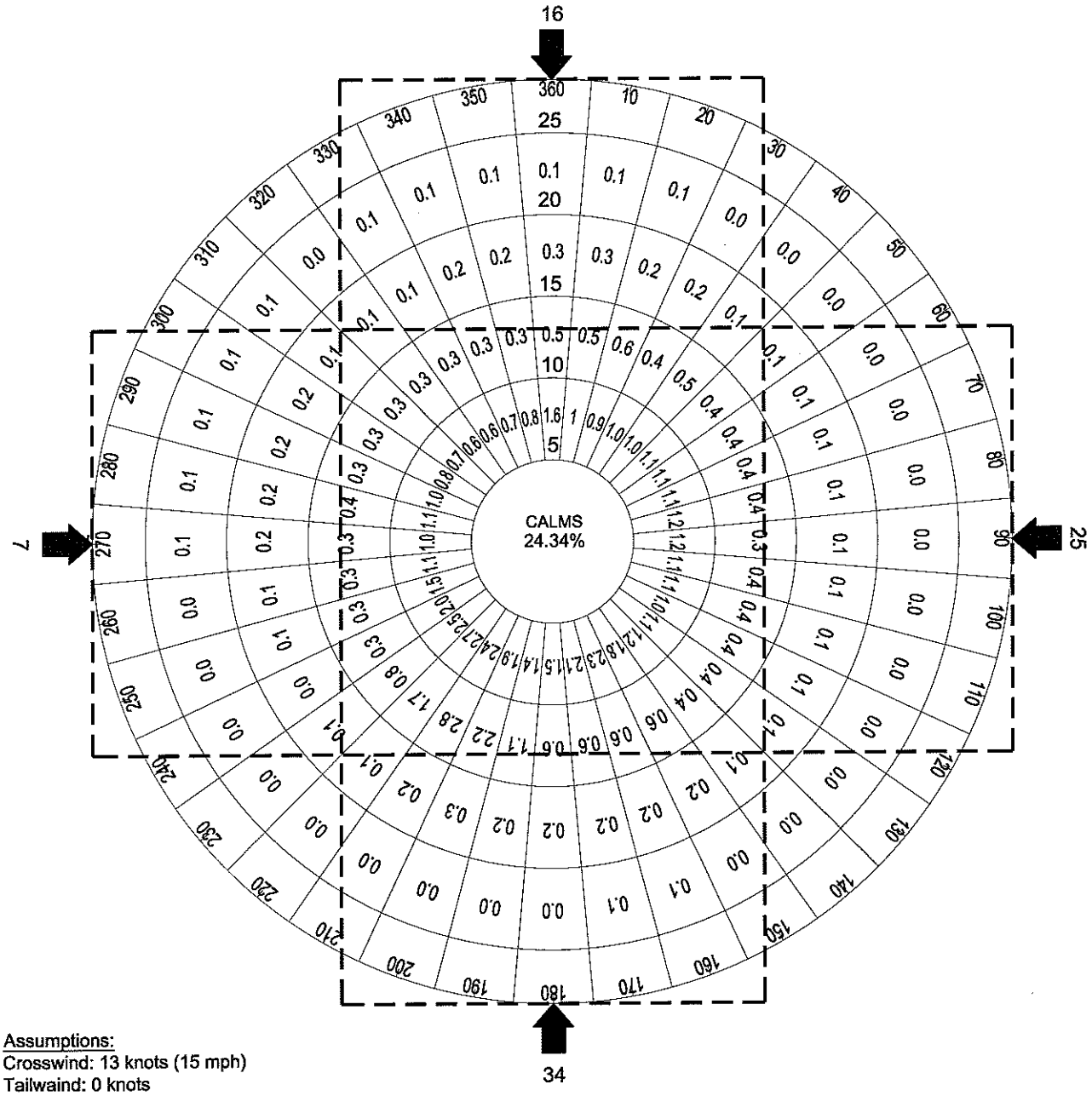
3.3 Existing Runway Operating Configurations

Exhibits 3-1 through **3-6** include wind roses for Visual Flight Rules (VFR) conditions, IFR conditions, and All Weather conditions. The wind coverage percentages for the Airport are listed in **Table 3-2**. The definition of various weather conditions and the frequency with which they occur at DIA are summarized below:

- VFR-1 conditions exist when the cloud ceiling is greater than 2,700 feet and visibility is greater than five miles. During those periods, there are little or no procedural constraints in terms of separations on aircraft flows. VFR-1 conditions occur approximately 89.8 percent of the time.
- VFR-2 conditions exist when the cloud ceiling is greater than 1,000 feet but less than 2,700 feet and visibility is greater than three miles but less than five miles. During this weather condition, as well as those listed below, instrument procedures and separations are required. VFR-2 conditions occur approximately 3.7 percent of the time.
- Category I ILS conditions exist when the cloud ceiling is greater than 200 feet but less than 1,000 feet and visibility is greater than 1/2 mile but less than three miles. Category I ILS conditions occur approximately 4.8 percent of the time.
- Category II ILS conditions exist when the cloud ceiling is greater than 100 feet but less than 200 feet and visibility is greater than 1/4 mile but less than 1/2 mile. Category II ILS conditions occur only 0.9 percent of the time.
- Category III ILS conditions exist when the cloud ceiling is less than 100 feet and visibility is less than 1/4 mile. Category III ILS conditions occur only 0.8 percent of the time.

All Weather Wind Rose

Ceiling: Unlimited Visibility: Unlimited



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-1

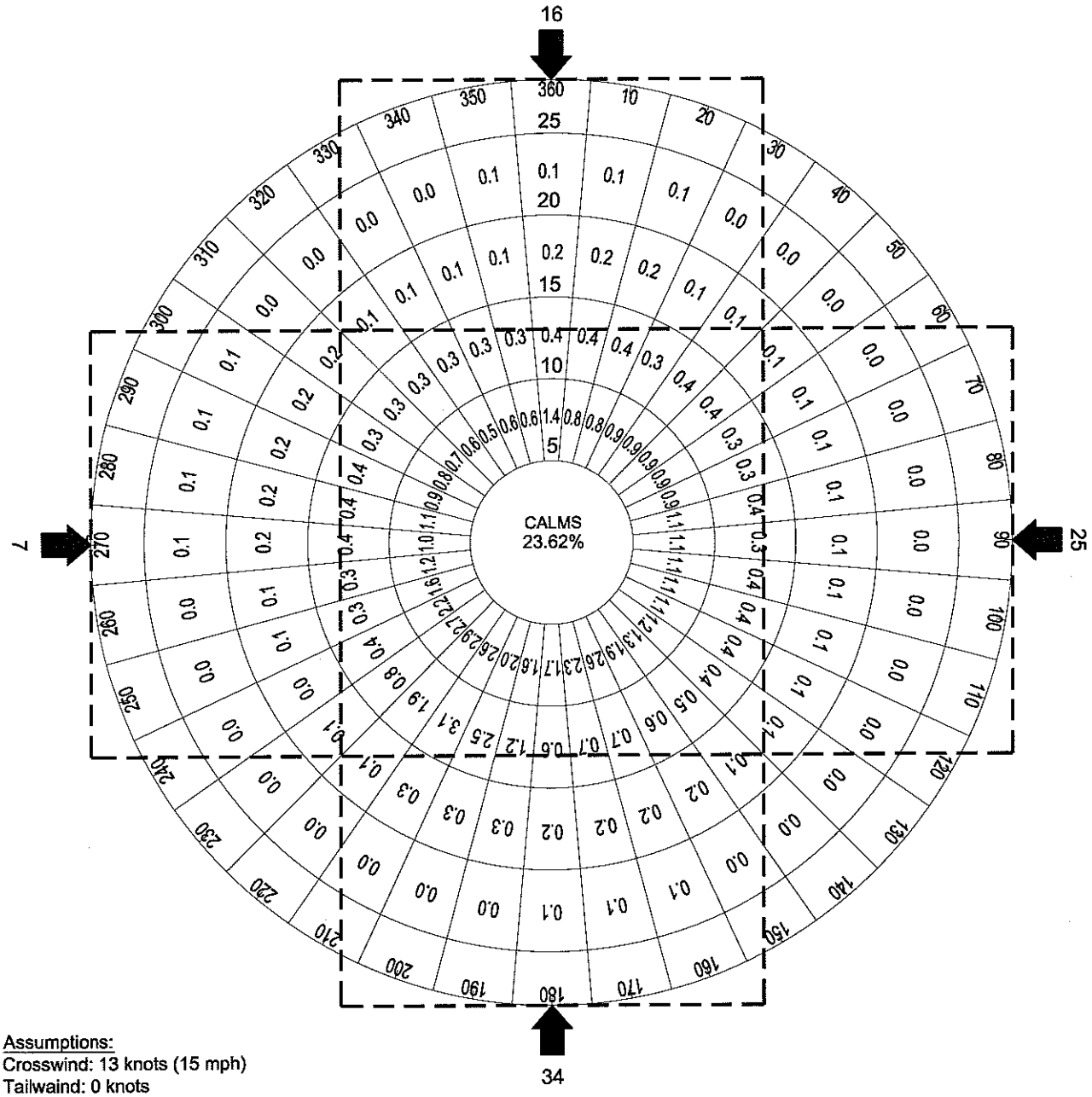
No Scale

Wind Rose
All Weather

Z:\DIA\02~5-Year Dev Plan\ALP Narrative - Final\WindRose.dwg

VFR 1 Wind Rose

Ceiling: > 2,700 feet Visibility: > 5 miles



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-2

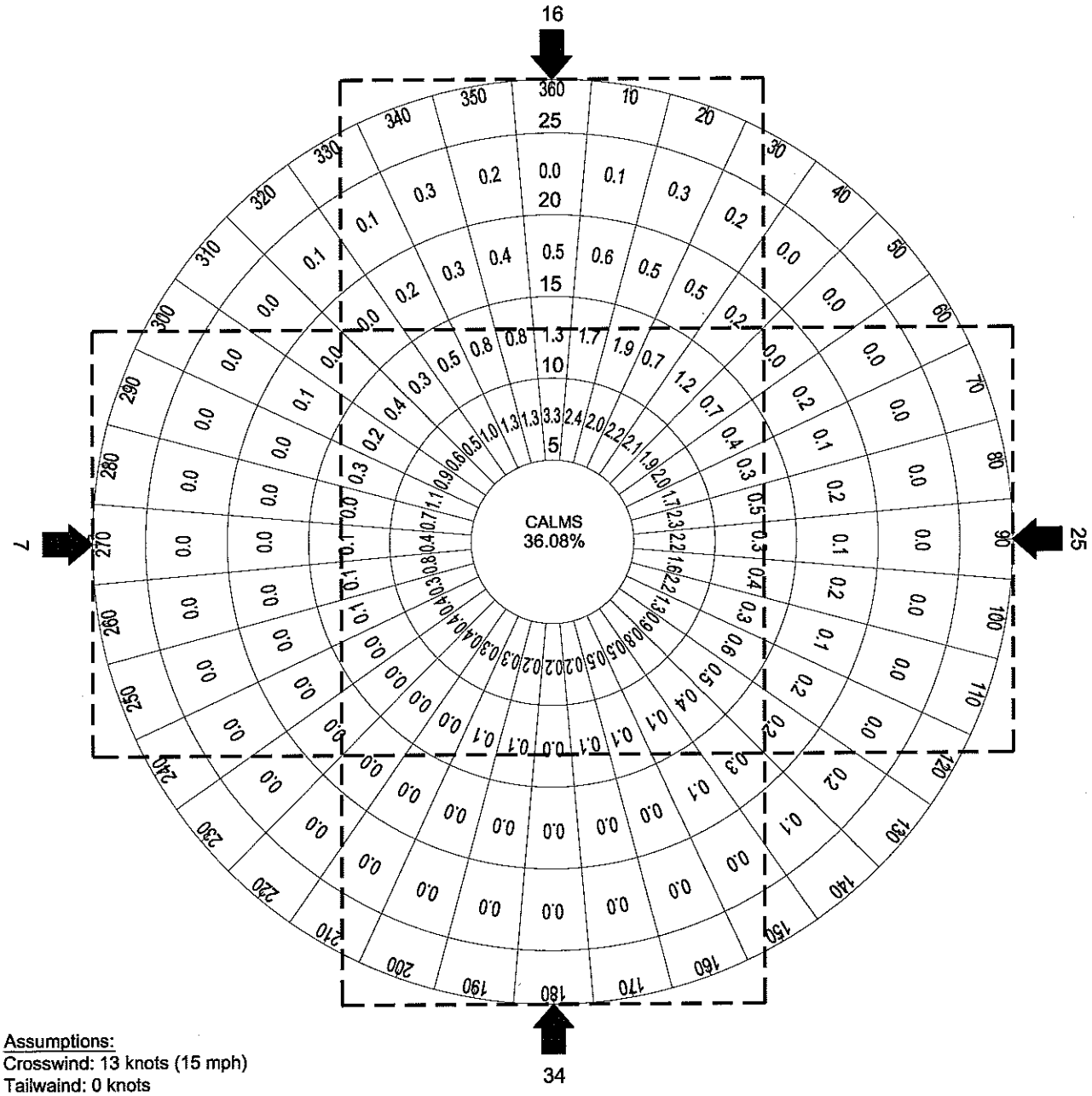
No Scale

Wind Rose
VFR 1

Z:\DIA\02~5-Year Dev Plan\ALP Narrative - Final\WindRose.dwg

VFR 2 Wind Rose

Ceiling: >1000 and < 2700 feet Visibility: > 3 and < 5 miles



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-3

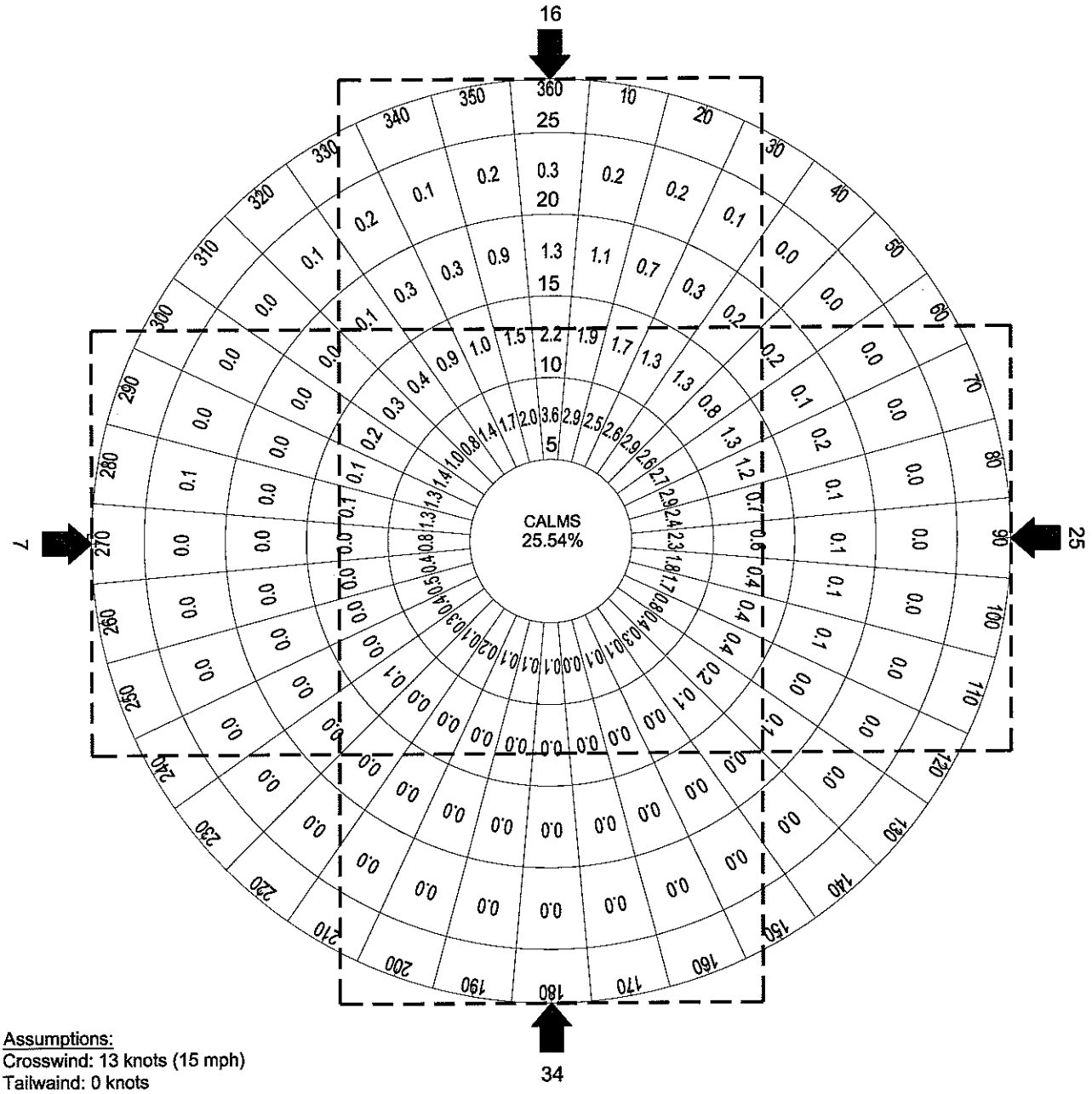
No Scale

Wind Rose
VFR 2

Z:\DIA\02-5-Year Dev Plan\ALP Narrative - Final\WindRose.dwg

IFR 1 Wind Rose

Ceiling: > 200 and <1000 feet Visibility: > .5 and < 3 miles



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-4

No Scale

Wind Rose
IFR 1

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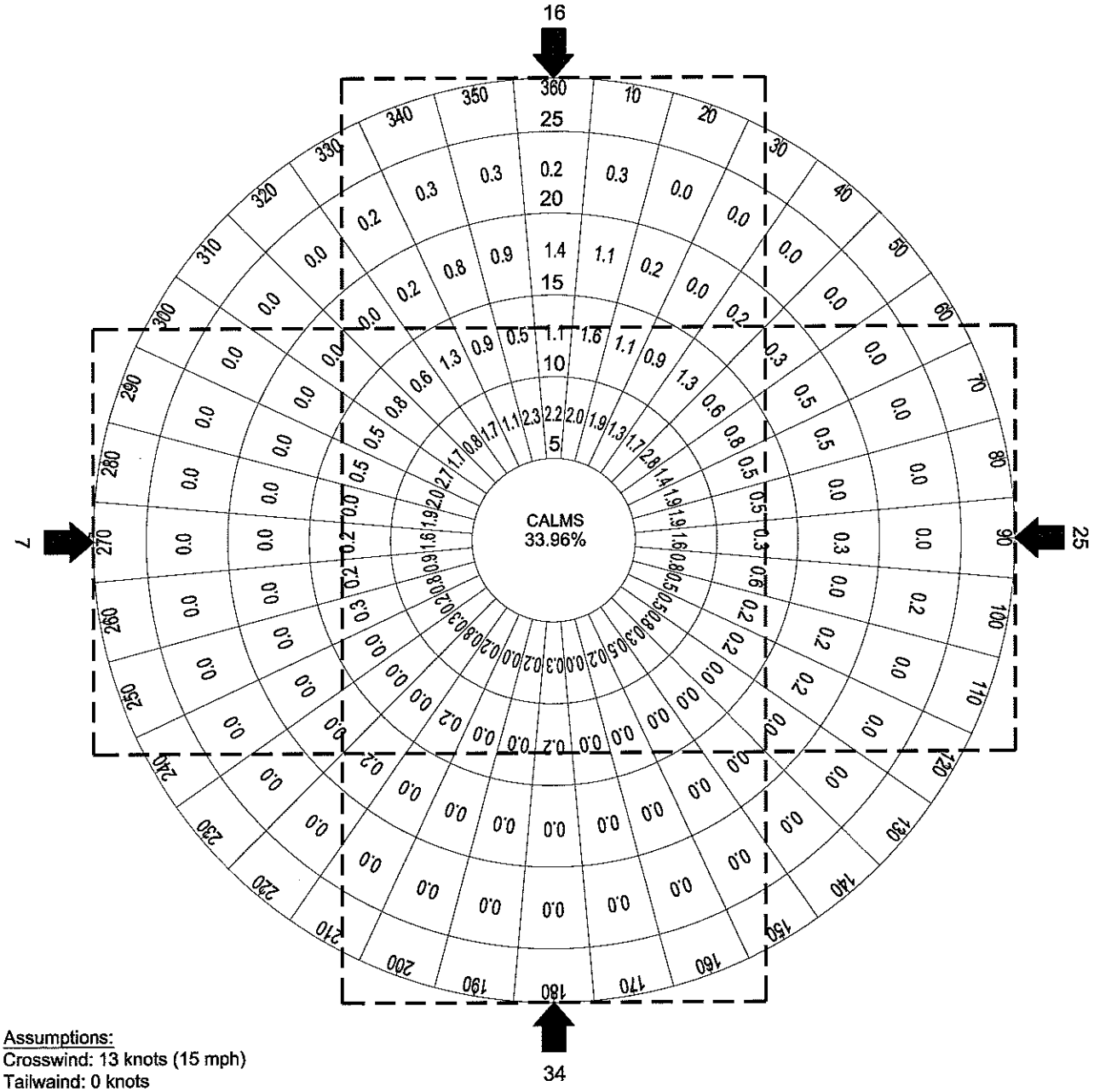
IFR 2 Wind Rose

Ceiling: > 100 and < 200 feet Visibility: > .25 and < .5 miles



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-5

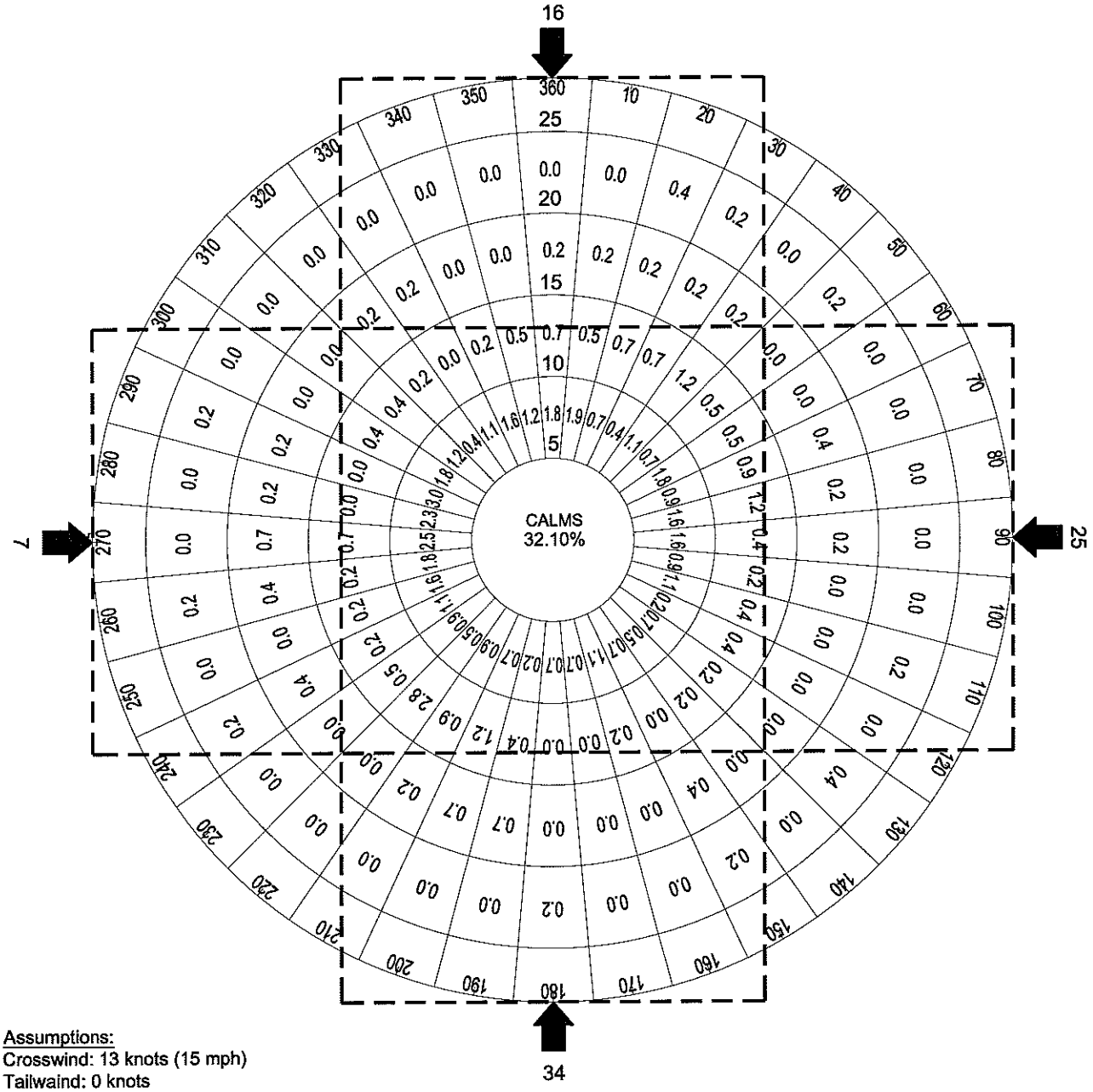
No Scale

Wind Rose
IFR 2

Z:\DIA\02~5-Year Dev Plan\ALP Narrative - Final\WindRose.dwg

IFR 3 Wind Rose

Ceiling: < 100 feet Visibility: < .25 miles



Assumptions:
Crosswind: 13 knots (15 mph)
Tailwaind: 0 knots
Calms: 0-5 knots

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

Exhibit 3-6

No Scale

Wind Rose
IFR 3

Z:\DIA\02~5-Year Dev Plan\ALP Narrative - Final\WindRose.dwg

Table 3-2

Wind Coverage Percentages

Category	7	25	16	34	Totals	Calms	Occurrence
All Weather	58.76%	64.06%	70.87%	51.11%	99.86%	24.34%	100.00%
VFR 1	56.93%	65.09%	73.91%	47.27%	99.87%	23.62%	89.78%
VFR 2	80.14%	55.98%	51.41%	82.93%	99.77%	36.08%	3.69%
IFR 1	74.10%	50.52%	35.67%	88.75%	99.79%	25.54%	4.80%
IFR 2	68.23%	62.60%	44.76%	87.32%	99.37%	33.96%	0.91%
IFR 3	61.73%	69.49%	59.79%	67.90%	99.65%	32.10%	0.81%

Source: NOAA - National Climatic Data Center, TD3280 Digital Data for Denver International Airport, Denver, Colorado, March 1, 1995 - February 28, 2003 (69,952 observations)
Prepared by: Ricondo & Associates, Inc., June 2003

The Airport's airfield provides extraordinary flexibility to FAA Air Traffic Control to meet demands with its four north-south and two east-west runways.[13] The various runway use configurations at the Airport and their approximate relative frequency of use are illustrated in simplified form on **Exhibit 3-7**. The individual runway arrival and departure percentages for 2003 are summarized in **Table 3-3**. Overall the Airport's existing annual service volume capacity is estimated to be 800,000-850,000 operations.

Table 3-3

Arrival and Departure Percentages by Runway in Year 2003

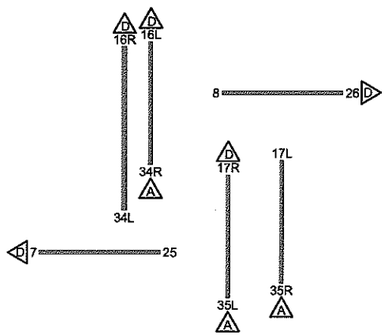
	Percent Runway Use	
Description	Arrival (%)	Departure (%)
Runway 16L	25.0	0.1
Runway 34R	3.6	18.1
Runway 16R	11.4	0.4
Runway 34L	0.1	9.4
Runway 7	5.2	0.0
Runway 25	0.4	22.6
Runway 8	0.0	25.4
Runway 26	8.2	0.0
Runway 17R	3.2	13.7
Runway 35L	26.0	2.5
Runway 17L	0.5	7.4
Runway 35R	16.4	0.4
TOTAL	100	100

Source: DIA 2003 Annual Noise Report
Prepared by: Ricondo & Associates, Inc., September 2004

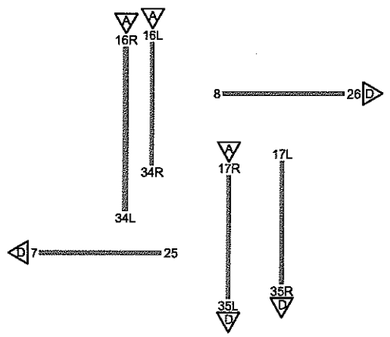
As noted, Visual Meteorological Conditions (VMC) occur at Denver approximately 94 percent of the year. Under these conditions demand is normally accommodated by arriving on two of the north-south runways and on one of the east-west runways and departing on the other two north-south runways and the other east west runway. Also, the airfield can be operated with three of the north-south runways used for arrivals and the one remaining north-south runway and both east-west runways used for departures. During these peak period

[13] FAR Part 36, Stage 2 Aircraft are not permitted to use Runway 25 for departures unless weather conditions dictate its use. Departures by hush-kitted Stage 3 and other "noise critical aircraft" are also requested not to use this runway for departures under the Airport's voluntary noise abatement rules.

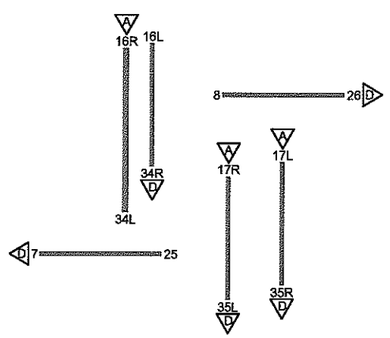
North - VFR/IFR
(36%)



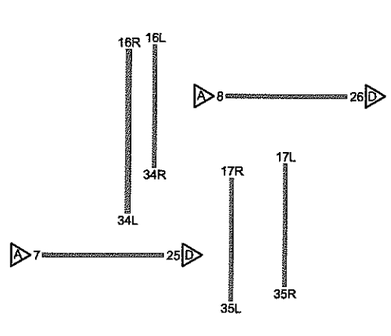
South - VFR Only
(49%)



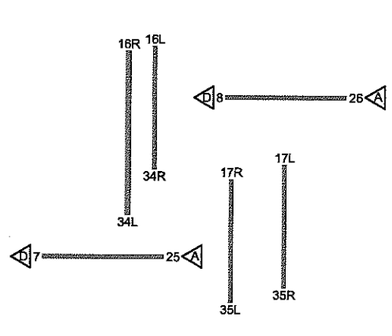
South - IFR Only
(1.25%)



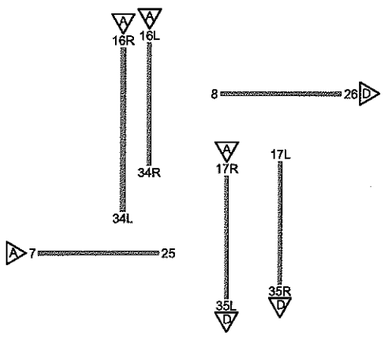
East - VFR/IFR
(0.5%)



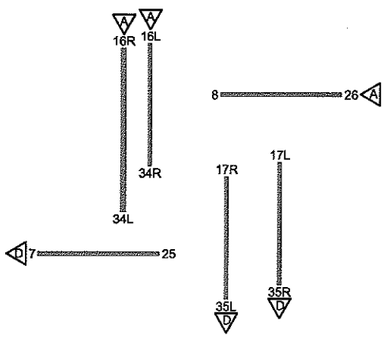
West - VFR/IFR
(1.25%)



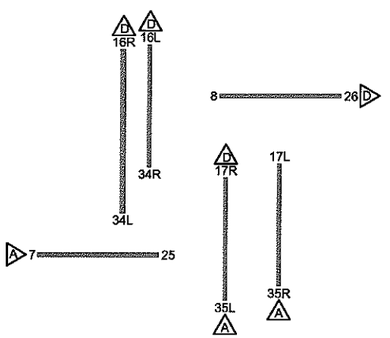
South & East - VFR Only
(2.5%)



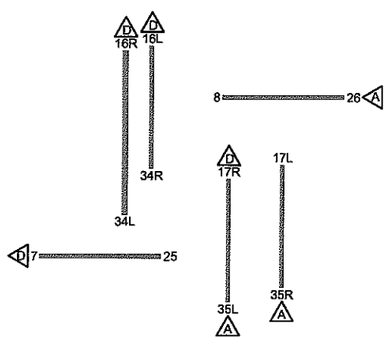
South & West - VFR Only
(5%)



North & East - VFR Only
(2.5%)



North & West - VFR Only
(3%)



Legend

- Arrivals
- Departures

Source: FAA, Denver TRACON 2002
Prepared by: Ricondo & Associates, Inc., March 2003

Exhibit 3-7

No Scale

north

Runway Use Configurations

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flow situations the airfield capacity with six runways is estimated to be 110-120 arrivals and 120-130 departures per hour or approximately 240 combined operations per hour.[14]

The strategy to utilize the crosswind runways to supplement the north-south runway configuration is generally based on the route of flight as winds permit. Westbound departures utilize Runway 25 and eastbound and southbound departures use Runway 8. This configuration is beneficial from the capacity/air traffic flow perspective. Similarly, arrivals from the west and east are assigned Runways 7 and 26, respectively, for landings. Runway 26 is limited in this usage due to potential airspace conflicts with simultaneous arrivals to Runways 17-35 and eastbound departures from Runway 34.

Runway 16R-34L normally operates as a dedicated departure runway when the Airport and airspace is in north flow (Runway 34L) and as an arrival runway during south flows (Runway 16R). However, as the Airport's longest runway with a length of 16,000 feet, Runway 34L may infrequently be used for departures by long-haul overseas flights. Also, as the Airport's only runway meeting ADG VI standards, it will be infrequently used for takeoffs and landings by very large aircraft (such as the Airbus A380) projected to enter the fleet over the next 5-10 years.

Runway 17R-35L is currently utilized by occasional mixed activity that disrupts its planned function as the primary arrival runway during north air traffic flows and as the primary departure runway during south flows. The inability to attain the original role of Runway 17R-35L is due to the lack of access across Peña Boulevard to the runways on the west side of the terminal from the existing cargo area and general aviation area located in the southeast quadrant of the Airport. The cargo area was moved to the south from its originally planned location on the north side of the Airport.

During the Instrument Metrological Conditions (IMC) that occur the remainder of the year, more reliance is placed on the north-south runway system and the arrival capacity provided by the triple simultaneous independent instrument approaches from the south (Runways 34R, 35L, and 35R). While some marginal VMC/IMC conditions occur in all wind conditions, the winds begin to favor a northwest, north and northeast flow as the conditions deteriorate. Except during extremely low visibility conditions, Runways 8 and 25 often are available to supplement departures on the north-south runways. Runway 34L normally operates as a dedicated departure runway, except when needed to substitute for Runway 34R as an arrival runway during snow removal or other maintenance operations.

Under IMC, the airfield capacity with six runways varies between over 200 operations per hour when the east-west runways can be used and 165 per hour when they cannot.[15] During busy arrival periods, the three simultaneous independent instrument approaches provide an arrival capacity of approximately 105-110 arrivals per hour.

[14] Federal Aviation Administration, Airport Capacity Benchmark Report, 2001 and DIA Analysis

[15] Ibid

3.4 Design Standards and Modifications to Standards

3.4.1 Airport Design Standards

With a limited number of exceptions described in the following section, all existing runways at the Airport were designed to meet ARC D-V except for Runway 16R-34L which is designed and constructed according to ARC D-VI design standards.

Table 3-4 lists the airport design standards identified in FAA AC 150/5300-13 (Change 7), *Airport Design*, for ARC D-V and ARC D-VI. As summarized in the table and illustrated on the ALP, ARC D-V runways have been constructed at 150 feet wide and ARC D-VI runways will be constructed to be 200 feet wide. The Airport was originally designed for ARC D-IV aircraft and, as such, runway shoulders were constructed to a width of 25 feet. In order to meet ARC D-V standards, the shoulders are being widened to 35 feet as construction and rehabilitation occurs. Runway Safety Areas (RSAs) at the Airport are established 305 feet from the centerline of each runway. The Airport has been advised by the local Airport District Office (ADO) to continue with prior Advisory Circular criteria that incorporates elevation in determining RSA half-width (250 feet + 55 feet based on airport elevation). The Runway Safety Area extends 1,000 feet beyond each runway end. The Runway Object Free Area is 800 feet wide and extends 1,000 feet beyond each runway end.

The Runway Protection Zones (RPZs) begin 200 feet beyond the runway threshold. The inner width of the RPZ is 1,000 feet, the outer width is 1,750 feet, and the length is 2,500 feet for all runways. The FAR Part 77 approach surface has an inner width of 1,000 feet, an outer width of 16,000 feet, and a length of 50,000 feet. It has a slope of 50:1 within the first 10,000 feet (inner approach surface) and a slope of 40:1 for the remainder of the 50,000-foot surface.

Table 3-4

Airport Design Standards

	Airport Reference Code D-V	Airport Reference Code D-VI
Runway Width	150'	200'
Runway Shoulder Width	35'	40'
Runway Safety Area		
Width[16]	500'	500'
Length Beyond Runway End	1,000'	1,000'
Runway Object Free Area		
Width	800'	800'
Length Beyond Runway End	1,000'	1,000'
Precision Object Free Area		
Width	800'	800'
Length Beyond Runway End	200'	200'
Runway Protection Zone	1,000' x 1,750' x 2,500'	1,000' x 1,750' x 2,500'
FAR Part 77 Approach Surface		
Approach Slope	50:1	50:1
Approach Surface	1,000' x 16,000' x 50,000'	1,000' x 16,000' x 50,000'
Runway Centerline to:		
Parallel Runway Centerline	Variable	Variable
Taxiway/Taxilane Centerline	450'	600'
Aircraft Parking Area	500'	500'
Taxiway Width	75'	100'
Taxiway Edge Safety Margin	15'	20'
Taxiway Shoulder Width	35'	40'
Taxiway Safety Area Width	214'	262'
Taxiway Object Free Area Width	320'	386'
Taxilane Object Free Area Width	276'	334'

Source: FAA AC 150/5300-13 (Change 7), *Airport Design,* October 2002
Prepared by: Ricondo & Associates, Inc., November 2002

3.4.2 Modifications to Design Standards

As of mid-2004, the Airport has obtained FAA approval for 15 Modifications to Design Standards (MODs). These are tabulated on Sheet 5 of the ALP Drawing Set and reproduced in **Table 3-5**. The MODs approved to date have typically been minor deviations from the accepted design standards and, therefore, have had little or no impact on Airport operations.

One of the more significant MODs currently facing the Airport is related to the increased activity of ADG V aircraft compared to ADG IV aircraft for which the Airport was originally designed. For example, the paved shoulder width associated with each existing runway, with the exception of recently constructed Runway 16R-34L, is 25 feet per ADG IV standards, as opposed to 35 feet or 40 feet per ADG V or ADG VI standards, respectively. To date, this has not been a significant issue because the overwhelming majority of current (and future) ADG V aircraft operations are twin-engine Boeing 777-type aircraft. Consequently, the need to increase the paved shoulder width to provide blast protection has been minimal.

[16] As previously noted, the local ADO requires the Airport to maintain a RSA with a width of 610 feet.

Table 3-5
Modification to Design Standards

No.	Item	Aircraft Design Group	FAA Existing Design Standard	Approved Modification	Remarks	Approval Authority	Date
1	Distance Between Connector Taxiway VPI's	Approach Category C, D, E, +	100' x sum of grade change	Less Than	Due to 600' separation and taxiway crown	DEN-600	04/01/91
2	ARFF Station – Watch/Alarm Tower Handicapped Access	N/A	Comply with ADA	NO HC Access to Cupola	Waived due to physical Requirements of ARFF positions	DEN-600	08/16/91
3	Taxiway Edge Safety Margin at Beginning of Exits with Cockpit Over Centerlines	VI	Runway widening of 5' required at beginning of curve	2' short	Taxiway speeds at 90° exits are low Would Require inconsistent runway widths	DEN-600	07/21/92
4	90° Runway Exit Taxiway Centerline Radius	IV, V, and VI	200' centerline radius with spiral	150' centerline radius without spiral	18 MPH vs. 20 MPH Taxi Speed	DEN-600	07/21/92
5	High Speed Exit Taxiway Centerline Spiral	All	Spiral Curve on Centerline of HS Taxiway Exits AC 150/5300-13 Para 413(d)	Long Radius Centerline Curve	Standard edge survey margin met	DEN-600	07/21/92
6	Pavement Edge Drop (Transverse Only)	All	1 ½" Max. AC 150/5300-13 Para 502a (2) (e)	2 ½" maximum	Improve surface runoff	DEN-600	07/21/92
7	Marking of Glide Slope Towers	All	Seven bands of alternating white and orange	Five bands of alternating white and orange	FAA Owned Facility	DEN-600	08/24/92
8	MITL at PT with 7/25 and 8/26 Runway Intersections	All	AC 5340-24 Para 4 Taxiway Light at PT of Taxiway – Runway intersection pavement fillet	Plate Last Taxiway Light not at PT But Along Fillet Curve 10' from Edge of Taxiway Pavement	Applies to Runways 8/26 and 7/25 to avoid HIRL conduit	DEN-600	10/02/92
9	Taxiway WB Longitudinal Slope and Cross Slope	All	1.5% maximum longitudinal 1.5% - 5% transverse	1.9815% Maximum Longitudinal 1.0% - 3% Transverse	Required for Taxiway WD to pass through Runway 34 ALS	DEN-600	12/10/92
10	24" Tall Edge Light Height Clearance	All	6" clearance	Approximately 5" clearance	B720B and DC-8-70 are the only aircraft which will be operating with less than standard clearance	DEN-600	05/12/93
11	Longitudinal Spacing of Taxiway Lights on Tangent of Taxiway P7 Near Taxiway ED	All	50" maximum spacing	62'± maximum spacing	Fixture omitted during construction due to confusing visual effect	DEN-600	10/05/93
12	Delete 200' of Lighting and 80'± of Marking from the South End of Taxiway F9 Exit	All	200' tangent	Delete 200' lighting Delete 80' ± marking	Would overlap lighting and marking for Taxiway D	DEN-600	10/07/93
13	Longitudinal Spacing of Taxiway Centerline Lights on Curve at Taxiway P7 and ED Intersection	All	12.5' maximum spacing	9.7' – 14.6' spacing	An in-pavement taxiway centerline light was inadvertently omitted during construction	DEN-600	04/27/95
14	Taxiway SC Longitudinal Slope	All	1.5% maximum	1.615%	Keeps Cargo Apron slope less than 1% while maintaining line-of-sight requirements	DEN-600	04/17/95
15	Taxiway Safety Areas	V (VI)	214' for ADG V (171' for ADG IV)	Use of ADG IV width for grading	Safety Areas (Grades) will be upgraded on existing taxiways to ADG V (and Possibly VI) standards when taxiways are rehabilitated and/or reconstructed	ANM-600	12/12/95
16	Holding Position Markings on Taxiway WE	All	AC 150/5340-1H Para 24–Multiple holding positions collocated when distance < 50'	Runway 16L holding positions are > 50' apart will be collocated and placed west of the glide slope critical area	Crossfield Taxiway WE is not a primary route to terminal area - will not adversely affect capacity	DEN-613	01/28/03

Source: Denver International Airport Layout Plan, 1998
Prepared by: Ricondo & Associates, Inc., August 2001

The FAA's annual certification inspection in 1995 determined that the critical aircraft for the Airport was ADG V, upgrading it from AGD IV due to daily scheduled operations of ADG V aircraft. The runways and their separations meet or exceed this standard, however, the taxiway and runway shoulders were constructed to meet ADG IV standards. In a letter from the FAA dated December 12, 1995, it is mandated that as any existing taxiway is reconstructed or expanded, it must be improved to meet current design standards per Federal Aviation Regulation (FAR) Part 139.309(a)(2). This FAR states, "If construction, reconstruction, or significant expansion of the runway or taxiway began on or after January 1, 1988, the sponsor shall provide a safety area which conforms to the dimension acceptable to the Administrator at the time construction, reconstruction or expansion began." The change of the ARC from D-IV to D-V requires the Airport to increase the width of shoulders from 25 feet to 35 feet and to increase all Taxiway Safety Areas (TSAs) to a minimum width of 214 feet, which will be deferred until major airfield pavement construction or rehabilitation occurs. The TSA expansion is currently being considered a separate project.

There are currently four penetrations of the Airport's FAR Part 77 surfaces in addition to those allowed by the FAA for navigational/operational facilities.[17] These are shown on Sheets 17, 18, and 20 of the ALP and summarized below:

- The antenna tower at Airport Rescue and Fire Fighting (ARFF) Station 1 penetrates the 7:1 transitional surface that is associated with Runway 16L-34R by approximately six feet. The FAA has determined that this penetration is not hazardous to air navigation through the Form 7460 process. The tower has been obstruction lighted in accordance with FAA guidelines.
- A vent on the roof of the East Airfield Lighting Vault penetrates the 7:1 transitional surface that is associated with Runway 17R-35L by approximately two feet. The vent has been obstruction lighted in accordance with FAA guidelines.
- The FAA Airport Traffic Control Tower (ATCT) penetrates the Airport's horizontal surface by approximately 114 feet. The ATCT has been obstruction lighted in accordance with FAA guidelines.
- All new development will be coordinated with the FAA to ensure that (1) there will be no penetrations of Part 77 imaginary surfaces that present a hazard to air navigation or obstruction of the ATCT lines-of-sight, (2) FAA facility capabilities will be protected, and (3) approved obstacles will be marked and lighted as directed by the FAA.

The Airport was approved in its Phase I development with facilities envisioned to accommodate approximately 45 to 50 million annual passengers (enplanements plus deplanements) and aircraft activity levels of up to approximately 640,000 annual operations. The original master plan for the Airport, retained on the updated Airport Layout Plan, provides flexible development to accommodate ultimate annual demand levels at 100-110 million passengers and 1.2 million aircraft operations (with five concourses and 12 runways).

[17] Part 77 surfaces are defined in Title 14 of the Code of Federal Regulations, Part 77 Section 25, *Civil Airport Imaginary Surfaces* (14 CFR 77.25).

3.5 Ultimate Airfield Plan

To meet these near-term and long-term demands while minimizing delays, the Airport was designed with a flow-through concept that places the main north-south arrival runways on one side of the terminal complex and main departure runways on the other side of the terminal's linear satellite concourses. The east-west runways provide crosswind capability and additional flexibility for arrivals and departures when winds permit. All runways are equipped with Instrument Landing Systems and procedures for triple simultaneous independent approach configurations are established in both the north and south directions.

The six runway airfield provides an annual service volume (ASV) of 800,000 – 850,000 operations based on average delay levels of four minutes per operation. As noted earlier, hourly throughput capacity on the runway system is approximately 240 operations during VMC, 175-200 operations during IMC when either Runway 8 or 25 is usable for departures, and 140-165 operations during when only the north-south parallels are available.

Due to the predominance of northerly winds during extremely low visibility and snow conditions, approximately 0.8 percent of the time, Category III Instrument Landing System approaches and a Surface Movement Guidance and Control System (SMGCS) program have been installed and approved for the four approaches from the south (Runways 34L, 34R, 35L, and 35R) when visibility is below 600 feet Runway Visual Range (RVR).

Due to the northerly winds in poor weather, most of the Airport's deicing pad capability is located on four pads at the western end of the terminal concourses. SMGCS departure capability exists on Runways 34L, 34R, and 35L when visibility is below 600 feet RVR.

Five of the "Phase 1" runways were planned to be 12,000 feet in length. This length provides adequate runway length for anticipated domestic air services from Denver but is extremely marginal for international service to Europe and does not provide the capability for non-stop service to Asia. The sixth runway is 16,000 feet in length to accommodate international service, which is expected to increase at the Airport.

As noted earlier, the geometry of the airfield, as completed, provides runway-to-parallel taxiway and taxiway-to-parallel taxiway separations to meet current ADG VI standards, runway and taxiway full-strength pavement widths to meet ADG V standards, and runway and taxiway shoulder widths and taxiway safety area widths to meet ADG IV standards. Additionally, all future runways will be spaced for VFR wake turbulence and independent operations. Eventually, runway construction will allow for quad IFR approaches in the north-south directions, with CAT I approaches from the north and CAT II/III from the south.[18]

Table 3-6 depicts future annual runway use projected by the FAA ATC for the ultimate 12-runway configuration. During peak traffic demand periods, the "outboard" north-south runways will be used for arrivals, while the "inboard" north-south runways will be used for departures, temporarily setting aside the normal flow-through operational concept. The east-

[18] Improvements to instrumentation and lighting to allow CAT II-III capability on at least one approach from the north should be considered in the future.

west runways will be used for departures, except when strong winds would necessitate an east or west flow configuration. There is no operational advantage in converging operations when all north-south runways are being utilized, so the Airport would utilize non-converging operations to simplify the operations of the flexible 12-runway system. During the remaining non-peak periods the existing flow-through operation will resume.

Table 3-6

Future Average Runway Annual Use[19]

Runway Designation	Arrivals (%)			Departures (%)			Total (%)		
Existing / Future	Day	Night	Total	Day	Night	Total	Day	Night	Total
07/Ultimate 07L	2.1	0.4	2.0	-	-	-	1.1	0.2	1.0
07R	0.5	0.4	0.5	-	-	-	0.2	0.2	0.2
08L	-	-	-	5.5	6.9	5.6	2.8	2.8	2.8
08/Ultimate 08R	-	-	-	18.3	20.7	18.4	9.3	8.4	9.2
15	8.2	-	7.5	-	-	-	4.1	-	3.8
16R/Ultimate 16C	5.5	1.1	5.1	4.0	-	3.8	4.7	0.7	4.5
16L	9.4	25.1	10.7	4.0	-	3.8	6.7	14.9	7.2
16R	8.2	-	7.5	-	-	-	4.1	-	3.8
17C	-	8.2	0.7	4.0	1.0	3.8	2.0	5.3	2.3
17L	8.3	-	7.6	2.3	-	2.2	5.3	-	4.9
17R	3.9	24.7	5.6	9.5	18.2	10.0	6.7	22.0	7.8
18	8.2	-	7.5	-	-	-	4.1	-	3.8
25L	-	-	-	7.0	-	6.6	3.6	-	3.3
25/Ultimate 25R	-	-	-	15.7	-	14.8	8.0	-	7.4
26/Ultimate 26L	2.9	3.0	2.9	-	-	-	1.4	1.8	1.5
26R	0.2	2.0	0.3	-	-	-	0.1	1.2	0.2
33	6.7	-	6.1	-	-	-	3.3	-	3.1
34L/Ultimate 34C	-	-	-	7.5	-	7.1	3.8	-	3.5
34L	6.7	-	6.1	-	-	-	3.3	-	3.1
34R	0.8	0.1	0.7	11.0	26.6	11.9	6.0	10.9	6.3
35C	-	5.6	0.5	4.9	6.7	5.0	2.5	6.0	2.7
35L	9.4	29.4	11.0	5.7	19.9	6.5	7.5	25.5	8.8
35R	12.5	-	11.4	0.3	-	0.2	6.3	-	5.8
36	6.7	-	6.1	-	-	-	3.3	-	3.1
Total	100	100	100	100	100	100	100	100	100

Sources: Denver TRACON, HNTB Analysis, 2002
Prepared by: Ricondo & Associates, April 2004

[19] Absence of projected aircraft operations on a runway does not preclude future use of that runway for such operations. The table shows overall average runway use; runway use may vary by aircraft type.

3.6 Terminal and Other Facilities Expansion

3.6.1 Terminal Complex

The existing passenger terminal complex consists of a central terminal building (Jeppesen Terminal) and three concourses (A, B, and C), which currently provide a total building area of 5.8 million square feet. The terminal building includes 1.5 million square feet of passenger processing space.

The terminal building is dual-sided and generally symmetrical in configuration with east and west curbsides, ticket counters, and baggage claims. A central "great hall" houses the station for the inter-concourse Automated Ground Transportation System (AGTS), passenger security screening checkpoints, concessions, and public circulation space. Alternative access to Concourse A is provided by a separate passenger security screening checkpoint and a two-level passenger bridge at the north end of the Terminal over Apron Taxiways AA and AS (there is a 42-foot aircraft tail height restriction on these taxiways).

The interior of the terminal has four functional levels. Ticket counters and support offices are located on Level 6, while baggage claim areas and related offices, as well as ground transportation counters, are located on Level 5. Level 5 also houses the "great hall," which contains the passenger security screening checkpoints and provides escalator access to the AGTS station. Level 4 mainly houses sortation and circulation space for the automated baggage system and related security baggage screening system, while Level 3 contains the baggage make-up and claim input areas. The AGTS tunnels and platforms occupy the center of Levels 3 and 4.

The east and west roadways and curbsides of the Terminal are virtually identical, with public departures on Level 6, multiple commercial arrival and departure curbs on Level 5, and public arrivals at Level 4.

The layout and design of the terminal allows for incremental expansion to the south, providing the ability to ultimately double the terminal's size and provide a second AGTS station and a future landside rail station.

The linear concourses were each planned and designed to accommodate up to 60 narrowbody (B737/MD80/A320) aircraft gates, and it is possible to accommodate widebody aircraft by utilizing alternative parking layouts. The five concourses planned for ultimate build-out expand the Airport to 300 narrowbody gates. Each concourse has a central "core" containing the AGTS station, concessions, restrooms, airline leasable space, and building utilities and services. Located at standard intervals outboard of the central core are "subcores," which provide additional space for concessions, restrooms, leasable space, and building services and utilities.

Concourse A contains the gates for international arrivals requiring Federal Inspection Services (FIS) clearing of passengers. A passenger on an international flight enters a sterile corridor on the mezzanine level via an escalator from the concourse level. The corridor then crosses over the passenger bridge and descends into the FIS facility on Level 5 in the northern end of the terminal. Eight narrowbody aircraft gates are currently accessible to these corridors. The gates can be quickly repositioned to accommodate four wide-body

aircraft (B747/A340) plus one narrowbody aircraft. Additional international arrival gates can be added in Concourse A by extending existing sterile corridors at the concourse mezzanine level and adding vertical access "nodes" at the loading bridge doorways.

The existing FIS facility can accommodate 800 passengers per hour and can be reconfigured to handle up to 1,250 passengers per hour. The FIS facility was designed to ultimately handle 2,000–2,500 passengers per hour by expanding the building to the east and west sides of the existing structure.

The AGTS is the only system available for passengers to travel between the terminal and Concourses B and C and alternatively to Concourse A. It has a current capacity of approximately 8,400 passengers per hour in each direction during peak passenger periods. With incremental improvements to train headways via changes to the train control system, the addition of a track cross-over south of the existing terminal station (once the Terminal is extended south), and purchase of additional vehicles, peak period system capacity can be increased to approximately 11,000 passengers per hour. The 11,000 passengers per hour figure equates to the demand of the full build-out of Concourses A, B, and C, depending on the volume of inter-concourse connecting passengers. Beyond this capacity, further AGTS development is envisioned to expand the existing "out and back" shuttle configuration into two independent loops passing back towards the terminal via the concourse outer subcores and then onto the existing "spine" at the south end of the enlarged terminal. The capacity of this concept would be approximately 16,000-17,000 passengers per hour, enough to accommodate the additional demand of future Concourses D and E.

Terminal parking is located in three structures on either side of the terminal building and in outlying lots beyond the terminal. These are planned for expansion to the south alongside the terminal, with the exception of one of the structures on the east side where the Airport hotel will be located. Long-term parking needs are unknown due to the possibility of the construction of a commuter rail and/or implementation of other mass transit concepts. Additional parking in the terminal complex can be added by constructing parking structures, as needed, in the outlying lots. If these structures are constructed in the outlying lots, consideration should be given to the costs and benefits of adding moving walkways or other people mover systems to replace existing courtesy van operations within the lots.

The two bus-served remote public shuttle lots, the year-round Pike's Peak Lot on 75th Avenue, and the holiday overflow facility at Mount Elbert Lot on 68th Avenue are planned to remain available in the foreseeable future. The Pike's Peak Lot is to be expanded in the near future and adequate areas are available for future public shuttle lot expansion nearby.

3.6.2 Cargo Facilities

Air cargo activity at DIA was originally planned to be accommodated on the north side of the Airport, accessed via 114th or 120th Avenues. However, the proximity of the south side of the Airport to the existing regional cargo handling and distribution infrastructure along the Interstate 70 corridor caused a relocation of the planned air cargo facilities to the area south of the terminal complex.

Expansion of this area to accommodate additional facilities is limited, due to the land reserved for development of Future Runway 7R-25L and Future Taxiways A, F and G and

the related airspace and sight line issues. However, significant space remains available south of this future runway for a new parallel taxiway and cargo aprons and buildings. The current capacity of the existing cargo facilities can easily be doubled in this area. A connection to the current west side of the airfield via planned taxiway bridges across Peña Boulevard (Taxiways F and G) will provide better airside access for the air cargo facilities.

The originally planned cargo area on the north side of the Airport also remains available for expansion with most rough grading and utilities completed. It is anticipated that the option to locate future cargo facilities on the north side of the Airport will become more attractive as better regional access is provided and more freight distribution activities locate to the northern metropolitan area.

3.6.3 Rental Car Facilities

Adequate space for rental car expansion to meet foreseeable needs is available within the existing rental car area along 78th Avenue. The industry is currently consolidating; and existing facilities are being returned to the Airport. All customer transaction activities and personnel have been relocated from the terminal to their respective administrative buildings at their lease site. There are no plans for a common rental car bus operation or a consolidated rental car facility at DIA at this time.

3.6.4 Access Facilities

It is envisioned that Peña Boulevard will remain functioning as the primary access route into the terminal complex, cargo, and rental car facilities. This road is currently two lanes wide in each direction and is planned to ultimately expand to five lanes in each direction between the terminal and 56th Avenue. The long-range plan is to have a collector-distributor roadway system south of 56th Avenue. Rough grading has been completed for a third lane and bridges from the terminal up to Tower Road have been constructed to accommodate the third lane.

E-470, a toll road operated by an independent expressway authority and located just west of the airfield with a major interchange at Peña Boulevard, is of growing importance in serving the eastward, southward, and northward expansions of the metropolitan area and providing improved airport access from Colorado Springs, Boulder, and Fort Collins.

A route alignment has been reserved for construction of a commuter rail connection between the Airport and downtown Denver. Once entering Airport property at Peña Boulevard and Interstate 70, this corridor is currently planned to run along the east and south sides of Peña Boulevard. In the vicinity of Piccadilly Road, the rail goes under Peña Boulevard and follows the north side of 78th Avenue past the rental car facilities to the terminal. The station will be located on the south end of the terminal on Level 1 with the arriving and departing passengers escalating between the rail station platforms and Levels 5 and 6, respectively. The reserved corridor width assumes two tracks with additional room for a third track at the terminal station.

3.7 Airport Land Use

Denver International Airport, whose property comprises approximately 53 square miles, falls mostly within the jurisdiction of the City and County of Denver, but has outlying portions in Adams County and the Cities of Aurora and Commerce City. In April 1988, an

"Intergovernmental Agreement" (IGA) between the City and County of Denver and Adams County was effected that allowed Denver to annex the majority of airport property purchased by the City.

Land use for the portion of DIA within the City and County of Denver is zoned "O-2," or Open Space. The O-2 zoning classification allows for a primary "use by right" (as an airport) along with "accessory uses." Under Denver zoning, accessory uses (1) are clearly incidental and customary to and commonly associated with the operation of the use by right, (2) are operated and maintained under the same ownership and on the same lot as the use by right, (3) do not include structures or structural features inconsistent with the use by right, and (4) do not include residential occupancy except by owners and persons employed on the premises and the immediate families of such owners.

In the 1988 IGA, "accessory uses" at DIA were further defined as "only those land uses that are necessary for or directly related to the operation of the Airport as a major air carrier airport, including but not limited to retail or concession space designed to primarily serve airline passengers and employees, such as rental cars and parking; manufacturing or other commercial activities, which by customary practice require direct airside access; and office space directly related to aviation or airport operations."

Also stipulated within the 1988 IGA, land use is restricted within the "Transportation Corridor" running along Peña Boulevard between Interstate 70 and Himalaya Road. Residential, commercial, or industrial development is only permitted in the Transportation Corridor south of 72nd Avenue and south and east of the designated Scenic Buffer, which extends 1,000 feet on either side of the centerline of Peña Boulevard. All other portions of the Transportation Corridor are to be maintained as open space except for transportation uses.

The portions of DIA property outside of the City and County of Denver annexation are permitted for installing, operating, and maintaining navigational and visual aids used by aircraft, aviation weather reporting equipment, noise monitoring equipment, etc. required by the FAA for the safe operation of the Airport. As set in the 1988 IGA, this property (termed as "Clear Zones" in the Agreement) is to be maintained as "passive use (including but not limited to agriculture), which does not interfere with airport operations, clear aerial approaches, or use of any equipment" (as noted above) "as mutually agreed between Denver and Adams County or any Adams County city within which the property might lie." Rights of way for roads and trails are permitted within these areas.

Permitted uses on DIA are also subject to height and hazard restrictions per Federal Aviation Regulation Part 77 (objects affecting navigable airspace) and related airspace studies, designated view planes to preserve views of the terminal from certain points along Peña Boulevard, noise compatibility criteria, and wildlife attraction mitigation requirements.

The following are Land Use Categories at the Airport:[20]

[20] Exceptions for interim uses may be approved, on a case-by-case basis in writing by the Department of Aviation, only if the leases or similar agreements allow for the establishment of the long-term use by the Airport when needed for that primary use, without additional cost or obligation to the Airport.

Airfield Areas - These areas are dedicated to protect operational areas for aircraft movements other than those within the Terminal and Airport/Airline Support Areas. Included are all areas within 750 feet of runway centerlines, 217 feet of taxiway centerlines, the FAA Runway Protection Zones, deicing pads and aircraft holding aprons, and critical Object Free Areas for FAA navigational and visual aids.[21] Only uses and objects that are fixed by function are allowed in these areas. Vehicle service roadways are allowed as long as they are located outside of Runway and Taxiway Safety and Object Free Areas and under Obstacle Free Zones and runway approaches. The only exceptions to this criteria are the public roadways and rail transit corridor that lie within the Runway Protection Zone for Runway 25R. Leasing within airfield areas is not permitted.

Terminal Area - This area is defined to include the area to be used for passenger aircraft parking, apron, taxiways, taxilanes used for gate access, concourse buildings, and the passenger terminal building. Several support uses, including the UAL Aircraft maintenance facility and airfield deicing material storage, are currently located in the development "envelope" for future Concourse E. These are considered interim uses and the UAL lease requires the facility to be relocated when Concourse E is needed. On the airside, the terminal area limits are defined by the boundary of the adjacent Airfield Areas, on the east and west by Vandriver St. and Oak Hill St., respectively, and on the north by future Taxiway Z. On the landside, the Terminal Area includes all areas allocated by terminal building development/expansion and related uses, such as adjacent automobile parking, terminal curb front and recirculation roadways, parking access/exit areas, and the Airport hotel.

Terminal Support Areas - These areas include landside functions that are directly related to the support of the air passenger terminal, but are not included in Airport/Airline Support Areas. Permitted uses include rental car lots and servicing facilities, remote public parking, and commercial vehicle staging lots and terminals. Some of these uses may also be accommodated in the Terminal Area if justified by feasibility and practicality.

Airport/Airline Support Areas - These areas include a number of functions related to airport and airline operational support and related activities that generally require airfield access: air cargo, freight forwarder, and air mail facilities; flight kitchens; airline maintenance and hangar facilities; offices for airlines, airport administration and aviation-related tenants; fuel farm; airport maintenance facilities; ARFF stations; employee parking; general aviation terminals, hangars, and aprons; and infrastructure buildings (HVAC, communications, sewer lift stations, glycol storage and recycling facilities, etc.). Some of these uses may also be accommodated in the Terminal Area if justified by feasibility and practicality.

Secure Aviation-Related Areas - These areas are located within the security perimeter of the airfield but have no specified use, as they are not accessible to the public and many airport employees. They are often affected by required lines-of-sight for the Airport Traffic Control Tower and site requirements for navigational aids and related systems. Within these constraints, these areas may include ARFF facilities, FAA navigational aids and support

[21] The 217 feet within taxiway centerlines consists of a 193 feet ADG VI taxiway object free area plus 24 feet allowance for service roads, when necessary. In some areas, interim design standards for ADG V aircraft provide 184 feet width (160 feet taxiway object free area plus 24 foot allowance for service roads).

facilities, and airport support facilities such as electrical vaults, drainage channels and ponds, industrial waste facilities, etc.

Airport Compatible Development – Located within the City and County of Denver, the use of these areas is limited to retail, commercial, office, industrial, and warehousing activities that are classified as "accessory uses" under the 1988 IGA and the City and County of Denver O-2 zoning classification. Open space activities, such as recreation, farming, and resource recovery, are also permitted. No residential uses are allowed in these areas. Within the Airport Compatible Development, no occupied structures are allowed within an area defined by the extended runway protection zone extended to 5,200 feet beyond runway ends. Uses that are highly sensitive to noise and vibration should remain outside of the existing and anticipated long range 65 DNL noise contours and at least 1,000 feet from the runway centerline, along the runway, and up to 10,000 feet beyond the runway ends.

Passive / Open Space – Located on airport property, but outside of the City and County of Denver, the use of these "clear zone" areas is restricted by the terms of the 1988 IGA and zoning of Adams County, Aurora, and/or Commerce City.

Principal Transportation Alignments - These areas preserve rights of way and landscaped areas for existing and future roadway and rail transportation development. These do not include driveways into leaseholds. West of Himalaya Road, this use also includes the restrictions for the Transportation Corridor and its "Scenic Buffers" established under the 1988 IGA.

Primary Utility Right of Way/Easements - These Corridors have been reserved for placement of major underground regional utility trunk lines that serve the Airport or that circumvent the secure airfield areas and associated height restrictions. These utilities include, but are not limited to, electric; communications; gas, fuel, and oil pipelines; and water and sewer lines.

3.8 Airport Development Issues

As noted earlier, financial considerations caused a scaling back of planned Phase 1 programs late in the initial airport development process. Major airfield projects deferred to a five-to-ten-year post-opening construction program include Taxiways B5, B6, F7, P5, and L south of the Terminal apron area. The construction of Runway 16R-34L and Taxiway EA were initially deferred but have since been completed. The planned third lane in each direction on Peña Boulevard, the lengthening of the Concourse A, and the automated baggage system were also scaled back. Another significant issue includes the reliance on the congested Interstate 70 corridor link with the Central Business District (CBD) and coordinating with state, regional, and local agencies to plan and fund improvements.

In addition, the initial cargo facilities were moved to the area south of the terminal from the north side of the Airport due to relative inaccessibility of the northern cargo area site to established warehousing and support areas around the former Stapleton International Airport. Much of the original north cargo area site has been rough graded or is naturally flat and utilities have been installed.

Operational procedure solutions have been found for small, remaining airfield concerns such as aboveground tug and truck crossings of taxilanes between the concourses not using established vehicle service roads and airside vehicle parking at the Airport Office Building within the Object Free Area of Taxiway AA.

There are other facility issues that may need to be addressed as the Airport expands. These issues include: (1) the need for improved fire and rescue response for the large airfield as it expands, (2) requirement for additional deicing recovery facilities and related environmental needs, and (3) the continuing strong demand for additional landside facilities (parking, rental car, etc.) and the need to manage this demand due to the Airport's distance from the CBD and other regional activity centers.

It should be noted that the elevation and contour data shown is based on the best information available from as-built information, photogrammetry completed during construction, topographic information on the United States Geological Survey quadrangle maps, and new survey data of structures and obstacles. New comprehensive photogrammetry is planned and will be utilized in the next major ALP update.

Additionally, further studies will evaluate geometry, location, and implementation timing of future runways and taxiways and alignments of several taxiways. These include future Taxiways C and WA on the western side of the Airport, which are within the critical area of the Airport Surveillance Radar, and Taxiway P north of existing Runway 8-26. Currently, all CAT II/III IFR approaches are conducted from the south on the north-south runways. An evaluation should be conducted to determine the future need for a CAT II/III approach from the north.

4. DIA Development Program

4.1 Overview of DIA Development Program

The DIA Development Program, as described here, presents the recommended facility improvements in a manner that is based on the character and rates of growth anticipated under the previously described planning activity levels.

Since actual growth may vary from that which has been projected, the Implementation Plan defined for the proposed development includes a discussion of factors that are expected to trigger a development action. This approach offers the Airport the ability to assess actual demand and the flexibility to respond effectively. Through regular monitoring and analysis of statistics and an understanding of the potential impacts of various trends, the Airport can respond in a strategic manner to meet tenant and user needs by developing demand-driven facilities in a timely manner. However, in dealing with a dynamic industry and related uncertainties, close management scrutiny is needed of benefits vs. costs and of related risks before making decisions to finalize plans and commence construction.

The development program outlined herein reflects near-term and long-term components, defining the ultimate configuration of the Airport over the planning horizon.

The Section is subdivided into three discussion topics:

- **Factors that determine timing and need for implementation** – discusses general criteria upon which decisions for facility development should be based and identifies specific implementation indicators.
- **Near-Term Development (0-6 year time frame)** – outlines development projects that are considered to be near-term (up to six years).
- **Longer-Term Development (7-20 year time frame)** – presents projects that are considered to be intermediate-to-long term. DIA is fortunate that its master planned facilities extend well beyond the 20-year time frame, with areas set aside to accommodate development needs for airfield, terminal, and landside development far into the future.

4.2 Factors Influencing Implementation and Development Phasing

In general, implementation of the development plan should be based on demand and the need to provide additional capacity. Ideally, projects should be implemented in adequate time to serve the needs of growing demand, but not so early that facilities are underutilized. The ability to time implementation correctly requires an understanding of the factors that trigger facility development, ongoing data monitoring and analysis to identify when action should be taken, and an organizational structure to implement project planning and construction when demand dictates. The timing of implementation also has to consider the financial implications of development decisions.

4.2.1 Volume and Character of Growth

The volume and character of activity is one factor in determining when development should occur. Activity characteristics such as connecting passengers versus originating and departing (O&D) passengers may require different improvements regardless of total passenger counts. The number of operations by various sizes and types of aircraft will influence facility requirements. It is essential that the overall activity monitoring account for all elements of activity.

There are many metrics used to determine the rate and character of growth in any particular area of the Airport. For instance, overall performance of the airfield may be measured by aircraft delay. Various other statistics need to be analyzed in order to determine development of Airport facilities. Changes in technology, airline operating policies, and security requirements need to be considered, including such recent trends toward e-ticketing and self-service units, de-peaked "rolling hubs" for flight scheduling, and security inspection process improvements and related technologies for passengers and baggage.

4.2.2 Relocation and Replacement of Displaced Facilities

While DIA has master-planned expansion areas for various needs, the future expansion of terminal, cargo, or airfield facilities to meet specific demand could impact existing buildings or other facilities. The need to minimize disruption of Airport and tenant activities can influence project phasing. This means that detailed planning, design, and phasing analysis are necessary to ensure that the operational impacts of any facility relocations or replacement are defined, communicated, and minimized.

4.2.3 General Criteria for Planning Implementation

There are several criteria that should be considered when phasing development projects, including the following:

- **Ensure that sufficient time is allowed** – This includes completing the necessary planning, obtaining required regulatory reviews and approvals, coordinating with appropriate stakeholders, and undertaking final design and construction to ensure that the development project is in place and operational to meet demand. On many major projects, the time for this process through project delivery can exceed two years or considerably more if full federal environmental review under the National Environmental Policy Act is required.
- **Minimizing operational impacts** – This includes minimizing gate loss or other tenant impacts, minimizing closure of runways and taxiways to avoid the loss of interim capacity and/or airfield congestion and delay, maintaining roadway and parking facility accessibility, and minimizing passenger inconvenience and confusion.
- **Maintaining a logical sequence of development** – Near-term development projects should be configured to consider further long-term development, protecting the flexibility of future options.

4.2.4 Implementation Indicators

Various development projects will be triggered by certain levels of activities. These "indicators" signal the impending need for additional or modified facilities given present demand/capacity relationships.

4.2.4.1 Airfield Indicators

There are several indicators that can signal the need for additional airfield capacity. The most prominent indicator is average aircraft delay. When the Airport reaches a defined level of delay, planning for additional airfield facilities should begin. The future airport layout plan for DIA depicts six additional runways in its ultimate configuration. The timing of the full airfield implementation is undefined and should be planned by carefully considering characteristics of the entire airfield. While benefit-cost analysis will be the determining factor in major airfield projects, anticipated aircraft average delay levels of more than four to six minutes or aircraft operational levels reaching 80-85 percent of airfield Annual Service Volume should trigger the start of the detailed planning/environmental process.

Delayed taxi operations resulting from the congestion of Airport taxiways and aprons may warrant the expansion of other airfield facilities. Expansion of the deicing pads may be required if the Airport is experiencing extended queues and delayed departures.

4.2.4.2 Terminal/Gate Indicators

The timing for terminal/gate expansion or development will be based on airline demand for additional facilities. There are several indicators related to terminal capacity, including delays in processing times (e.g., security), reduced level of service, gate utilization, and delays due to aircraft occupancy. Planning for future terminal facilities must also consider airline characteristics such as the difference in operating procedures for low-cost and mainline carriers. Lead times of two years or more need to be considered in project timing.

4.2.4.3 Parking Indicators

The primary indicator for parking development is parking occupancy in the peak month. Planning consideration should be initiated when average peak month occupancy reaches 90 percent of total capacity, so that improvements can be in place when needed. Other indicators may include rate of growth, type of growth, and the introduction of other forms of transportation to the Airport.

4.2.4.4 General Aviation Indicators

The number of private and corporate-based aircraft is an indicator of the potential need for facilities development. Tenant demand typically signals the need for additional general aviation facilities. Growth in the number of general aviation operations can indicate the need to initiate planning for hangar or apron expansion.

4.2.4.5 Cargo Indicators

Cargo facility development is driven largely by tenant demand. Assessing the growth of such indicators as cargo tonnage, cargo aircraft operations, and fleet mix, the Airport can anticipate demand and planning for cargo tenant expansion.

4.3 Near-Term Development (0-6 year time frame)

The following major capacity-related projects are currently anticipated to be constructed within the next six years (through 2010).

4.3.1 Airfield

ARFF Station 4 Relocation – This project entails the relocation/replacement of the current fire station to provide improved emergency response access to Runway 16R-34L, especially during low-visibility (SMGCS) operations.

WA Aircraft Deicing Pad – The construction of a new aircraft deicing pad west of Concourse A on Taxiway WA will provide six additional deicing positions for narrowbody aircraft or three positions for widebody aircraft. The pad will be linked into the Airport's glycol collection, recycling, and disposal system.

Taxiway Safety Area Upgrade – This project includes a phased multi-year widening of Taxiway Safety Area grading from FAA Airplane Design Group (ADG) IV standards (85.5 feet on either side of the taxiway centerline) to ADG V standards (107 feet) and to ADG VI aircraft standards (131 feet) in those areas where these very large aircraft may operate in the future.

Exit Taxiways P5, B5, B6, F7, R5 – The construction of high speed exit taxiways will help improve runway occupancy times by allowing for early runway turn-offs.

4.3.2 Terminal and Concourses

Concourse B Regional Aircraft Facility Replacement and Expansion – This includes the replacement and expansion of regional aircraft facility to accommodate larger regional aircraft and provide an additional 10-12 parking positions (depending on aircraft "mix"), and the construction of passenger holdrooms, restrooms, concessions, etc. adjacent to the aircraft gates. A new interim Apron Taxilane K will provide access to the extended concourse "fingers," which will be upgradeable to a full ADG V apron taxiway in the future.

Concourse A West Expansion – This project entails the expansion of Concourse A to the west by adding six narrowbody gates and up to five regional aircraft parking positions at apron level. The concourse "sub-core" as master planned for the project area will be deferred to provide space for the long-term expansion of the AGTS system into a "double loop" configuration when Concourse D and E are required.

Concourse C Interim Extension – This project includes the addition of two narrowbody gates on the west end of Concourse C. The project is currently envisioned to use fixed enclosed passenger loading bridge walkway tubes to connect the loading bridges to the existing end of the Concourse, the interior of which will be reconfigured to provide the additional passenger holdroom space required.

Federal Inspection Services (FIS) Facility Expansion – The initial phased expansion of the current international passenger entry processing facility will relocate existing offices and baggage claim devices and add a third widebody-sized claim device, increasing processing capacity from 800 passengers/hour to 1,250 passengers/hour. A second phase, likely to be completed later, possibly in conjunction with the Concourse A Security Checkpoint

Expansion (see below), will relocate the immigration counters to an expanded area at the south end of the Concourse A bridge before passengers escalate down into the existing FIS facility. In place of the relocated immigration counters, an additional three narrowbody aircraft baggage claim devices are planned, bringing the total processing capacity of the facility to 2050 passengers/hour.

High-Speed Baggage System (Phase 1) – Phased development of a high-speed baggage belt system to move post-security baggage sortation and make-up from the interim areas in the terminal parking structures to the concourse basements. Currently under study and dependent on concourse expansion timing, the first phase will likely replace the tug and cart system to Concourse A and possibly Concourse B. Later phases will extend the system to Concourses B and C, with consideration for future Concourses D and E.

Concourse A Security Checkpoint Expansion – This project includes expanding the number of security checkpoint from six lanes to 10 lanes by expanding eastward onto the roof of the Airport Office Building parking structure, which has been stressed for this expansion. As mentioned above, this project may be coordinated with the later phase of the FIS Facility Expansion project.

4.3.3 Roads and Parking

Peña Boulevard Widening – Jackson Gap to Tower Road This project includes the phased expansion of Peña Boulevard from two to three through lanes eastbound and westbound from Jackson Gap St. to Tower Road. This work will include revision of the westbound Peña/E-470 exit. Bridge widening has previously been completed for this project.

78th Avenue Widening – An addition of one through lane westbound and an acceleration/deceleration/turning lane eastbound on 78th Ave. between Jackson Gap St. and Gun Club Road will provide capacity and "calm" flows to rental car facilities. At the completion of this project, 78th Ave. will have two through lanes in each direction plus an eastbound acceleration/deceleration lane and a center median with turning bays westbound.

'Pike's Peak Lot' Shuttle Parking Expansion – This project entails the addition of 3,000 public parking spaces at this remote parking lot. Planned expansion will be to the west of the existing lot.

Terminal/Concourse Employees Parking Expansion – The existing airside/concourse employee parking lot will be expanded by approximately 400 spaces.

Terminal Mod 4 West Public Parking Structure – This project includes the construction of a planned 1200-space, five-level parking structure in the Terminal Mod 4 West location, immediately southwest of the existing terminal building and south of the west side parking structures.

Landscape Master Plan Implementation – This includes the phased development of landscaping along Peña Boulevard from E-470 to the area south of the terminal complex. This landscaping is planned to primarily use earth forms supplemented by plantings.

4.3.4 Other

Hotel – This project entails the construction of a 500-room business-class hotel connected to the southeast end of the existing terminal building, south of the east side parking structures. The hotel will be a full service facility and include conference and ballrooms, a pool, and exercise areas. It will also be expandable to a total of approximately 1,000 rooms.

Commercial Vehicle Holding Lot Improvements – Project need includes expansion of the existing building to provide improved break room and restroom facilities for taxi, bus, and other ground transportation personnel and the expansion of the vehicle storage lot.

4.4 Longer-Term Development (7-20 year time frame)

The full build-out of the airport layout plan is planned to be completed incrementally as demand warrants over time. Based on current projections and anticipated needs, the following major projects are envisioned for the seven to 20-year planning horizon (2011-2024). As time passes, some of these projects may be accelerated to the near-term, some may be deferred, and new projects may be added.

4.4.1 Airfield

Seventh Runway – This project includes the construction of a 7th runway with associated taxiways to increase capacity and reduce flighttime and delay costs to aircraft operators. It has not been determined which of the six additional runways outlined in the master plan will be constructed. Design and construction of the runway will be preceded by a master plan update/runway alternatives study and the beginning of the federal Environmental Assessment/Environmental Impact Statement process. These studies are currently anticipated to start when aircraft operational demand reaches about 80 percent of existing ASV capacity (approximately 650,000 annual operations).

Upgrade for New Large Aircraft (ADG VI) – This project entails the upgrade of the existing runway and taxiway system to accommodate ADG VI/ICAO Code F aircraft and allow access to passenger gates and the Airport's cargo area as well as an east-side runway. Initial accommodation will be established between the international gates and the existing ADG VI Runway 16R-34L and its associated taxiways by following FAA Engineering Brief 63 or newer FAA guidelines. Once demand warrants it, the runway on the east side of the airfield and related taxiways will also be upgraded. The new north-south Taxiway L (see below) is currently planned to meet ADG VI standards.

Taxiway L – The construction of Taxiway L will improve taxiway flows from Runway 17R-35L and will provide two taxiways for bi-directional taxi capability between the terminal complex, the general aviation ramp, and the cargo area. Aircraft activity levels will determine the timing of this project, especially those for cargo and general aviation aircraft.

Taxiway for Connection of Cargo Area to West Airfield – This project includes the extension of Taxiway A west and Taxiway G south to provide a connection between the southside cargo area and the west airfield. This project will involve bridging Peña Boulevard, 75th and 78th Avenues, and the planned regional rail transit connection to the terminal. Allowance should be provided for the further extension of the parallel Taxiway F to ultimately provide dual parallel taxiway capability for these crossings.

Taxiway G North Extension – Extension of dual parallel taxiway capability for improved flows for aircraft exiting Runway 16L-34R and accommodation of envisioned future development of additional aircraft maintenance and support facilities along the east side of this runway/taxiway system north of Taxiway WC.

Taxiway K between Taxiways AS and CN – The construction of Apron Taxiway K will provide north-south aircraft circulation in the non-movement area along the east side of the Concourses. This capability will provide more flexibility in accessing deicing pads and re-positioning aircraft. While ultimately planned to meet ADG V standards, initially the project may be phased; the segment between Taxiway BN and BS is to be constructed in the very near-term as an ADG III Taxilane, but with pavement design to allow upgrade to ADG V taxiway standards in the future.

4.4.2 Terminal/Concourses

International Gates – This project includes the addition of up to four narrowbody or two widebody gates on Concourse A, as international demand develops, and the extension of mezzanine-level sterile walkways for arriving passengers. Most likely these will convert existing domestic gates, with new international "nodes," as Concourse A is expanded and more domestic-only gates become available.

Concourse A East Extension – This project includes the east extension of Concourse A by up to 12 additional narrowbody gates. This total may be modified depending on need for widebody or regional aircraft requirements or storage areas for GSE equipment, snow, etc. Also, consideration needs to be given to the installation of additional escalators on either end of the AGTS station in the main core of the Concourse.

Concourse C Expansion – This project includes the phased development of Concourse C as demand warrants. Initial development most likely will be an extension on the western end with six narrowbody gate positions (four new positions and reconnection of the two near-term interim "tube" gates). Later phases will extend the east end of the Concourse by up to 18 additional narrowbody gates. This total may be modified to meet widebody or regional aircraft requirements or the need for storage areas for GSE equipment, snow, etc. These extensions will require the installation of moving walkways at the concourse level. Also, consideration needs to be given to the installation of additional escalators on either end of the AGTS station in the main core of the Concourse.

Main Terminal Security Checkpoint Expansion – This project entails the expansion of the two security checkpoints in the main terminal. Each of the two existing checkpoints has the capacity to be expanded from 10 up to 16 lanes (a combined addition of 12 lanes), without major changes to passenger flows or terminal facilities, if current processing procedures and equipment remain the same. Additional capability can be provided in conjunction with the Terminal Module 4 project (see next) and, for capacity compatibility, with the extension of AGTS (see below).

Terminal Module 4 Construction – The south extension of the existing main terminal building by 360 feet will provide additional ticketing, baggage processing, and bag claim functions and expanded public area, concession space, and offices. This project is also planned to add new delivery loading docks on Level 1 and needs to be coordinated with or

include the Security Checkpoint Expansion (see above), the south extension of the AGTS (see next), and the Commuter/Light Rail Station (see below).

South Extension of Automated Guideway Transit System (AGTS) – The expansion of the AGTS will include an extension of the dual track inter-concourse people mover south of the existing Terminal station, installation of a crossover, and changes to the train control system. These changes increase AGTS capacity from approximately 8,400 passengers/hour to 11,000 passengers/hour in each direction. For capacity compatibility, this project should be coordinated with the main Terminal Security Checkpoint Expansion (see above) and may be combined with the Terminal Module 4 Construction (see above).

High-Speed Baggage System (Phase 2) – This project is a continuation of the phased development of the system described earlier with the Near-Term Projects. This phase will likely complete the envisioned high-speed belt system connecting the Terminal and relocated make-up devices on Concourses A, B, and C.

Commuter/Light Rail Station – This project includes the construction of a commuter/light rail station at the south end of the existing Terminal Building. The rail system will link the Airport with a central transit hub at Denver Union Station in downtown Denver and to neighborhoods enroute. This station will be located on the north-south Terminal Building centerline at Level 1, at the Terminal's south end, to allow Terminal Modules 5 and 6, along with the AGTS system, to be extended over the station. Passengers will escalate from the two rail transit platforms to Terminal level 5. The final rail technology and requirements are currently under study and the transit line to the Airport, funded by others, will determine the station construction schedule.

4.4.3 Roads and Parking

Peña Boulevard Widening – Tower Road to I-70 – The addition of one lane in each direction on Peña Boulevard between Tower Road and I-70 will provide three through lanes in each direction and increased capacity. This six-mile project will also include bridge and drainage structure widening as may be needed. The project will require coordination with the Colorado Department of Transportation and other agencies to be compatible with planned upgrades to the I-70 corridor.

Peña Boulevard Widening – Jackson Gap St. to Terminal Split – This project provides addition of one lane in each direction on Peña Boulevard between Jackson Gap St. and the terminal roadway east-side/westside roadway "split." This 1.5-mile capacity project will result in four through lanes in each direction with an additional lane in the weaving area between the return to terminal ramp and the "split."

Widen Jackson Gap St. – 75th Ave. to 78th Ave. – The project provides addition of one through lane in each direction and turning lanes at 75th Ave., Peña Boulevard, and 78th Ave. to add capacity and improve flows.

Relocation of Terminal-Landside Employee Parking – This project includes the relocation and expansion of parking areas for terminal-landside employees. As overall employee growth requires its expansion, the continuing need for the airside-concourse employee parking to be convenient to the airfield must be considered. While decking over both the

airside and landside employee lots is an option, a likely scenario would be to relocate and enlarge the landside lot in an available alternate area, planned for parking use, south of the Peña Boulevard, west of Jackson Gap St. Further study will be required, considering employee needs and development options.

Public Parking Expansion – This project includes a significant expansion of public parking facilities. Areas have been set aside for additional close-in parking structures and additional remote "shuttle" lots. Further study will be required, which should consider types of parking needs, impacts of changing the parking rates, impacts of transit, on-site development options, and off-site private facilities.

4.4.4 Other

Cargo Area Expansion – This project entails the expansion of cargo apron and processing building facilities. Two options are available on the south side of the Airport: (1) extend the existing cargo aircraft apron by approximately 325 feet to the west to accommodate increases in aircraft activity by tenants in the current cargo buildings (or minor expansions of the buildings) and/or increases in "through the fence" truck delivery from off-site and (2) construction of new building and apron facilities south of the future Runway 7R-25L and existing Taxiway A. This latter option would require construction of a new connecting taxiway(s), relocation of roads, and extension of utilities. Another site for cargo development, with utilities readily available, is on the north side of the Airport, just east of existing Runway 16L-34R. Decisions for development of cargo will be dependent on tenant needs; further study will be required.

Airport Maintenance Facility Expansion – The major expansion of warehousing, vehicle maintenance, storage, and other related facilities will accommodate additional personnel, equipment, and materials needed to support additions to airfield and other facilities at the Airport. The expansion will take place at the existing site, west of Runway 17R-35L and southeast of the Terminal area

Expansion of "Dirty Water" Storm Drainage Collection and Storage Facilities – This project includes the expansion of facilities, when required, to maintain commitments for discharging storm and wastewater. Development of expanded and/or new drainage detention ponds will be required as the area of impervious surfaces associated with Airport development will be increased.

5. Community Involvement and Agency Coordination

The ALP drawing set and this report do not differ significantly from the Airport Development Plan, the final Federal EIS, and the Intergovernmental Agreement between Adams County and the City and County of Denver (and concurred to by the Cities of Aurora and Commerce City). These entities served as the basis for community approvals (and referendum) on the site.

New major airport planning studies and associated ALP revisions will be fully coordinated with various government agencies, organizations, and users as required. Also, the Airport, which is owned and operated by the City and County of Denver, is subject to the city and county's open decision-making and approval process including City Council public meetings and hearings. The Airport will also conform to all regulations in the National Environmental Policy Act (NEPA) and will hold public meetings for major environmental evaluations.