RAPID CITY REGIONAL AIRPORT

Airport Master Plan Update

CHAPTER THREE
AIRPORT FACILITY REQUIREMENTS

Chapter Three identifies the long-range facility requirements for the Rapid City Regional Airport to satisfy the annual aviation demand through the year 2017. The facility requirements are developed from information assembled in the inventory and forecast analyses and from FAA criteria for design of airport components. The analysis yields estimates of required **"airside"** improvements such as runways, taxiways, navigational aids, marking and lighting, and **"landside"** improvements such as the terminal building, hangars, aircraft parking aprons, fueling facilities, vehicle parking spaces, and airport access requirements.

3.1 Airfield System

The primary components of the **"airside"** are those directly related to the arrival and departure of aircraft. These facilities are comprised of the runways and taxiways, navigational aids, and airport lighting and marking.

The development of airport facilities is based primarily on the characteristics of the aircraft which are expected to use the airport. The most important characteristics are the approach speed and the size (wingspan) of the "critical" aircraft expected to use the airport. A "critical" aircraft is defined as the most demanding aircraft which performs 500 itinerant operations annually at the airport.

The FAA groups aircraft according to their performance and size. The categories range from Approach Category A, for slower single-engine piston aircraft, to Approach Category E, for supersonic jet aircraft. A description of the FAA classifications were previously presented in Table 1-11. The "critical" aircraft group now using Rapid City Regional Airport falls into Category C (approach speed less than 166 knots), which is considered a transport aircraft. Based on the forecasts of aviation demand, and for future long-term airport requirements, the "critical" aircraft group would remain within Category D.

Along with the aircraft's approach speed, the airplane's wingspan is another principal characteristic which affects airport design standards. There are six Airplane Design Groups which range from Group I, for small aircraft with wingspans less than 49 feet, to Group VI for the largest air carrier and cargo aircraft. The predominant civil aircraft now using the Rapid City Regional Airport fall generally into Design Groups I and II (wingspans less than 79 feet). However, based on the forecast analysis, the specific long-range "critical" design aircraft group for Rapid City Regional Airport will fall within FAA Airport Reference Code C-III. This includes the ***Douglas DC-9-30*** (see Figure 3.1) which Northwest Airlines operates in and out of Rapid City more that 500 times annually. The Boeing 737, which in the past has also been used at Rapid City, is also a C-III aircraft.

3.2 Runway Requirements and Orientation

The condition and adequacy of the existing runway system at Rapid City Regional Airport, including the number of runways, runway length, pavement strength, and their orientation relative to area winds were assessed. From this analysis, future runway requirements were determined.

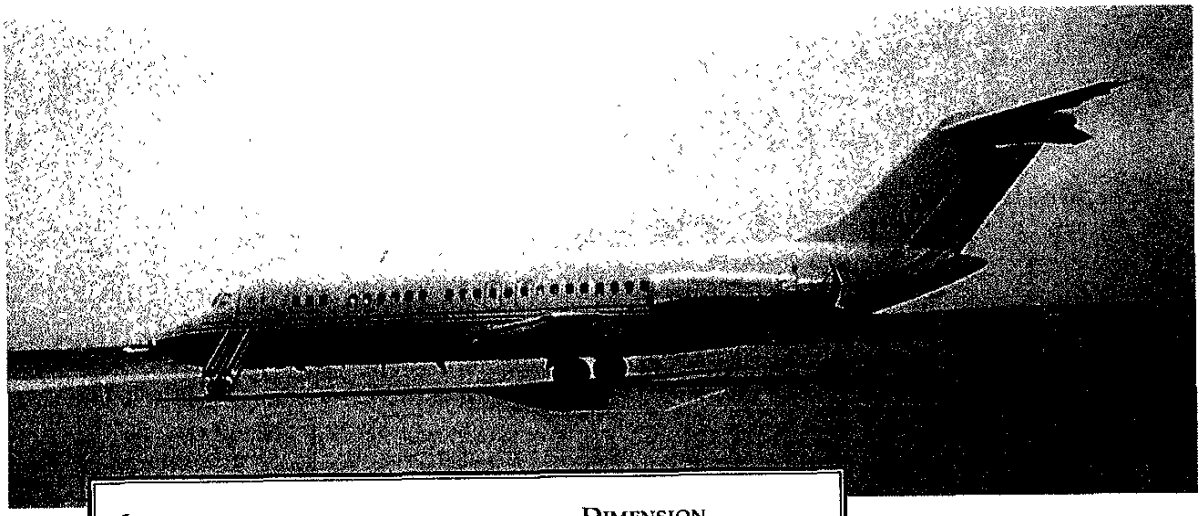
Area wind characteristics were assessed and are a major factor in determining the optimum number and alignment of runways. Wind coverages are shown on Table 3-1. Wind velocity data (speed and direction) have been recorded and assembled from the Rapid City Regional Airport Weather Station and were used to develop the wind rose shown in Figure 3.2.

The established goal for wind coverage is ninety-five percent (95%); that is, a light plane should be able to operate at an airport ninety-five percent (95%) of a given period without experiencing a crosswind component greater than 12 m.p.h. (10.5 knots). Wind coverages required for larger, transport-type aircraft are 15 m.p.h (13 knots). Where a single runway does not provide a ninety-five percent (95%) usability factor, a crosswind runway is recommended. The two-runway configuration currently in place at Rapid City exceeds this established goal.

TABLE 3-1
WIND COVERAGES
Rapid City Regional Airport

Runway (All Weather)	Wind Speed	Percent Coverage
14-32	10.5 Knots	95.90 %
14-32	13 Knots	98.20 %
14-32	16 Knots	99.52 %
05-23	10.5 Knots	70.49 %
05-23	13 Knots	78.02 %
Combined	10.5 Knots	98.24 %
Combined	13 Knots	99.52 %
Combined	16 Knots	99.68 %

Source: Rapid City Regional Airport Weather Reporting Station, 1986-1995, 84,270 Observations



ITEM	DIMENSION
Wingspan	93' 4"
Length	119' 4"
Height	27' 9"
Wheelbase	53' 3"
Wheel Track	16' 5"

ITEM	PERFORMANCE
Maximum Take Off/Landing	110,000 lbs.
Maximum Cruising Speed	514 Knots\585 mph
Approach Speed	127 Knots\145 mph

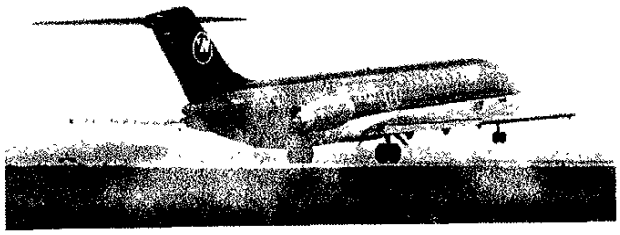


Figure 3.1

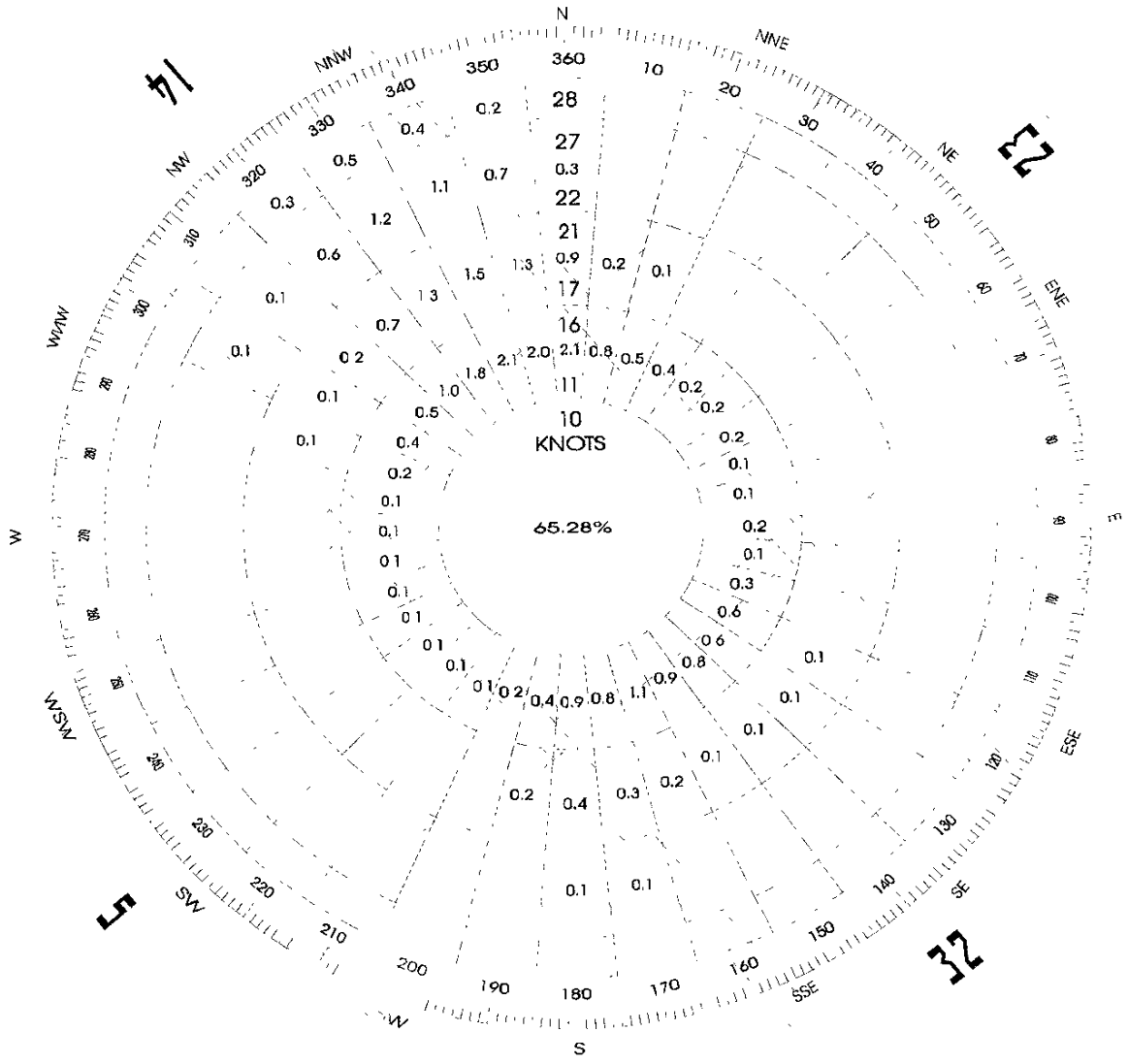


Figure 3.2

All Weather Windrose

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3.3 Demand/Capacity Analysis

Another factor used to determine necessary airfield improvements is the comparison between demand and capacity. The most common means of measuring airfield efficiency is by determining the airport's operational capacity, or Annual Service Volume (A.S.V.). The A.S.V. is defined in *FAA Advisory Circular 150/5060-5, Airport Capacity and Delay*, as a reasonable estimate of an airport's annual capacity. Overall, demand/capacity figures establish a time-frame for projecting development to preserve and enhance airport operational safety.

3.3.1 Airport Annual Service Volume (A.S.V.)

The A.S.V. takes into account various airfield assumptions regarding the following features and operational characteristics that would be encountered over a year's time:

* Runway and taxiway configuration
* Runway use (expressed as a percent-use)
  - Visual Meteorological Conditions (VMC)
  - Instrument Meteorological Conditions (IMC)
  - Touch and Go factors
* Aircraft mix categories (expressed a percent-use)
* Weather conditions
* Runway lighting

The relationship between capacity, demand and delay is described by the Advisory Circular as:

"As demand approaches capacity, individual aircraft delay is increased. Successive hourly demands exceeding the hourly capacity result in unacceptable delays. When the hourly demand is less than the hourly capacity, aircraft delays will still occur if the demand within a portion of the time interval exceeds the capacity during that interval. Because the magnitude and scheduling of user demand is relatively unconstrained, reductions in aircraft delay ***can best be achieved through airport improvements which increase capacity.***"

According to FAA Airport Design Program version 4.2, the ultimate annual serve volume at Rapid City Regional Airport is approximately 230,000 operations annually. The ASV is based upon number of runways, separations between runways and the configuration of the airfield. If airport operations reached this number, Rapid City Regional Airport would be at 100% capacity.

3.3.2 Airfield Demand/Capacity Analysis

Ultimate annual operations are estimated to total approximately 83,900 per year by the year 2017. The ASV divided by the total annual operations produces the demand/capacity ratio, as expressed in percent. Given the forecast operating level of 83,900 the ultimate ASV is a follows:

$$\frac{\text{Annual Operations (83,900)}}{\text{230,000 A.S.V.}} = 36.48\%$$

As described in *FAA Order 5090.3B, Field Formation of the National Plan of Integrated Airport Systems (NPIAS)*, airports are recommended by the FAA to initiate planning to preserve and enhance capacity when 60 percent of the ASV has been reached. With an ASV of 230,000, it would take 138,000 annual operations to generate a demand/capacity ratio of 60%.

Some improvements will affect a particular element of the ASV, but will not significantly change the ASV from its present level. For instance, additional connecting taxiways or additional runway length is typically not an alternative means of adding airport capacity. Any runway extension would not increase the ASV, but is an accommodation of aircraft performance. To increase the ASV at Rapid City Regional Airport, a parallel runway would be required. However, the 60 percent capacity level will not be reached during the planning period therefore a parallel runway is not necessary.

3.4 Runway Length Requirements

Runway length is generally a function of the performance characteristics of the "critical" aircraft and site conditions at the airport. Runway length is also relative to the A.R.C. of the critical aircraft and to the role the airport is forecast to assume. Several critical aircraft have been previously identified in Chapter Two.

The main site conditions that affect runway lengths are airport elevation and the mean temperature of the hottest month of the year. Runway length is usually more dependant on take-off characteristics rather than landing characteristics of aircraft. Take-off requires the aircraft engines to provide thrust, which in turn, creates lift over the leading edge of the wing. On hot days, lift is harder to create due to reduced air molecule density. Elevation is also a contributing factor to air density. The higher the airport elevation, the less dense the air becomes. To make up for the lost air density from heat or elevation, the aircraft needs to move faster and farther down the runways to create the lift needed to get airborne.

The primary runway length requirements at Rapid City Regional Airport were determined based on three factors: (1) the "critical aircraft" expected to use the airport; (2) the mean maximum daily temperature of the hottest month: and (3) the airport elevation. Based on Rapid City Regional Airport site factors MSL = 3,202', design temperature = 86°F., wet and slippery runways, the required runway lengths were determined and are shown in Table 3-2.

TABLE 3-2
RUNWAY LENGTH REQUIREMENTS
Rapid City Regional Airport

Runway Design Category	Runway Pavement		
	Length	Width	Strength
A.R.C. A-I, B-I 75% of Small Airplanes	3,620'	60'	12,500 SWG
A.R.C. B-I 95% of Small Airplanes	4,520'	60'	12,500 SWG
A.R.C. B-II 100% of Small Airplanes	4,950'	75'	12,500 SWG
A.R.C. B-II Small Airplanes +10 Passenger Seats	4,960'	75'	30,000 SWG
A.R.C. C-II 75% of Large Airplanes at 60% Useful Load	6,100'	100'	30,000 SWG
A.R.C. C-II 100% Large Airplanes at 60% Useful Load	7,490'	100'	60,000 DWG
A.R.C. C-III 75% Large Airplanes at 90% Useful Load	8,520'	150'	150,000 DWG
A.R.C. D-IV 100% Large Airplanes at 90% Useful Load	9,600'	200'	200,000 DWG

SWG = Single-Wheel Gear
DWG = Dual-Wheel Gear
ARC = Airport Reference Code

Based on FAA Advisory Circular 150/5325-4A "Runway Lengths for Airport Design" and FAA Advisory Circular 150/5300-13, "Airport Design".

3.4.1 Primary Runway 14-32

Based on current facilities at Rapid City, the runway length, width, and strength remains adequate throughout the planning period other than periodic. The runway was recently reconstructed and will not need any major upgrades during the planning period. General maintenance will be required.

3.4.2 Secondary Runway 05-23

Runway 05-23 is provided for small aircraft during high crosswind situations. The runway length, width, and strength are adequate throughout the planning period. As stated in the inventory, Runway 05-23 has a line-of-site problem and several dips in the pavement. These problems will need to be corrected in order to comply with FAA safety, design, and paving criteria.

3.5 Taxiway Requirements

Taxiways are one of the most important factors in determining and maintaining the operational safety of an airport. As airport activity increases (take-offs, landings, and touch and go maneuvers), faster access from the runways to the taxiway system is required to maintain safety.

Because taxiways are considered critical areas, they should be constructed to the same pavement strengths as the runways they serve. Current taxiway pavement strengths are estimated at 190,000 pounds (dual) and will be adequate over the planning period. The northern and southern portions of the parallel taxiway do not currently meet the 400' separation criteria as specified by FAA. However, Rapid City Regional Airport has an FAA variance to this standard runway separation distance of 400 feet (Category C-III). This variance was granted in consideration of the site limitations due to terrain. An operational restriction has been implemented prohibiting simultaneous use of runway and parallel taxiway by large aircraft.

Parallel taxiways to Runway 05-23 should be constructed at a minimum of 35' wide and a separation (240') based on probable runway usage by small aircraft. The current separations meet FAA criteria.

3.6 Airport Lighting and Marking

In order to obtain the maximum utilization of the airport, lighting is necessary to accommodate aircraft during night and adverse weather conditions. There are several different types of lighting aids recommended to facilitate and enhance the identification, approach, landing, and taxiing operations. Recommended systems, many of which are already in place, include:

3.6.1 Runway Lighting

Runway edge lighting is the standard lighting system used to define the lateral and longitudinal limits of the usable landing area. This lighting system is classified according to its intensity and brightness. Airports with over 10,000 annual operations, or runways with visual or non-precision instrument approaches should be equipped with standard medium intensity runway lighting (MIRL). Light posts are placed along the edge of the runway sides and separated by a maximum of 200 feet. Runways with an Instrument Landing System (ILS) are required to have High Intensity Runway Lights (HIRL). The existing types of edge lighting systems at Rapid City Regional Airport are adequate throughout the planning period.

3.6.2 Taxiway Lighting/Marking

Taxiway edge lights emit blue light and are used to outline the edges of the taxiway system.

The existing and ultimate taxiway system has Medium Intensity Taxiway Lights (MITL) for use on taxiways and aprons. MITL's are recommended in conjunction with a runway having MIRL's or HIRL's. Taxiway lights can

also be pilot-controlled and wired to the same remote system as the runway lights.

3.6.3 Visual Guidance Indicators

Visual slope descent indicators are used as an approach aid during the final transition to a runway end. Precision Approach Path Indicators (PAPI) are a system of lights, normally installed on the left side of the runway, which provide continuous visual descent guidance information (5 miles for daytime and up to 20 miles at night) during a visual or instrument approach to the runway. These lights are primarily intended for use during visual flight rules weather conditions. PAPI's are recommended for all runways used by turbojet and air carrier type aircraft.

3.7 Airport Signs

Standard airport signs provide taxiway and runway directional and identification guidance for aircraft movement on the ground. A system of standard signs are currently in-place and are recommended to distinguish runway, taxiway and aircraft parking destinations. As improvements to the runway and taxiway system at Rapid City are implemented, runway intersections and connecting taxiways adjacent to the terminal area should be identified through adequate signage.

3.8 Terminal Electronic Navigation

Airport navigation aids (NAVAIDS) are facilities and equipment installed on or near the airport for the purpose of providing pilots with electronic guidance and visual references for executing an approach to the airport and landing on a specific runway. The purpose of installing and/or upgrading navigational aids is to increase an airport's reliability. The use of this equipment depends on the ratings of the pilot and the instrumentation capability of the aircraft. Each facility in the NAVAID development process adds greater reliability but at increasing cost. Progressively, each additional NAVAID allows aircraft to fly during lower ceiling and visibility minimums. The traditional development process is as follows: 1.) Non-directional beacon (NDB); 2.) VOR or VORTAC.; 3.) Localizer, and; 4.) Precision Instrument Landing System (ILS/MLS). All of the above systems are now available at Rapid City Regional Airport.

On the forefront of navigational systems for aircraft is the Global Positioning System (GPS). GPS is a navigational system that links on board aircraft receivers to satellite transmitters. The FAA has approved non-precision approaches and a small amount of precision approaches. A differential GPS system will be necessary to have a precision approach. Rapid City currently has non-precision GPS instrument approaches to Runways 14 and 32 and will need a differential GPS in the future.

Upgrading and installation of a navigational aid system is usually accomplished with federal fund assistance from the FAA Airport Improvement Program (AIP) or Facilities and Equipment Program (F&E). Eligible items include visual navigational aids, electronic navigational aids, and weather aids.

3.9 Commercial Service Terminal Area Requirements

The terminal area or *landside* is defined as that portion of the airport other than the landing area. Facilities include the terminal building, aircraft storage hangars, the aircraft parking apron for based aircraft and itinerant aircraft, fixed base operations (aircraft repair and maintenance, flight training, aircraft sales, fuel facilities, etc.), aviation-related service businesses, and auto parking. There are two factors which drive the phasing for improved terminal facility development: (1) capacity, and (2) comfort and aesthetics. An analysis was performed for each terminal component to determine its ultimate role and future development requirements.

Terminal area facilities include facilities other than those in the landing area and include the following structures and activities:

* Commercial Service Terminal Building
* Commercial Service Apron
* Automobile Parking
* General Aviation Facilities
* Air Traffic Control Tower
* Airport Access Road
* Aircraft Rescue and Fire Fighting Equipment (ARFF)
* Fuel Facilities

3.9.1 Commercial Service Passenger Terminal

The characteristics of the commercial service passenger terminal involve one of the most important functional relationships at an airport in allowing the passenger to physically move from aircraft to aircraft or to an alternative mode of transportation, usually the automobile. The terminal also has a strong influence on the image of a community as it creates the first impression on the traveler when arriving at a new city. Circulation, holding space, and processing are the primary functions of the terminal building. To operate smoothly and to assure the passenger the high level of service needed for air travel, numerous facilities are necessary. To determine the facility size, the peak demand of passenger loads must be determined.

3.9.2 Peak Hour Passengers

Peak hour passengers are the primary factor in determining the size of passenger terminal facilities. As previously stated in Chapter Two, there are several peaks that occur during the day at Rapid City Regional Airport. The first occurs between 6:15 a.m. and 8:15 a.m., the second between 11:05 a.m. and 1:05 p.m. and the third between 4:00 p.m. and 6:30 p.m.

The FAA has established design parameters to determine Typical Peak Hour Passengers (TPHP). From reviewing monthly enplaned passenger data at Rapid City, August has historically had the highest percentage of annual passengers, at 12.5 percent. The annual peak hour is assumed to be 20 percent, based on the number of peaks during the day and the number of annual airline operations.

Studies have shown that as passenger volume increases, peak hour percentages generally decrease as the volume of passengers is spread throughout the day. At Rapid City, the peak hour was not adjusted downward because of the potential increase in aircraft size and the increase in the potential numbers of passengers per flight. Table 3-3 shows the forecasted peak hour passengers at Rapid City through the planning period.

TABLE 3-3
COMMERCIAL PEAK HOUR PASSENGERS
Rapid City Regional Airport

	Passengers	Peak Month 12.5%	Peak Day	Peak Hour Percent	Peak Hour Passenger
Existing	361,588	45,199	1,487	20%	297
2002	454,050	56,756	1,867	18%	336
2007	525,690	65,711	2,162	16%	346
2012	572,300	71,356	2,353	16%	376
2017	623,896	77,987	2,565	16%	410

Source: BWR

Once the peak hour passenger level is determined, the special requirements per passenger can be applied to determine the ultimate size of the terminal building. Based on the number of passengers processed at each facility, areas can be estimated so that reasonable spacial levels can be provided. The FAA has guidelines that, if applied to peak hour passengers, will provide the amount of space required for peak hour passengers. Table 3-4 shows the FAA Standard space per 100 peak hour passengers. The table also shows the typical areas for sub-functions within the terminal building. As indicated, to meet forecast peak hour passenger demand, a 83,230 s.f. terminal will be needed by the end of the planning period (2017).

The existing terminal building was completed in 1988, and is approximately 90,000 square feet in size. Table 1-4 previously identified the current square footage for the many terminal building functions. Table 3-4 provides a comparison of future requirements compared to existing space. As can be seen, most of the functional areas will be adequate throughout the 20-year planning period. Areas which should be monitored for possible future expansion are the airline operational/ticketing areas, future concession areas, and terminal storage areas.

TABLE 3-4
COMMERCIAL TERMINAL BUILDING REQUIREMENTS
Rapid City Regional Airport

	Space per 100 peak hour passengers	YEARS				
		Actual Use Areas	2002	2007	2012	2017
Design Hour Passengers		297	336	346	376	410
Ticket Lobby	1,000 s.f.	12,000	3,360	3,460	3,760	4,100
Airline Operational/ Circulation	4,800 s.f.	19,635	16,128	16,608	18,048	19,680
Baggage Claim	1,000 s.f.	11,400	3,360	3,460	3,760	4,100
Waiting Rooms	1,800 s.f.	9,597	6,048	6,228	6,768	7,380
Eating Facilities	1,600 s.f.	5,468	5,376	5,536	6,016	6,560
Office and Storage	1,600 s.f.	3,350	5,376	5,536	6,016	6,560
Other Concessions (Rental Car/Gift Shop,)	500 s.f.	2,368	1,680	1,730	1,880	2,050
Restrooms	300 s.f.	2,200	1,008	1,038	1,128	1,230
Circulation, Mechanical., Maintenance, Walls	7,700 s.f.	23,982	25,872	26,642	28,952	31,570
Total	20,300 s.f.	90,000	68,208 s.f.	70,238 s.f.	76,328	83,230

Source: BWR

3.9.3 Automobile Parking

Parking demand is a function of the number of persons utilizing the airport, either as passengers, meeters and greeters, or vendors. The size of parking facilities varies depending on the amount of passengers that transfer and ones that use the airport as their final destination. At Rapid City Regional Airport, the percentage of transferring passengers is small.

Projections are increased proportionally to the increase in peak hour enplanements. The parking requirement is approximately 1.5 spaces times the peak hour passenger plus 15 percent, needed to reduce time looking for a parking space (FAA-AC 150/5360-13, P. 122). Table 3-5 shows the forecast parking space requirements through the planning period. Approximately 300 square feet (33.3 square yards) per parking space should be provided.

TABLE 3-5
COMMERCIAL SERVICE AUTO PARKING REQUIREMENTS (NEEDS)
Rapid City Regional Airport

	Actual	2002	2007	2012	2017
Parking Spaces	540	580	597	649	707
Space Requirement (S.Y.)	18,000	19,334	19,900	21,634	23,567

3.9.4 Commercial Airline Apron

At regional airport locations like Rapid City Regional Airport, aircraft are generally taxied in-and-out of parking positions under their own power. This is the most cost-effective operating procedure but requires more space between parked aircraft.

One parking position is necessary per airline, one position for regularly scheduled flights with two additional for the possibility of a delayed or off-schedule flight. There are seven parking spaces and three airlines operating at Rapid City Regional Airport. Existing apron space is estimated to be adequate through the planning period.

3.10 Air Traffic Control Tower

The Air Traffic Control Tower (ATCT) at Rapid City Regional Airport provides valuable guidance to arriving and departing aircraft.

The criteria for the establishment of an air traffic control tower is found in FAA Order 7031.2C Change 1 "Criteria and Justification for Air Navigation Facilities", Chapter 4. To continue the ATCT at Rapid City , the following criteria have been established by the FAA with regard to different categories of aircraft operations. Each category of total operations is divided by a set level of operations determined by FAA. The sum of each ratio must equal one or above for continued tower operation. As shown in Table 3-6, the existing and forecast operations ratio calculation exceeds one; therefore, the ATCT at Rapid City Regional Airport should continue in operation through the planning period. Furthermore, the radar service from Ellsworth Air Force Base will not decrease the need for a non-radar tower at Rapid City Regional Airport.

TABLE 3-6
TOWER OPERATIONAL CRITERIA
Rapid City Regional Airport

Year	FAA Operational Ratio Requirements						Total
	Air Carrier Ops 15,000 Ops	Air Taxi Ops 40,000 Ops	General Aviation Itinerant Ops 75,000 Ops	General Aviation Local Ops 135,000 Ops	Military Itinerant Ops 20,000 Ops	Military Local Ops 35,000 Ops	
Existing*	2,047 15,000 (.1365)	11,371 40,000 (.2843)	20,997 75,000 (.2800)	17,180 125,000 (.1374)	2,571 20,000 (.1286)	1,762 35,000 (.0503)	1.017
2017	3,016 15,000 (.2010)	22,364 40,000 (.5591)	28,123 75,000 (.3749)	24,998 125,000 (.2000)	1,800 20,000 (.0900)	3,600 35,000 (.1029)	1.528

Note* - Primary runway closed for two months for reconstruction Source: BWR Corporation

3.11 Aircraft Rescue and Firefighting (ARFF) Requirements

Aircraft Rescue and Firefighting services are located along the Runway 14-32 flightline north of the terminal. ARFF facilities and equipment appropriate to Index A will need to continue to be provided at Rapid City Regional Airport. Response time to the midpoint of the farthest runway serving commercial aircraft must be within 3 minutes[1]. The current location of the ARFF station at Rapid City Regional Airport will be adequate; however, the facilities are dated and a new building will be needed during the planning period.

3.12 General Aviation Facilities

General aviation encompasses the majority of activity at Rapid City Regional Airport. The forecast of operations indicates that this will continue; therefore, it is important to determine what facilities will be required to accommodate this portion of the aviation sector. The functions and facilities for general aviation include:

* Pilot/Passenger Facilities
* Aircraft Ramp and Parking Facilities, both itinerant and based aircraft
* Aircraft Storage Hangars
* Fuel Storage Facilities
* Auto Parking and Access

The analysis of existing demand/capacity conditions relative to forecast levels of activity helps determine the extent of general aviation facility improvements. The calculations for determining the following elements of capacity are shown below:

[1] FAA FAR Part 139 p. 46 - Response Requirement.

Peak Month = (12.5 percent) x (Annual operational demand)
D Factor = (Annual operational demand) ÷ (Peak day demand)
Average Day = Peak month ÷ 30.4 days
H Factor = Peak day ÷ Peak hour
Peak Hour = (Peak month x 12%)

Generally, the *peak month* traffic averages approximately 12.5 percent of activity for an airport with annual aircraft operations over 50,000 per year. The peak month at Rapid City occurs in August. The *peak hour* is approximately 12 percent of peak day activity at airports with over 40,000 operations per year.

The *design hour passenger* refers to the average number of general aviation pilots and passengers expected to use the terminal facilities during the peak hour period. In calculating the design hour passenger levels, an average of 1.9 passengers per operation was considered based on the pilot survey conducted for this study. In the future, the ratio is expected increase to average 2.5 passengers, as more frequent, larger, more sophisticated and active aircraft make up a higher aircraft mix.

Table 3-7 identifies the anticipated airport peaking criteria calculated for the determination of future general aviation terminal area requirements. The design hour passengers are estimated to increase from 47 in 1997 to about 77 by the year 2017.

TABLE 3-7
GENERAL AVIATION AIRPORT PEAKING CHARACTERISTICS
Rapid City Regional Airport

Operations	Existing	2002	2007	2012	2017
Annual G.A. Aircraft Operations	50,373	50,904	53,424	57,456	62,496
Peak Month Operations	6,297	6,363	6,678	7,182	7,812
Peak Day Operations	207	209	220	236	257
Peak Hour Operations	25	25	26	28	31
Passenger/Operation Ratio	1.9	2.0	2.2	2.4	2.5
Design Hour Passengers	47	50	58	68	77

Source: BWR, Terminal Forecast - Airport Peaking Characteristics.

The airport terminal facilities for general aviation serve several important functions. Adequate space should be available for the fixed base operator management office(s), a quiet and convenient pilot's lounge, a flight planning area, restrooms, storage rooms, equipment/maintenance rooms, and public-gathering rooms with tables, food service or snacks and other small concession items. At Rapid City Regional Airport these facilities are generally provided by the existing fixed base operators.

General aviation terminal facilities should be adequate to accommodate the levels of peak hour activity that are forecast to occur during normal demand levels. Anticipated space for general aviation terminal facilities is dependent on airport development. Table 3-8 shows estimated design hour passengers through the planning period and the space requirements for the general aviation terminal facilities.

TABLE 3-8
GENERAL AVIATION PASSENGER/PILOT BUILDING REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Aviation Fuel Storage Factors	Existing	2002	2007	2012	2017
Design Hour G.A. Passengers	47	50	58	68	77
Waiting Area/Foyer (15 S.F. per passenger)	705	750	870	1,020	1,155
Pilot Lounge/Planning Room (5 S.F. per passenger)	235	250	290	340	385
Management/Operations Room (3 S.F. per passenger)	141	150	174	204	231
Restrooms (Men/Women) (5 S.F. per passenger)	235	250	290	340	385
Concessions Area (4 S.F. per passenger)	188	200	232	272	308
Equipment/Circulation/Storage (20 S.F. per passenger)	940	1,000	1,160	1,360	1,540
Meeting Room/Classroom - optional	600	600	600	600	600
Total Terminal Building Area (S.F.)	3,044	3,200	3,616	4,136	4,604

Source: BWR, GA Terminal Building Requirements.

3.12.1 Aircraft Hangar Facilities

For most general aviation airports, adequate capacity usually exists for 80 percent of the based aircraft to be stored in hangars. Of this, approximately 20 percent of all hangar space is normally conventional hangars, and 80 percent is T-hangars. At Rapid City Regional Airport, 40 percent of all aircraft are currently stored in conventional hangars, 48 percent in T-hangars, and 12 percent are tied down on the apron.

The principal use of conventional hangars is for larger business and corporate aircraft storage, maintenance storage, and for housing the Fixed Based Operator (FBO). The need for additional T-hangars, along with some additional conventional hangars, will be necessary through the planning period. It is recommended that the clearance between T-hangars be 75 feet for one-way traffic and 125 feet for two-way traffic.

Table 3-9 shows the total hangar space requirements for the airport over the planning period. The conventional and T-hangar space demand will increase over the next twenty years as based aircraft increase. For standard planning purposes, an average of 1,200 square feet per based aircraft was used for determining T-hangar space and 1,800 square feet for conventional hangar space due to the high amount of large corporate aircraft basing at Rapid City Regional Airport.

TABLE 3-9
GENERAL AVIATION AIRPORT HANGAR REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Hangar Component	Actual	2002	2007	2012	2017
Based Aircraft	100	101	106	114	124
Percent Hangared Aircraft (88%)	88	88	93	100	109
Conventional Hangar Spaces	40	41	43	45	48
Conventional Hangar Area (1,800 S.F./based aircraft)	72,000	73,800	77,400	81,000	86,400
T-Hangar Spaces	48	48	50	55	61
T-Hangar Area (1,200 S.F./based aircraft)	57,600	57,600	60,000	66,000	73,200
Total Hangar Area (S.F.)	129,600	131,400	137,400	147,000	159,600

Source: BWR, Terminal Forecast - Aircraft Hangar Facilities.

3.12.2 General Aviation Aircraft Apron Facilities

Table 3-10 shows the future general aviation apron requirements. It is projected that the existing apron area, and associated tie-down space, will be of adequate size to accommodate the demand of local and transient aircraft in the short-range planning period. By the year 2017, there will be a demand for about 60,200 square yards of apron. Based on daily general aviation capacity levels, 11,400 square yards of apron expansion are anticipated, most likely in the long-term (10-20) year timeframe.

Paved aircraft parking and tie-down areas should be provided for approximately 25 percent of the peak/design day itinerant aircraft, plus approximately 12 percent of the based aircraft. Airport planning criteria recommends an area of 360 square yards per transient aircraft space, and approximately 300 square yards per based aircraft. However, based on experiences at many airports across the country, these areas are insufficient for required taxilanes and aircraft manuevering. A more effective design parameter is 800 square yards for transient aircraft and 600 square yards for based aircraft. These numbers reflect efficient double loaded or nested parking patterns.

TABLE 3-10
GENERAL AVIATION AIRCRAFT APRON REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Aircraft Parking Factors	Actual	2002	2007	2012	2017
Total Based Aircraft	100	101	106	114	124
Local Aircraft Demand 12% Based AC (600 S.Y. per aircraft)	12	12	13	14	15
Transient Aircraft Demand 25% Peak Day (800 S.Y. per aircraft)	52	52	55	59	64
Total Apron Tie Downs Apron Area	64 48,800 S.Y.	64 48,800 S.Y.	68 51,800 S.Y.	73 55,600 S.Y.	77 60,200 S.Y.

Source: BWR, Terminal Forecasts - Aircraft Apron Requirements.

3.12.3 General Aviation Auto Parking and Access

The requirement for vehicle parking adjacent to the general aviation terminal facilities is a function of the design hour passengers. The total number of parking spaces was determined as 0.67 spaces per design hour passenger multiplied by 315 feet per space for parking and circulation.

Adequate parking currently exists, and expansion should not be required. Table 3-11 indicates the general aviation automobile parking requirements through the planning period.

Total Parking Area = (Design Hour Passenger) x (0.67) x (315 sq. feet).

TABLE 3-11
GENERAL AVIATION AUTOMOBILE PARKING REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Automobile Parking Factors	Existing	2002	2007	2012	2017
Design Hour Passengers	47	50	58	68	77
Public Vehicle Parking Spaces	32	34	39	45	51
Total Parking Area (S.Y.)	1,120	1,190	1,365	1,575	1,785

Source: BWR, General Aviation - Airport Automobile Parking.

3.13 Fuel Storage

Future fuel storage requirements were determined based on annual operations and average utilization rates for commercial service and general aviation aircraft. It is recommended that fuel storage should be provided for an average month of airport activity. Recommendations suggest the need for a fuel facility capable of supplying AvGas and Jet A grade fuels based on the following calculation:

Fuel Storage Needs =

$$\frac{\text{(Annual Aircraft Operations)x (Gallons per Operation)}}{\text{12 (months per year)}}$$

Table 3-12 shows future fuel requirements. There is a need for fueling facilities capable of supplying AvGas and Jet A grade fuels as evidence of the fuel storage calculation shown previously. The present fuel capacity is 60,000 gallons (30,000 Jet A; 30,000 AvGas). Total fuel storage should be adequate through the planning period. Due to spillage/leakage concerns, above ground tanks are recommended.

TABLE 3-12
GENERAL AVIATION FUEL FACILITY REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Aviation Fuel Storage Factors	Existing	2002	2007	2012	2017
Annual Aircraft Operations	50,373	50,904	53,424	57,456	62,496
Average Monthly Operations	4,198	4,242	4,452	4,788	5,208
Average Gallons/Operation	10.0	10.2	10.4	10.6	11
Yearly Demand (gallons)	60,000 (Actual)	43,268	46,300	50,752	57,288

Source: BWR, Terminal Forecasts - Fuel Capacity Requirements.

3.14 Aviation Facility Summary

The purpose of this chapter has been to quantify and explain the requirements for future airport facility development and expansion which will be needed to meet the projected aviation demand for the Rapid City Regional Airport. Table 3-13 summarizes the general aviation facility requirements, and Table 3-14 summarizes the phased airside facility requirements for Rapid City Regional Airport.

TABLE 3-13
SUMMARY - GENERAL AVIATION FACILITY REQUIREMENTS (NEEDS)
Rapid City Regional Airport

Facility	Existing	Phase I (1997-2002)	Phase II (2003-2007)	Phase III (2008-2017)
G.A. Passenger/Pilot Building (S.F)	3,044	3,200	3,616	4,604
Apron Tie-Down Capacity	64	64	68	77
Apron Area (S.Y.)	48,800	48,800	51,800	60,200
Conventional Hangars		41	43	48
T-Hangar Spaces	48	48	50	61
Total Hangar Area (S.F.)	129,600	131,400 S.F.	137,400 S.F.	159,600 S.F.
Fuel Capacity (Gal.)	60,000	43,000 gal.	46,000 gal.	57,000 gal.
Public Auto Parking Spaces	32	34	39	51
Auto Parking Area (S.Y.)	1,120	1,190	1,365	1,785

Source: BWR, Terminal Forecast - Summary Table

TABLE 3-14
SUMMARY - AIRSIDE FACILITY REQUIREMENTS (NEEDS)
Rapid City Regional Airport

	Actual	Phase I (1997-2002)	Phase II (2003-2007)	Phase III (2008-2017)
Commercial Service Terminal (S.F.)	90,000	68,208 S.F.	70,238 S.F.	83,230 S.F.
Aircraft Parking Spaces	7	5	6	7
Auto Parking Spaces	540	580	597	707
Auto Parking Area (S.Y.)	18,000	19,334	19,900	23,567

Source: BWR