Section 5

FACILITY REQUIREMENTS

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Facility requirements are calculated dimensional quantities that serve as guidelines for the preparation of airport plans. Calculated component facility dimensions are not definitive, but instead undergo continual change from time of calculation to the time that facility construction is completed. Toward the latter part of the planning period, unforeseen changes can be expected to cause greater differences between calculated and constructed facility dimensions.

This section describes the physical facilities required to adequately accommodate the forecast aviation demand for Window Rock Airport and the methodologies used to calculate these facility requirements. Methodologies blend the forecast aviation demand presented in the preceding section of this report with planning criteria contained in FAA documents and other references on airport planning. The actual planned size of system components are described in Section 7, Airport Systems Design, and are delineated on the several airport plans accompanying this report.

Following the summary of calculated facility requirements is presented the detailed facility requirements and methodologies. Facility requirements are grouped by airside and landside and, in the latter case, by general aviation and airport support.

5.1 FACILITY REQUIREMENTS SUMMARY

Airside system facility requirements calculated in this section identified the need for one runway throughout the long-range planning period. The runway should be oriented $020^{\circ}/020^{\circ}$ magnetic north, have

a length of 6,750 feet, a width of 100 feet, and a pavement bearing strength of 60,000 pounds single-wheel loading. Air navigation aids required include two-box visual approach slope indicator (VASI-2) lights for both runway ends, medium-intensity runway lighting (MIRL), and non-precision instrument (NPI) runway marking. A summary of the facility requirements is presented in Exhibit 5-1.

Landside facility requirement calculations project the need for one fixed-base operator during the short- and intermediate-range planning periods and, potentially, a second FBO during the long-range planning period. Facility requirements for the purpose of facilities planning were calculated for each FBO independently. The combined facility requirements for the Navajo Tribe and both fixed-based operators show a need for 21 automobile parking spaces in 1985, growing to 78 by 2000, and a terminal building, growing from 784 square feet in 1985 to 2,940 square feet by 2000. Required for the indoor storage of aircraft are tee hangars and one conventional hangar for each fixed-base operator and for the Navajo Department of Air Transportation, conventional hangars to be used for performance of maintenance services. Tie-down positions required for the outdoor storage of aircraft are estimated to grow from 21 in 1985 to 156 in 2000.

The only foreseen airport support facility requirement is a common fuel farm to provide for the underground storage of aviation fuel.

5.2 AIRSIDE SYSTEM

The airside system is comprised of all facilities supporting the transition of aircraft between the parking apron or hangar storage facilities and enroute flight. Facilities that normally support the transition are runways and associated taxiways and air navigational aids. The succeeding analysis calculates runway and air navigational aid requirements, followed by an analysis of the terminal airspace and identification of the need for additional airfield capacity.

Exhibit 5-1

FACILITY REQUIREMENTS

	AIRSIDE SYSTEM		
	1981-1985	1986-1990	1991-2000
AIRFIELD			
Runway 02/20			
Length (feet)	6,750	6,750	6,750
Width (feet)	80	80	100
Strength (pounds)	33,000	33,000	60,000
AIR NAVIGATION AIDS			
Approach Aids	None	None	None
Approach Lights Rwy 02	VASI-2	VASI-2	VASI-2
Rwy 20	VASI-2	VASI-2	VASI-2
Runway Lights	MIRL	MIRL	MIRL
Runway Marking	NPI	NPI	NPI
OPERATIONAL CAPACITY			
Practical Annual Capacity	166,000	166,000	166,000
Practical Hourly - VFR	118	118	118
Practical Hourly - IFR	53	53	53
HAT/VIS Runway 02	860/1 1/4	860/1 1/4	860/1 1/4
HAT/VIS Runway 20	860/1 1/4	860/1 1/4	860/1 1/4
	LANDSIDE SYSTEM		
Fixed Base Operations	1	1	1
Automobile Parking Spaces	21	33	78
Automobile Parking Area (SY)	746	1,172	2,343
Terminal Building (SF)	784	1,225	2,940

Exhibit 5-1 (Continued)

Conventional Hangars	2	2	3
Conventional Hangar Aircraft Spaces	18	18	27
Tee Hangars	13	23	60
Total Indoor Storage Spaces	22	32	78
Outdoor Tiedown Positions	21	33	78
Total Aircraft Parking Positions	43	65	156

Source: PRC Speas

5.2.1 Runway Requirements

Three dimensional criteria are normally specified for planning primary, parallel and crosswind runways. These are pavement length, width and bearing strength. Runway requirements are calculated for general aviation airports according to the airport's projected operational role. The operational role is defined using current Federal Aviation Administration criteria.

Forecasts of aviation activity for Window Rock suggest that the operational role of the airport will be "General Utility" through 1995, with a need for a "Basic Transport" facility by 1996. This classification is based on a projection of some 518 turbojet operations by the year 1996 at Window Rock. Runway requirements for planning basic and general utility airports are normally calculated using the FAA publication, "Utility Airports Air Access to National Transportation." The FAA publication, "Airport Design Standards - General Aviation Airports - Basic and General Transport," is used in calculating runway requirements for transport facilities. Each publication contains runway length curves for determining the required runway length based on the airport's operational role, the airport's elevation, and normal maximum temperature during the hottest month of the year.

Due to Window Rock's elevation of 6,737 feet above mean sea level (MSL) and normal maximum temperature of 86^{o}F, the runway length curves could not be used with the desired reliability. Therefore, aircraft runway requirements were secured from various aircraft manufacturers. Additionally, the U.S. Interior Department's Office of Aircraft Services, Boise, Idaho, was contacted to secure runway requirements for current and future fire-fighting aircraft staged at Window Rock.

Current aircraft activity indicates a need for runway of some 6,750 feet in length and a bearing strength of at least 33,000 pounds. This requirement is based on the requirements of the PV-2 aircraft, annually staged at Window Rock for fire-fighting during the May, June and July

timeframe. Future (1996) requirements indicate the same runway length, but an increase in bearing strength to 60,000 pounds. Exhibit 5-2 presents the calculated runway requirements for Window Rock Airport.

Planning guidelines suggest that, given a primary basic transport (BT) runway, the need for a crosswind runway should be evaluated, assuming a 15 mph maximum allowable crosswind component. Further, the guidelines recommend that sufficient runways of differing orientations be planned so that the airport will achieve a 95 percent all-weather wind coverage. Wind coverage is that percent of the time for which operations are considered safe due to acceptable crosswind components.

The closest weather station to Window Rock recording wind data is located at Gallup Municipal Airport, Gallup, New Mexico. It is approximately twenty (20) miles southeast of Window Rock. Discussions with the Chief Pilot, Navajo Aviation Authority, and other pilots at Window Rock Airport suggest that wind conditions at Window Rock are comparable to Gallup. Therefore, the Gallup wind rose was used to evaluate runway orientation and wind coverage.

Data obtained from the Gallup Municipal Airport layout plan revealed that a runway orientated $050^{\circ}/230^{\circ}$ will have the desired 95 percent all-weather wind coverage assuming a maximum crosswind component of 15 mph. Achieving this runway orientation in the Black Creek Valley, however, is not considered feasible. The narrow width of the valley, combined with the rapid rise in elevation of the surrounding mountains, suggest that a $050^{\circ}/230^{\circ}$ runway orientation would place aircraft operations directly into and over the Chuska Mountains and Defiance Plateau.

Recognizing this topographic constraint, the existing Window Rock runway has an orientation of $020^{\circ}/200^{\circ}$. This orientation provides a 91.0% wind coverage, assuming the 15 mph. maximum allowable crosswind component. This orientation appears to provide the highest achievable

Exhibit 5-2

RUNWAY REQUIREMENTS

	PLANNING PERIOD		
	1980-1985	1986-1990	1991-2000
RUNWAY			
Length (feet)	6,750*	6,750	6,750
Width (feet)	75*	75	100
Strength (000 pounds (S))	33*	33	60

(S) - Single Wheel Loading

*Current runway is 7,000 feet long, 80 feet wide, and has a bearing strength of 30,000 pounds.

wind coverage without creating an operational conflict with the surrounding topography. As such, while a crosswind runway appears desirable, it does not appear operationally feasible.

5.2.2 Air Navigation Aids

Air navigation aids directly affecting airport operations can be classified as either a transition or approach aid. Transition aids provide guidance to pilots during the period of transition from departure to enroute, and enroute to approach phase of flight. Approach aids provide guidance during the approach to landing and are often used for departure guidance.

Transition aid requirements of pilots operating aircraft into and out of Window Rock Airport will be satisfied by transition aids located at Gallup Municipal Airport. During transition, electronic guidance will be provided by the existing VOR (Very High Frequency Omnidirectional Range Station), supplemented by instructions issued by the Gallup Air Traffic Control Tower and Approach Control Facility. These transition aids will be sufficient to meet the projected long-range aircraft activity at Window Rock. Installation of an air traffic control tower will not be required, nor justified, using current FAA planning criteria.

Approach aid requirements are determined as a function of the requirement for instrument approach procedures. This functional relationsnip occurs because many instrument approach procedure requirements are usually satisfied by a single approach aid. Instrument approach procedures are procedures that pilots follow when approaching to land during inclement weather conditions. The pilots' needs are based on the prevailing wind direction, ceiling (height of cloud cover above ground) and visibility.

Currently, a non-precision approach to Runway 02 exists utilizing a circling approach off the Gallup VOR.

The installation of an instrument landing system (ILS) will be neither justifiable nor eligible for federal financial assistance based on the forecast of instrument approaches.

In addition to the instrument air navigation aids, a VASI-2 (two-box visual approach slope indicator) is required for each runway end to enhance safety during visual flight weather.

5.2.3 Airspace Analysis

An airport's airspace is analyzed with respect to two primary concerns: interaction with surrounding airports, and obstruction clearance requirements. The former concern--interaction with surrounding airports--occurs when the airspace reserved for aircraft arriving and departing one airport must be shared with airspace reserved for aircraft arriving and departing another airport. The airspace interaction, if any, can determine a particular airport's capacity by controlling the number of airfield arrivals and/or departures. Investigation of Window Rock Airport's airspace revealed that there are no current or anticipated airspace interactions between Window Rock and any other existing airport.

The latter concern--obstruction clearance requirements--is not the clearance requirements per se, but effect of obstructions on the height above touchdown. The height above touchdown (HAT), the altitude to which a pilot may descend without visual reference to the ground, is specified in instrument approach procedures and determines to a great extent the IFR capacity or hours the airport is open during IFR weather conditions. Having an objective of a 350-foot HAT and 600-foot visual flight rule (VFR) traffic pattern altitude, an obstruction analysis was undertaken, applying design criteria for instrument approaches, instrument departures and VFR traffic patterns contained in the United States Standard for Terminal Instrument Procedures (TERPS) and the Flight Procedures and

Airspace Handbook. The analysis indicates that, due to the close proximity of the Chuska Mountains to the airport, the optimum achievable minimums are 860 feet and 1-1/4 miles.

5.2.4 Airfield Capacity

Capacity of an airfield is measured by the number of aircraft movements (takeoffs and landings) that can be accommodated, assuming an average tolerable level of delay. The assumption used in this study is that airfield capacity is reached when delays to aircraft departures average two minutes during the two adjacent peak hours of the week. The requirement for additional airfield capacity is identified by comparing the estimated long-range capacity of the initial airfield to the forecast of aircraft movements. Both hourly and annual demand/capacity comparisons are made to determine any required taxiway and runway improvements.

The assumptions for the calculation of Window Rock Airport's initial airfield long-range capacity are presented in Exhibit 5-3. Given these assumptions, the VFR Practical Hourly Capacity (PHOCAP) was calculated to be 118 aircraft movements, and the IFR PHOCAP was calculated to be 53 aircraft movements. Assuming that peaking will occur according to public desire, the long-range Practical Annual Capacity (PANCAP) was calculated to be 166,000 aircraft movements, and the Planning PANCAP to be 132,800 aircraft movements. The Planning PANCAP (80% of PANCAP) is the point at which the FAA recommends that additional airfield capacity becomes available for use.

A comparison of the forecast annual demand (38,780) and the airfield capacity (166,000) shows that a single runway will provide sufficient capacity to accommodate the long-range forecast demand for Window Rock Airport and a significant time thereafter.

Exhibit 5-3

ASSUMPTIONS FOR THE
CALCULATION OF AIRFIELD CAPACITY

. AIRCRAFT CLASS	2000 AIRCRAFT MOVEMENTS	2000 AIRCRAFT MIX (%)
C	640	1.7
D & E	38,140	98.3
TOTAL	38,780	100.0
. TOUCH & GO ACTIVITY	24,960	64.0

. NDB INVESTMENT APPROACH PROCEDURE

Source: PRC Speas

5.3 LANDSIDE SYSTEM

The airport landside system is comprised of all facilities supporting the movement of passengers and goods between the community's ground transportation system and the airport's airside system, and also any facilities used in the maintenance or protection of those facilities. For Window Rock Airport, these facilities are grouped according to two basic landside components: (1) general aviation facilities, and (2) airport support. Although both components must work together to facilitate the orderly movement of passengers and goods, the facility requirements associated with each component are calculated separately.

5.3.1 General Aviation Facilities

The general aviation landside system is normally comprised of competing privately-owned fixed-base operators (FBO's). The FBO's usually provide one or more of the basic general aviation services. These include: aircraft storage, fueling, maintenance, aircraft charter and rental or flight instruction. Facilities needed to support these services include automobile parking, pilot and passenger lounges, office space, classrooms, maintenance hangars, aircraft parking aprons and indoor aircraft storage.

General aviation facility requirements at Window Rock Airport will to a great extent be dependent on the number and type of FBO's conducting business at the airport. Therefore, prior to calculation of facility requirements, it is necessary to estimate the number of FBO's expected. At low-to-medium activity airports such as Window Rock, an FBO must provide all the basic services to remain competitive and financially viable. The primary factor determining the number of FBO's that will conduct business is the size of the total market, most commonly measured by the number of based aircraft.

Recognizing that based aircraft are forecast to grow from a current 25 (1979) to 74 (2000), it can be said with confidence that at least one FBO will continue business at the airport. Additionally, it is expected that a second FBO will initiate business during the long-range planning period. Clearly, demand is not forecasted to support a third FBO. Consequently, general aviation facility requirements should be planned for two FBO sites--one redeveloped now, and the second during the long-range planning period. This should not be construed, however, as a recommendation for the airport management to encourage development of only one FBO prior to 1985. Quite the contrary, airport management should strive to fulfill the second FBO site as soon as possible.

Facility requirements were calculated for each FBO and each planning period: short-range (1981-85), intermediate (1985-1990), and long-range (1991-2000). In each case, the facility requirements were calculated to satisfy the demand projected for the end of the planning period.

Weather conditions, investment incentives and the attitude of local aircraft owners determine the proportion of indoor aircraft storage spaces to the number of based aircraft at any particular airport. As an airport develops, the latter two criteria change, usually resulting in a changing proportion of indoor storage spaces to based aircraft. Planning of general aviation facilities at an existing airport typically is guided by the extrapolation of the proportion trend. However, at Window Rock, the opportunity to construct hangar facilities has not been afforded any existing or prospective aircraft owner. As a result, individuals basing their aircraft at the facility have had to allow their aircraft to stand exposed to the elements and the Navajo Tribe has foregone potential airport revenues.

For purposes of this study, therefore, facility plans are drawn to provide the greatest flexibility--that is, plans are drawn such that the FBO will have the option to build a higher percentage of indoor or a higher percentage of outdoor storage spaces. To guide facilities

planning, facility requirements have been calculated assuming that a maximum of 75% of the based aircraft will require indoor storage and a maximum 60% will require outdoor storage. A second unknown that arises is the question of how many aircraft the second FBO will attract away from the first. For purposes of facility planning, the FBO B has been assumed to attract 50% of the based aircraft; however, facilities for FBO A have been calculated assuming that FBO B never develops, just to prepare for that possible event.

The calculated facility requirements for secondary facilities planning are presented in Exhibit 5-4. Indoor storage requirements were calculated, assuming that each FBO will construct one conventional hangar for the purposes of providing maintenance and that each conventional hangar will also provide indoor storage for nine aircraft. Tee hangar requirements were calculated for aircraft requiring indoor storage and not accommodated in conventional hangars. Aircraft parking apron tie-down position requirements were calculated, assuming that one position is needed for each based aircraft not desiring indoor storage, plus one for each busy hour transient itinerant movement. It was assumed that the Navajo Tribe would continue to hangar tribal aircraft in separate facilities.

Terminal building space (pilot and passenger lounges, offices, classrooms, etc.) requirements were calculated by relating floorspace to the number of busy-hour pilots and passengers. Busy-hour pilots and passengers were estimated by applying a factor of 1.8 to the forecast busy-hour aircraft movements. Annual enplanements are estimated assuming an average of three occupants per itinerant departures. A unit figure of 49 square feet per person was applied. Automobile parking requirements were calculated by assuming that 1.3 spaces are needed for each busy-hour pilot and passenger and that each space requires 35.5 square yards of pavement including roadways.

Exhibit 5-4

FACILITY REQUIREMENTS LANDSIDE SYSTEM

	PLANNING PERIOD		
	1981-1985	1986-1990	1991-2000
FACILITIES DESIGN DEMAND			
Navajo Tribal Aircraft	5	5	5
Total Based Aircraft	29	42	69
Busy Hour Transient Aircraft	2	3	5
Total Storage Positions Required	36	50	79
Busy Hour Pilots & Passengers	16	25	40
FIXED BASE OPERATOR (A)			
Conventional Hangars	1	1	1
Conventional Hangar Spaces	9	9	9
Tee Hangars	13	23	43
Aircraft Tiedown Positions	19	28	43
Terminal Building (SF)	784	1,225	1,960
Auto Parking Spaces	21	33	52
Auto Parking Area (SY)	746	1,172	1,420
FIXED BASE OPERATOR (B)			
Conventional Hangars	-	-	1
Conventional Hangars Spaces	-	-	9
Tee Hangars	-	-	17
Aircraft Tiedown Positions	-	-	23
Terminal Building (SF)	-	-	980
Auto Parking Spaces	-	-	26
Auto Parking Area (SY)	-	-	923

Source: PRC Speas

5.3.2 Airport Support

Airport management needs, as distinguished from the management of the delivery of tribal aviation (flight) services, does not, nor is it anticipated to, generate sufficient demand to support a full-time staff and can be best satisfied by continuing to have the Air Transportation Department provide this capability. Similarly, airport maintenance requirements will not be sufficient to support a full-time staff and will be best satisfied by contracting for services with a tribal department with an ongoing maintenance capability.

There will be a continuing need for physical facilities at Window Rock to support the ongoing air transportation service provided by the Air Transportation Department. Minor expansion of the existing terminal can provide anticipated space requirements. A weather observation/operations control facility on the roof of the terminal is recommended for consideration.

The flight service station located at Gallup Municipal Airport will satisfy pilot weather briefing requirements via radio or phone. In the interest of safety and efficiency, the installation of a direct line to the FSS at Gallup from the existing terminal should be considered. A single fuel farm area will be adequate for underground fuel storage requirements. Each FBO will be able to load fuel trucks at the area and keep ready trucks parked near hangar areas. A separate area should be provided for staging firefighting aircraft. This area should include a concrete apron and sufficient space to fire-retardant storage tanks.

The FAA recommends that, for fire, crash and rescue protecton, the airport have 200 gallons of AFFF water for foam protection, 300 pounds of dry chemical powder, and one vehicle. However, for Window Rock Airport, it should be sufficient if well-placed hand-held fire extinguishers are available and services of the Division of Public Safety secured.