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Introduction

The capacity of an airfield is primarily a function of the major aircraft operating surfaces that compose the facility and the configuration of those surfaces (runways and taxiways). However, it is also related to and considered in conjunction with wind coverage, airspace utilization, and the availability and type of navigational aids. Capacity refers to the number of aircraft operations that a facility can accommodate on either an hourly or yearly basis. It does not refer to the size or weight of aircraft. Facility requirements are used to determine those facilities needed to meet the forecast demand and aircraft fleet. Evaluation procedures will focus on runway length, dimensional criteria, aprons, and hangars.

Knowledge of the types of aircraft currently using, and those aircraft expected to use, the Minden-Tahoe Airport provides information concerning the Airport Reference Code (ARC). FAA Advisory Circular 150/5300-13, *Airport Design*, provides guidelines for this determination. The ARC is based on the "Design Aircraft" that is judged the most critical aircraft using, or projected to use, the Airport. The ARC relates aircraft operational and physical characteristics to design criteria that are applied to various airport components. Under this methodology, safety margins are provided in the physical design of airport facilities.

There are two components in determining the ARC for an airport. The first component, depicted by a capital letter, is the Aircraft Approach Category and relates to aircraft approach speed. The second component, depicted by a Roman numeral, is the Airplane Design Group and relates to airplane wingspan. An example of aircraft by ARC designation is shown in the following illustration entitled *REPRESENTATIVE AIRCRAFT BY AIRPORT REFERENCE CODE (ARC) DESIGNATION*.

Figure C1
Representative Aircraft by Airport Reference Code (ARC) Designation

Currently, a large number of single engine general aviation aircraft and glider aircraft utilize the Airport on a regular basis. As indicated in the previous chapter, these types of aircraft are the predominate users of the Minden-Tahoe Airport.

Runway 16/34. The majority of general aviation aircraft including single engine and multi-engine piston aircraft, turboprop aircraft, and jet aircraft use this runway. Past planning documents have determined that the "Design Aircraft" for this runway is the Lockheed P-3 Orion aircraft with an ARC of C-III. The P-3 Orion is a large twin-engine turboprop fire bomber aircraft that has an approach speed of 134 knots and a wingspan of 99.7 feet. According to current operational estimates, approximately 176 annual operations were conducted at the Airport in 2006 by large fire bomber aircraft. Since 1999, large fire bomber operations at the Airport have ranged from a low of 68 per year to a high of 426 per year. It is also estimated that these fire bomber operations combined with annual operations estimates by business jet aircraft with approach speeds of 121 knots or higher (Category C), exceed the FAA substantial use threshold of 500 annual operations. Consequently, the existing ARC of C-III for Runway 16/34 is appropriate and should be maintained.

Runway 12/30. Small general aviation aircraft and gliders are the primary users of this runway. Past planning documents have determined that the "Design Aircraft" for Runway 12/30 is the Beech Baron with an ARC of B-I. The Beech Baron is a medium size twin-engine piston aircraft that has an approach speed of 96 knots and a wingspan of 37.8 feet. However, the 1993 Airport Master Plan also determined that this runway is used by larger general aviation aircraft and that the design standards for an ARC of B-II should be accommodated wherever possible. According to airport personnel, this runway is not often utilized by ARC B-II aircraft and the ARC of B-I is more appropriate. Yet another ARC designation to consider is B-I (small aircraft only). The dimensional standards related to ARC B-I (small aircraft only) pertain to facilities designed for small airplanes (less than 12,500 pounds) exclusively. According to airport personnel, most large aircraft at the Airport use Runway 16/34 and the B-I (small aircraft only) is the most appropriate designation for this runway.

Runway 12G/30G. Small glider aircraft and tow planes are the main users of this runway. The runway is primarily used for tow plane landings, but is also used for glider landing and recovery operations while Runway 12/30 is used for glider launching operations. Past planning documents have identified this runway as an ARC A-I (small aircraft only) facility and it is recommended that this ARC designation be maintained.

Glider Operations Area. The significant glider activity (estimated at 40% of annual operations) at the Minden-Tahoe Airport warrants further study and discussion. Gliders and tow planes often perform towed departures from Runway 34 in the morning and Runway 30 in the afternoon. Departures are occasionally conducted from the intersection point of Runway 12/30. The vast majority of the glider aircraft have long high aspect ratio wings, in the range of forty-five to sixty feet in length. Moreover, some are high performance competition sailplanes, and as such, can have wingspans that approach or exceed eighty feet in length. Such competition sailplanes with wingspans in excess of seventy-nine feet, are classified as Airplane Design Group (ADG) III aircraft, and therefore, could have an impact upon airport geometry. It is estimated that these larger sailplanes are currently responsible for greater than 500 annual operations (the FAA's general planning threshold for use as a design standard) at the Minden-Tahoe Airport. Therefore, consideration must be given to potential effects upon not only airfield layout and design, but also flight patterns.

Airfield Capacity Methodology

The evaluation method used to determine the capability of the airside facilities to accommodate aviation operational demand is described in the following narrative. Evaluation of this capability is expressed in terms of potential excesses and deficiencies in capacity. The methodology used for the measurement of airfield capacity in this study is described in Federal Aviation Administration (FAA) Advisory Circular 150/5060-5, *Airport Capacity and Delay*. From this methodology, airfield capacity is defined in the following terms:

- *Hourly Capacity of Runways*: The maximum number of aircraft that can be accommodated under conditions of continuous demand during a one-hour period.

- *Annual Service Volume*: A reasonable estimate of an airport's annual capacity (i.e., level of annual aircraft operations that will result in an average annual aircraft delay of approximately one to four minutes).

The capacity of an airport's airside facilities is a function of several factors. These factors include the layout of the airfield, local environmental conditions, specific characteristics of local aviation demand, and air traffic control requirements. The relationship of these factors and their cumulative impact on airfield capacity are examined in the following paragraphs.

Airfield Layout

The arrangement and interaction of airfield components (runways, taxiways, and ramp entrances) refer to the layout or "design" of the airfield. As previously described, the Minden-Tahoe Airport is served by two paved runways, Runway 16/34 and 12/30, which are both served by full parallel taxiways.[1] There are also several runway exit taxiways and connector taxiways that are designed to minimize aircraft runway occupancy time, thus increasing the capacity of the runway system.

Existing landside facilities, which include storage hangars, T-hangars, aprons, and other various aircraft storage facilities, are located west of Runway 16/34 and southwest of Runway 12/30. There are also landside facilities west of the Runway 16 end and northeast of Runway 12/30. All facilities are well situated to take advantage of the existing taxiway system.

Environmental Conditions

Climatological conditions specific to the location of an airport not only influence the layout of the airfield, but also impact the use of the runway system. Variations in the weather resulting in limited cloud ceilings and reduced visibility typically lower airfield capacity, while changes in wind direction and velocity typically dictate runway usage and also influence runway capacity.

Ceiling and Visibility. FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, describes three categories of ceiling and visibility minimums for use in both capacity and delay calculations. Visual Flight Rules (VFR) conditions are defined as cloud ceiling reported at least 1,000 feet above ground level and visibility reported of at least 3 statute miles. Instrument Flight Rules (IFR) conditions are defined as cloud ceiling reported at least 500 feet, but less than 1,000 feet and/or visibility reported of at least 1 statute mile, but less than 3 statute miles. Poor Visibility and Ceiling (PVC) conditions exist whenever the cloud ceiling is less than 500 feet and/or the visibility is less than 1 statute mile.

Meteorological data from the National Climatic Data Center, with observations from the Minden-Tahoe Airport are not available. Consequently, an analysis of VFR, IFR and below minimum conditions cannot be conducted for the Airport.

Wind Coverage. Surface wind conditions have a direct effect on the operation of an airport; runways not oriented to take the fullest advantage of prevailing winds will restrict the capacity of the airport to varying degrees. When landing and taking off, aircraft are able to utilize a runway as long as the wind component perpendicular to the direction of travel (defined as a crosswind) is not excessive. To determine wind velocity and direction at the Minden-Tahoe Airport, wind data to construct the all-weather wind rose were obtained from the Minden-Tahoe Airport AWOS, for the period January 2006 to January 2007. There were approximately 499,414 one minute observations stored on the AWOS hard drive and available for analysis during this one-year period. Appendix One

[1] Runway 12/30 is actually served by partial parallel taxiways on both sides of the runway , however, for capacity planning purposes, the entire runway is considered as served by a parallel taxiway.

of FAA AC 150/5300-13, *Airport Design* recommends analysis of wind observations covering the previous 10 consecutive years. However, the order also states that when data are not available "it may be necessary to obtain a minimum of one year of onsite wind observations," which is the case at the Minden-Tahoe Airport.

Wind conditions affect all aircraft in varying degrees; however, the ability to land and takeoff in crosswind conditions varies according to pilot proficiency and aircraft type. Generally, the smaller the aircraft, the more it is affected by the crosswind component. Also, aircraft with conventional landing gear (tail-draggers) are generally more affected by the crosswind component. The allowable crosswind component is dependent upon the Airport Reference Code (ARC) for each runway. According to the existing Airport Layout Plan, the current Airport Reference Code (ARC) for Runway 16/34 is ARC C-III and the current ARC for Runway 12/30 is ARC B-I (Small).

For the ARC C-III classification, airport design standards specify that the 10.5-knot, 13-knot and 16-knot crosswind components be utilized for analysis. For the ARC B-I (Small) classification, the standards specify that the 10.5-knot and 13-knot crosswind components be utilized. The following illustration, entitled *MINDEN-TAHOE AIRPORT ALL WEATHER WIND ROSE: 16-, 13-, & 10.5-KNOT CROSSWIND COMPONENTS*, illustrates a comparative analysis of the all weather wind coverage provided at the Minden-Tahoe Airport.

The desirable wind coverage for an airport's runway system is 95%. This means that the runway orientation and configuration should be developed so that the maximum crosswind component is not exceeded more than 5% of the time annually. The following table, entitled *MINDEN-TAHOE AIRPORT ALL WEATHER WIND COVERAGE SUMMARY*, quantifies the wind coverage offered by the Airport's existing runway system. Based on the comparative all weather wind analysis for the Minden-Tahoe Airport, utilizing the FAA Airport Design Software supplied with AC 150/5300-13, the existing dual runway configuration provides adequate combined wind coverage (99% at 16-knots, over 97% at 13-knots and over 95% at 10.5 knots) for the all crosswind components. Therefore, no additional runways are required or justified *based on the standard FAA wind coverage criteria.*

Table C1

MINDEN-TAHOE AIRPORT ALL WEATHER WIND COVERAGE SUMMARY

Minden-Tahoe Airport Master Plan

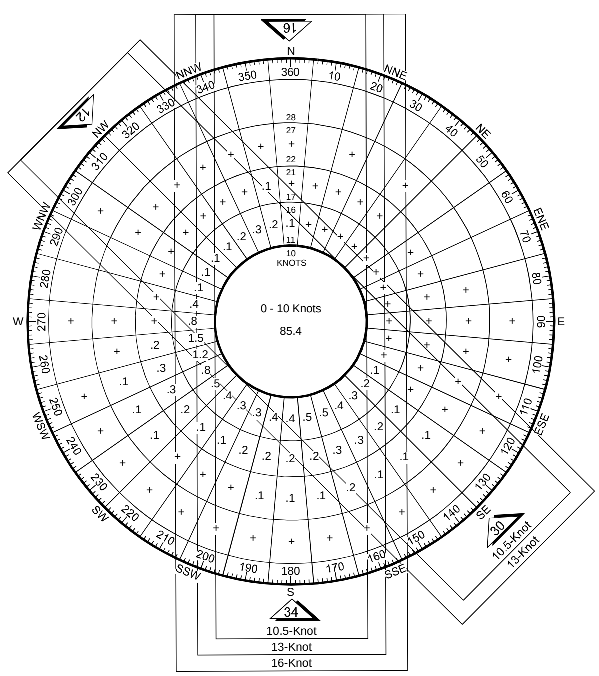
Runway Designation	10.5-Knot Crosswind Component	13-Knot Crosswind Component	16-Knot Crosswind Component
Runway 16/34	92.61%	95.55%	98.57%
Runway 12/30	92.28%	95.54%	--
Combined	95.38%	97.83%	99.00%

Source: *Wind analysis tabulation provided by Barnard Dunkelberg and Co., data provided by All-Weather Inc. Minden-Tahoe Airport, Automated Weather Observation System (AWOS).*

Figure C2

MINDEN-TAHOE AIRPORT ALL WEATHER WIND ROSE: 16-, 13-, & 10.5-KNOT CROSSWIND COMPONENTS

Minden-Tahoe Airport Master Plan



Source: *Wind rose developed by Barnard Dunkelberg and Co., data provided by All-Weather Inc.*
Period of Record – January 2006-January 2007. One Minute Observations, Total Observations: 499,414.

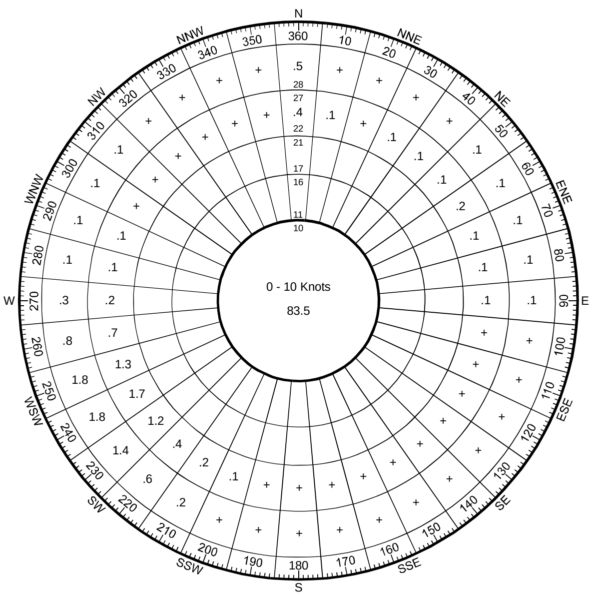
However, local reports from both powered small aircraft operators and glider operators indicate the presence of strong winds out of the west and southwest that often create a crosswind condition particularly during times when Mountain Wave conditions are prevalent. The mountain wave (often referred to as "the wave") is a meteorological condition that forms in the lee of mountains. The mountain wave created over the Carson Valley is described as one of the primary contributing factors to the world class soaring conditions and is also the primary reason for the high number of glider pilots who visit Minden on an annual basis.

According to the local soaring FBO, the three conditions that exist in the area of the Airport in order for soaring conditions conducive to the mountain wave to be present are as follows:

1. Daylight hours. Glider operations only take place during daylight hours and wave conditions are most prevalent during afternoon and early evening hours;
2. High winds over the ridge with increasing wind speed at altitude. Winds in excess of 25 miles per hour (21.7 knots) over Slide Mountain located approximately 20 nautical miles north/northwest of the Airport; and
3. Wind direction. Surface winds at the Airport between 210 and 310 degrees.

The problem that exists at the Minden-Tahoe Airport according to local reports, is that the existing runway layout at the Airport is not conducive to glider operations during the times when the glider-desirable mountain wave is present. This creates a serious safety concern for both glider pilots and tow pilots operating during these times. The local soaring FBO has keep monthly totals of days when these conditions exist for the past five years. The conditions can occur year round, but are most prevalent from November through June. January has historically been the peak month, averaging approximately 12.6 days per month of mountain wave presence. In order to further analyze this safety issue, wind data was collected from a weather station located on Slide Mountain. The following figure entitled *SLIDE MOUNTAIN ALL WEATHER WIND ROSE* presents this data in wind rose format with 25 miles per hour (21.7 knots) set as the calm wind threshold. As can be seen in the wind rose, the high winds at Slide Mountain which are conducive to the mountain wave, exist primarily out of 210 degrees to 270 degrees which correlates very well to the local soaring FBO's estimates. Based on this wind rose, and the wind rose in Figure C2, it would appear that a runway alignment of approximately 240 degrees true north (all wind rose data is measured to true north, however, runway designations are based on magnetic north) would be appropriate during wave conditions.

Figure C3
SLIDE MOUNTAIN ALL WEATHER WIND ROSE
Minden-Tahoe Airport Master Plan



Source: *Wind rose developed by Barnard Dunkelberg and Co., data provided by the Western Regional Climatic Center Station: Slide Mountain, Nevada. Period of Record – January 1997 to December 2006. Total Observations: 147,629.*
Notes: *Calm wind threshold set at 21.7 knots.*

In order to further analyze the wind conditions present at the Minden-Tahoe Airport during times when conditions are favorable for the mountain wave, an additional wind rose tabulation was ordered from All-Weather Inc. utilizing data from the AWOS at the Airport. This tabulation includes only wind observations for the eight month period from November to June[2] (the season with the highest number of mountain wave days) and only observations from 12 p.m. to 6 p.m. (the time of day most conducive to mountain wave conditions). This wind rose is presented in the following figure entitled *MINDEN-TAHOE AIRPORT ALL WEATHER WIND ROSE: 16-, 13-, & 10.5-KNOT CROSSWIND COMPONENTS DURING POTENTIAL MOUNTAIN WAVE CONDIITONS* and illustrates that the winds at the Airport are prevailing out of the southwest during both the season and time of day most conducive to mountain wave conditions. Also, as shown in the following table entitled *MINDEN-TAHOE AIRPORT ALL WEATHER WIND COVERAGE SUMMARY DURING POTENTIAL MOUNTAIN WAVE CONDITIONS*, Runways 16/34 and 12/30 do not combine to meet the 95% coverage requirements at 10.5 knots during these times.

[2] Actual months include February through June of 2006 and November 2006 through January 2007.

Table C2

MINDEN-TAHOE AIRPORT ALL WEATHER WIND COVERAGE SUMMARY DURING POTENTIAL MOUNTAIN WAVE CONDIITONS

Minden-Tahoe Airport Master Plan

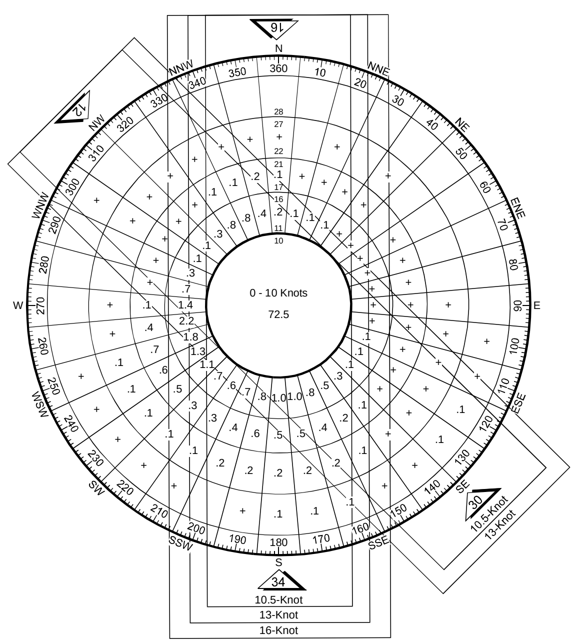
Runway Designation	10.5-Knot Crosswind Component	13-Knot Crosswind Component	16-Knot Crosswind Component
Runway 16/34	87.70%	92.45%	97.30%
Runway 12/30	84.09%	90.20%	--
Combined	91.58%	95.86%	84.92%

Source: *Wind analysis tabulation provided by Barnard Dunkelberg and Co., data provided by All-Weather Inc. Minden-Tahoe Airport, Automated Weather Observation System (AWOS).*

Figure C4

MINDEN-TAHOE AIRPORT ALL WEATHER WIND ROSE: 16-, 13-, & 10.5-KNOT CROSSWIND COMPONENTS DURING POTENTIAL MOUNTAIN WAVE CONDIITONS

Minden-Tahoe Airport Master Plan



Source: *Wind rose developed by Barnard Dunkelberg and Co., data provided by All-Weather Inc. Period of Record – February 2006 through June 2006 and November 2006-January 2007 during hours of 12 p.m. to 6 p.m., One Minute Observations, Total Observations: 87,005.*

The local solution proposed to address this safety issue has either been the reopening of the northeast half of Runway 03/21 (true bearing of approximately 225 degrees) as a landing only runway or the use of the closed parallel taxiway (same true bearing) to Runway 21 as a landing only runway. Runway 03/21 and its associated partial parallel taxiway were closed in 1969. Concerns have been expressed about the local airspace and traffic pattern impacts of reopening the northeast half of Runway 03/21, as well as Douglas County Initiative Ordinance 19.02 that currently restricts additional runway length at the Airport. Further concern has been expressed about the development of an additional "landing only" runway that is restricted from use by aircraft for takeoff operations. It will also be important to ensure the termination point of any additional runway facility does not intersect with the other runways and increase the potential of runway incursions at the Airport. Finally, airspace coordination with the FAA for any new runway facility would be necessary and a non-objectionable determination would be required.

Due to the fact that the existing dual runway configuration meets the FAA's 95% coverage requirement based on the all-weather wind rose presented in Figure C2, construction of any additional runway facilities would likely require total local funding. The purpose of this discussion was to present the rationale and justification for construction of additional runway facilities at the Minden-Tahoe Airport. This discussion indicates there is a conceptual basis for additional runway facilities to enhance safety at the Airport for tow plane and glider operations. The following chapter entitled *DEVELOPMENT CONCEPTS AND ALTERNATIVES ANALYSIS* will present various alternatives for addressing this need. The chapter will also discuss and analyze impacts and concerns with each alternative.

Characteristics of Demand

Certain site-specific characteristics related to aviation use and aircraft fleet makeup impact the capacity of the airfield. These characteristics include aircraft mix, runway use, percent arrivals, touch-and-go operations, exit taxiways, and air traffic control rules.

Aircraft Mix. The capacity of a runway is dependent upon the type and size of the aircraft that use the facility. Aircraft are categorized into four classes as defined in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. Classes A and B consist of primarily small single engine and twin-engine aircraft (both prop and jet), weighing 12,500 pounds or less, which are representative of the general aviation fleet. Class C and D aircraft consist of larger jet and propeller aircraft typical of those utilized by the airline industry and the military, along with the majority of the business jet fleet. Aircraft Mix is defined as the relative percentage of operations conducted by each of these four classes of aircraft. The existing percentage of aircraft weighing less than 12,500 pounds (i.e., Class A and B) is estimated to be more than 90% of total aircraft operations.

Runway Use. Runway use is defined by the number, location, and orientation of the active runway(s) and relates to the distribution and frequency of aircraft operations to those facilities. According to airport personnel estimates, operations occur to the south (Runway 16) approximately 5 percent of the time, to the north (Runway 34) about 45 percent of the time, to the southeast (Runway 12) approximately 1 percent of the time, and to the northwest (Runway 30) roughly 29 percent of the time. It is also estimated that the remaining 20 percent of operations are landing operations that occur to the northwest on Runway 30G. For capacity planning purposes, the operations on Runway 30G will be grouped with the operations on Runway 30. These runway use percentages indicate that the Minden-Tahoe Airport operates with a very unique dual primary runway configuration. In contrast to most general aviation airports where the crosswind runway is only utilized a very small percentage of the time, the crosswind runways (Runways 12/30 and 12G/30G) at MEV handle approximately 50% of annual operations. Prevailing winds often favor Runway 16/34 in the morning and Runway 12/30 in the afternoon (for glider and tow plane traffic) which can result in simultaneous operations.

Percent Arrivals. Runway capacity is also significantly influenced by the percentage of all operations that are arrivals. Because aircraft on final approach are typically given absolute priority over departures, higher percentages of arrivals during peak periods of operations reduce the Annual Service Volume. The operations mix occurring on the runway system at the Minden-Tahoe Airport reflects a general balance of arrivals to departures. Therefore, it was assumed in the capacity calculations that arrivals equal departures during the peak period.

Touch-And-Go Operations. A touch-and-go operation refers to an aircraft maneuver in which the aircraft performs a normal landing touchdown followed by an immediate takeoff without stopping or taxiing clear of the runway. These operations are normally associated with training and are included in local operations figures. Based on current estimates, touch-and-go operations presently comprise a small percentage of total operations at the Airport.

Exit Taxiways. The capacity of a runway is greatly influenced by the ability of an aircraft to exit the runway as quickly and safely as possible. Therefore, the quantity and design of the exit taxiways can directly influence aircraft runway occupancy time and the capacity of the runway system. The number of exit taxiways at the Minden-Tahoe Airport is considered adequate for existing and future operations.

Air Traffic Control Rules. The FAA specifies separation criteria and operational procedures for aircraft in the vicinity of an airport contingent upon aircraft size, availability of radar, sequencing of operations and noise abatement procedures, both advisory and/or regulatory, which may be in effect at the airport. The impact of air traffic control on runway capacity is most influenced by aircraft separation requirements dictated by the mix of aircraft utilizing the airport. Presently, there are no special air traffic control rules in effect at the Minden-Tahoe Airport that significantly impact operational capacity. The only exception to this is the occasional implementation of a temporary Air Traffic Control tower at the Airport during peak summer fire fighting operations. However, the Airport's operational capacity is not significantly hampered or limited as a result of the temporary tower.

Airfield Capacity Analysis

As previously described, the determination of capacity for the Minden-Tahoe Airport uses the methodology described in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, along with the Airport Design Computer Program that accompanies AC 150/5300-13. Several assumptions are incorporated in these capacity calculations: arrivals equal departures, the percent of touch-and-go operations is between zero and twenty five percent (0-25%) of total operations, there are full-length parallel taxiway with ample exits and no taxiway crossing problems, there are no airspace limitations, and the Airport is not equipped with an ILS. IFR weather conditions at the Airport are estimated to occur less than 10 percent of the time, and approximately 80 percent of the time the Airport is operated with the runway use configuration that produces the greatest hourly capacity.

Applying information generated from the preceding analyses, capacity and demand are formulated in terms of the following results:

- Annual Service Volume (ASV)
- Hourly Capacity of Runways (VFR and IFR)

Based on the methodology to determine the capacity at the Minden-Tahoe Airport for long-range planning purposes, the ASV has been determined to be approximately 230,000 operations, with a VFR capacity of roughly 98 operations per hour and an IFR capacity of approximately 59 operations per hour. It is recognized that the Minden-Tahoe Airport does not conform to all of the assumptions listed above (i.e., the Airport does not have a full time ATCT facility); however, if there was sufficient demand and permanent Air Traffic Control Tower (ATCT) facilities were operated in the future, the actual capacity would be similar to the projection for long-range planning purposes.

As can be seen, the Airport's Annual Service Volume is significantly greater than the number of annual operations forecast for the end of the planning period (89,141). It should be noted that the 2004 Nevada Airport System Plan (NASP) forecast of 139,400 annual operations by 2020 would exceed 60 percent of airfield capacity which is typically the threshold to start planning for additional runway facilities to increase capacity. However, this NASP forecast included a 2005 operations estimate of 98,400 for MEV, which is much higher than current estimates. The operations forecasts included in previous chapter indicate there is no need to plan for additional runway facilities for capacity purposes, however, the potential reservation of space for these facilities should be considered.

Facility Requirements

This section presents the analysis of requirements for airside and landside facilities necessary to meet aviation demand at the Minden-Tahoe Airport. For those components determined to be deficient, the type and size of the facilities required to meet future demand are identified. Airside facilities examined include the runways, taxiways, runway protection zones, runway thresholds, and navigational aids. Landside facilities include such facilities as the terminal area, the glider area, aircraft storage hangars, aircraft and glider apron areas, and airport support facilities.

This analysis uses the forecasts set forth in the preceding chapter for establishing future development of the Airport. This is not intended to dismiss the possibility that, due to the unique circumstances in Douglas County and the Carson Valley, either accelerated growth or consistently higher or lower levels of activity may occur. Aviation activity levels should be monitored for consistency with the forecasts. In the event of changes, the schedule of development should be adjusted to correspond to the demand for facilities rather than be set to predetermined dates of development. By monitoring activity levels, over-building or under-building can be avoided.

Airside Facilities

Dimensional Criteria. FAA Advisory Circular 150/5300-13, *Airport Design*, recommends standard widths, minimum clearances, and other dimensional criteria for runways, taxiways, safety areas, aprons, and other physical airport facilities. Dimensions are recommended with respect to the Aircraft Approach Category and Airplane Design Group designations (the Airport Reference Code), and availability and type of approach instrumentation.

Based on the previously described ARC for each runway, dimensional criteria (i.e., runway/taxiway separation, runway/taxiway safety areas, aircraft parking separation, threshold siting surface, etc.), are established. The following tables, entitled *ARC C-III DIMENSIONAL STANDARDS FOR RUNWAY 16/34 (In Feet)*, *ARC B-I (SMALL AIRCRAFT) DIMENSIONAL STANDARDS FOR RUNWAY 12/30 (In Feet)*, and *ARC B-I (SMALL AIRCRAFT) DIMENSIONAL STANDARDS FOR RUNWAY 12G/30G (In Feet)* compare existing conditions against the dimensional design requirements that would apply to the Minden-Tahoe Airport depending on the Airport Reference Code and approach visibility minimums that are possible in the future. Runway 16/34 at the Minden-Tahoe Airport meets or exceeds most dimensional standards with a few notable exceptions. Bliss Road north of Runway 16 penetrates the Runway Object Free Area (ROFA) preventing the full ROFA length and width standard from being met and the Airport Property Line (APL) and associated perimeter fence south of Runway 34 also penetrate the ROFA preventing the full standard from being achieved.

As presented in Table C3, *RUNWAY 12/30 ARC B-I (SMALL AIRCRAFT) DIMENSIONAL STANDARDS (In Feet)*, Runway 12/30 also meets or exceeds the "Small Aircraft Only" dimensional standards associated with ARC B-I (Small Aircraft). An assessment of the existing design standards for the Airport relative to the current criteria will be conducted during the airside alternatives analysis presented in the following chapter.

The approach surfaces to each runway threshold have adequate clearances over adjacent roadways, power lines, and other objects. However, these threshold siting requirements must be re-examined in conjunction with any future improvements or modifications to the Airport's approach visibility minimums.

Table C3
RUNWAY 16/34 ARC C-III DIMENSIONAL STANDARDS, (In Feet)
Minden-Tahoe Airport Master Plan

Item	**Existing Dimension**	**Visual Runways & Visibility Minimums Not Lower Than ¾-Mile** (1)
Runway:		
Width	100	100
Safety Area Width	500	500
Safety Area Length (beyond runway end)		
Runway 16	1,000	1,000
Runway 34	1,000	1,000
Object Free Area Width	**741**	800
Object Free Area Length (beyond runway end)		
Runway 16	**970**	1,000
Runway 34	**300**	1,000
Obstacle Free Zone Width	N.D.	400
Taxiway:		
Width	50	50
Safety Area Width	118	118
Object Free Area Width	186	186
Runway Centerline to:		
Holdline	250	250
Parallel Taxiway Centerline	500	400
Aircraft Parking Area	585	500
Threshold Siting Surface Criteria:		
Runway 16(2)	---	Criteria Met
Runway 24(3)	---	Criteria Met

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.
Existing dimensions delineated in **bold** text reflect potential non-standard criteria.
N.D.: Not designated in current planning information, however, the standard appears to be met or exceeded.
(1) Runway has existing approach visibility minimums of 1¼ Mile.
(2) Applies existing runway type 4 criteria for Appendix 2, AC 150/5300-13 Change 10.
(3) Applies existing runway type 4 criteria for Appendix 2, AC 150/5300-13 Change 10.

Table C4

RUNWAY 12/30 ARC B-I (SMALL AIRCRAFT) DIMENSIONAL STANDARDS, (In Feet)

Minden-Tahoe Airport Master Plan

Item	**Existing Dimension**	**Visual Runways & Visibility Minimums Not Lower Than ¾-Mile** [1]
Runway:		
Width	75	60
Safety Area Width	120	120
Safety Area Length (beyond runway end)		
Runway 12	240	240
Runway 30	240	240
Object Free Area Width	250	250
Object Free Area Length (beyond runway end)		
Runway 12	240	240
Runway 30	240	240
Obstacle Free Zone Width	N.D.	250
Taxiway:		
Width	25	35
Safety Area Width	49	49
Object Free Area Width	89	89
Runway Centerline to:		
Parallel Runway	**550**	700[4]
Holdline	200	125
Parallel Taxiway Centerline	275 to 500	150
Aircraft Parking Area	200 to 400	125
Threshold Siting Surface Criteria:		
Runway 12[2]	---	Criteria Met
Runway 30[3]	---	Criteria Met

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.

Existing dimensions delineated in **bold** text reflect potential non-standard criteria.

N.D.: Not designated in current planning information, however, the standard appears to be met or exceeded.

[1] Runway 12/30 is a visual runway.

[2] Applies existing runway type 3 criteria for Appendix 2, AC 150/5300-13 Change 10.

[3] Applies existing runway type 3 criteria for Appendix 2, AC 150/5300-13 Change 10.

[4] Standard applies to runways designed to accommodate simultaneous landings and takeoffs using Visual Flight Rules (VFR)

As can be seen in the following table, Runway 12G/30G at the Minden-Tahoe Airport is in non-compliance with the FAA specified dimensional criteria for the runway centerline to parallel runway centerline separation in consideration of simultaneous VFR landings and takeoffs. With respect to this runway, the current airport layout plan does not identify all dimensional criteria for the facility, therefore the runway was evaluated in consideration of ARC B-I (Small Aircraft) dimensional standards. As can be noted from the following table, the glider runway appears to meet all standards with the exception of the parallel runway separation. If the Airport were equipped with an Air Traffic Control Tower (ATCT), simultaneous same direction operations to Runways 30 and 30G could potentially be allowed under FAA Air Traffic Control regulations. However, because of the lack of an ATCT, consideration should be given to relocating the Runway 12G/30G to at least a 700-foot separation from Runway 12/30 to allow for simultaneous landings and takeoffs under VFR.

Table C5
RUNWAY 12G/30G ARC B-I (SMALL AIRCRAFT) DIMENSIONAL STANDARDS, (In Feet)
Minden-Tahoe Airport Master Plan

Item	Existing Dimension	Visual Runways & Visibility Minimums Not Lower Than ¾-Mile [1]
Runway:		
Width	60	60
Safety Area Width	N.D	120
Safety Area Length (beyond runway end)		
Runway 12G	N.D	240
Runway 30G	N.D	240
Object Free Area Width	250	250
Object Free Area Length (beyond runway end)		
Runway 12G	240	240
Runway 30G	240	240
Obstacle Free Zone Width	N.D.	120
Taxiway:		
Width	N.A.	35
Safety Area Width	N.A.	49
Object Free Area Width	N.A.	89
Runway Centerline to:		
Parallel Runway	**550**	700[4]
Holdline	N.A.	125
Parallel Taxiway Centerline	N.A.	150
Aircraft Parking Area	225	125
Threshold Siting Surface Criteria:		
Runway 12G [2]	---	Criteria Met
Runway 30G [3]	---	Criteria Met

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.
Existing dimensions delineated in **bold** text reflect potential non-standard criteria.
N.D.: Not designated in current planning information, however, the standard appears to be met or exceeded.
N.A.: Not Applicable
[1] Runway 12G/30G is a visual runway.
[2] Applies existing runway type 3 criteria for Appendix 2, AC 150/5300-13 Change 10.
[3] Applies existing runway type 3 criteria for Appendix 2, AC 150/5300-13 Change 10.
[4] Standard applies to runways designed to accommodate simultaneous landings and takeoffs using Visual Flight Rules (VFR)

Figure C5
Existing Dimensional Criteria

Runway Pavement Strength. Both Runway 16/34 and Runway 12/30 have published gross weights of 30,000 pounds single-wheel, 50,000 pounds dual-wheel landing gear configurations. However, Runway 16/34 was resurfaced in August of 2005 and a structural assessment of pavement capacity was completed following the project. The assessment concluded that the runway has adequate structural capacity to serve existing traffic mix and that for dual wheel aircraft the maximum load is 110,000 pounds.

Based on the weight requirements of the aircraft that currently use the Airport and those that are projected to use the Airport, the existing runway strengths are more than adequate for the duration of the planning period.

Airfield Capacity. The evaluation of airfield capacity presented earlier indicates that the Airport will not exceed the operational capacity of the existing runway/taxiway system before the end of the planning period. The Airport's Annual Service Volume (ASV) was determined to be approximately 230,000 operations. FAA planning standards indicate that when sixty percent (60%) of the ASV is reached (in this case approximately 138,000 operations), the Airport should start planning ways to increase capacity. Accordingly, when eighty percent (80%) of the ASV is reached (representing about 184,000 operations), construction of facilities to increase capacity should be initiated.

Even before an airfield reaches capacity, it begins to experience certain amounts of delay in aircraft operations. As an airport's operations increase toward capacity, delay increases exponentially. Therefore, it is important to monitor the number of aircraft operations regularly and identify factors that may be acting as capacity constraints. This will enable airport management to react to unexpected trends before the lack of operational capacity might become a critical issue.

Runway Length. Generally, runway length requirements for design purposes at general aviation airports similar to the Minden-Tahoe Airport are premised upon the category of powered aircraft using the airport. These categories are small aircraft under 12,500 pounds maximum takeoff weight and large aircraft under 60,000 pounds maximum takeoff weight.

Runway length requirements are derived from the computer based FAA Airport Design Software supplied in conjunction with Advisory Circular 150/5300-13, *Airport Design*. Using this software, three values are entered into the computer, including the airport elevation of 4,726 feet Above Mean Sea Level (AMSL), the Mean Normal Maximum Temperature (NMT) of 90 degrees Fahrenheit, and the maximum difference in runway elevation at the centerline of nine feet. This data generates the general recommendations for runway length requirements at the Minden-Tahoe Airport, which are provided in the following table entitled *RUNWAY LENGTH REQUIREMENTS*.

Table C6
RUNWAY LENGTH REQUIREMENTS
Minden-Tahoe Airport Master Plan

Runway Requirement	Runway Takeoff Length (Feet) Dry Pavement	Wet Pavement
Existing Conditions		
Runway 16/34	7,400	7,400
Runway 12/30	5,300	5,300
Runway 12G/30G	2,200	2,200
Small Aircraft with less than 10 seats [1]		
75% of Small Aircraft	4,450	4,450
95% of Small Aircraft	5,890	5,890
100% of Small Aircraft	6,120	6,120
Small Aircraft with more than 10 seats	6,120	6,120
Large Aircraft less than 60,000 pounds		
75% of fleet /60% useful load	6,620	6,620
100% of fleet /60% useful load	10,010	10,010
75% of fleet /90% useful load	8,690	8,690
100% of fleet /90% useful load	11,090	11,090

Notes: Runway Lengths Based on 4,726' AMSL, 90°F NMT, and Maximum difference in runway end of 9 feet.
(1) The majority of aircraft operating at the Airport are contained within the Small Aircraft Category (i.e., ≤12,500 lbs.).

As shown in the preceding table, the small aircraft fleet (under 12,500 pounds) requires a runway length between 4,450 and 6,120 feet, while the aircraft over 12,500 pounds, but less than 60,000 pounds, requires between 6,620 and 11,090 feet for both the dry and wet pavement scenarios. Each of the runway lengths given for large aircraft under 60,000 pounds maximum certificated takeoff weight provides a runway sufficient to satisfy the operational requirements of a certain percentage of the aircraft fleet at a certain percentage of the useful load. Useful load is defined as the difference between the maximum gross takeoff weight and the empty weight of the airplane, exclusive of fuel. Generally, the following business jet aircraft comprise seventy-five percent of the general aviation aircraft fleet between 12,500 and 60,000 pounds: Learjets, Sabreliners, Citations, Falcons, Hawkers, Challengers and the Westwind.

A significant factor to consider when analyzing the generalized runway length requirements given in the above table is that the actual length necessary for a runway is a function of elevation, temperature, and aircraft stage length. As temperatures change on a daily basis, the runway length requirements change accordingly (i.e., the cooler the temperature, the shorter the runway necessary). Therefore, if a runway is designed to accommodate seventy-five percent of the fleet at sixty percent useful load, this does not mean that at certain times a larger or more heavily loaded aircraft cannot use the runway. However, the amount of time such operations can safely occur is restricted. It is important to note that Douglas County Initiative Ordinance 19.02 currently states that runway length at the Airport is to remain as is.

Runway 16/34. The data presented in the table above indicates that Runway 16/34, with an existing length of 7,400 feet, can accommodate 100 percent of the general aviation aircraft fleet weighing 12,500 pounds or less, and 75 percent of the large aircraft fleet (less than 60,000 pounds) operating between 60 and 90 percent useful load. However, based on the frequent use of the runway by large fire bomber aircraft including the P-3 Orion with a maximum takeoff weight of up to 140,000 pounds, an extension of Runway 16/34 may be required depending on the specific operation requirements of these fire bomber aircraft. Preservation of area for this runway extension should be considered in the alternatives chapter of this Airport Master Plan.

Runway 12/30. With an existing length of 5,300 feet, this runway can accommodate between 75 and 95 percent of the aircraft fleet weighing less than 12,500 pounds. While the published pavement strength of this runway can accommodate larger aircraft, Runway 12/30 is not frequently used by large aircraft (aircraft over 12,500 pounds) and according to airport personnel, this runway is adequate to serve the small aircraft users of the facility including motor gliders and tow planes. Therefore, based on the current and future utilization of this runway, it is unlikely that an extension to Runway 12/30 will be programmed within the twenty-year planning period. However, consideration should be given to shifting Runway 12/30 to the southeast to increase the distance from the Runway 30 threshold to the intersection with Runway 16/34. Tow plane and glider operators have previously indicated that a length of 4,000 feet from the threshold to the intersection would greatly decrease the need for these operators to cross Runway 16/34 during glider landing and towed glider takeoffs.

Runway 12G/30G. With an existing length of 2,200 feet this runway is adequate to accommodate the aircraft that currently use and are projected to use the runway (tow planes and gliders). The glider FBO at the Airport estimates that most gliders and tow planes using the runway requires less than 1,000 feet for landing operations. It is unlikely that an extension of Runway 12G/30G will be programmed within the twenty-year planning period, however, alternatives to relocate this runway to increase the runway separation from the paved Runway 12/30 will be considered.

Additional Glider Only Runway. In order to enhance safety for glider operations at the Airport, consideration should be given to constructing additional runway facilities.

Alternatives to increase safety during Mountain Wave conditions include the reopening of the northeast end of Runway 21 as a glider/tow plane runway, the development of a portion of the closed parallel taxiway to Runway 21 as a glider/tow plane runway or the construction of a new runway in another location at a similar alignment to Runway 21. Tow plane and glider operators have indicated that 1,600 feet by 60 feet would be adequate for this additional glider/tow plane runway. As noted previously in this chapter, construction of additional runway facilities would require a local funding source and receive airspace approval from the FAA.

Runway Line-of-Sight and Gradient. According to existing runway line-of-sight standards, any two points located five feet above the runway centerline must be mutually visible for the entire length of the runway. If the runway has a full-length parallel taxiway, the visibility requirement is reduced to a distance of one-half the runway length. All runways at the Minden-Tahoe Airport currently comply with the runway line-of-sight standards for the entire length of each runway.

Runway Visibility Zone (RVZ). According to existing RVZ standards, a clear line-of-sight between the ends of intersecting runways is recommended and a clear line-of-sight between the designated runways' visibility points is required. Terrain needs to be graded and permanent objects need to be designed or sited so that there will be an unobstructed line-of-sight from any point five feet above one runway centerline to any point five feet above an intersecting centerline within the RVZ. The RVZ is an area formed by imaginary lines connecting the two runways' visibility points. The visibility points are determined by a formula based on the distance from the runway intersection to the runway ends. A small portion of the recently constructed glider staging apron is currently located within the RVZ.

Taxiways. Taxiways are constructed primarily to enable the movement of aircraft between the various functional areas on the Airport and the runway system. Some taxiways are necessary simply to provide access between aircraft parking aprons and runways, whereas other taxiways become necessary to provide more efficient and safer use of the airfield. All existing taxiways meet or exceed the required width according to the specified ARC criteria.

Runway Protection Zones (RPZS). The function of the RPZ is to enhance the protection of people and property on the ground beyond the end of runways. This is achieved through airport control of the RPZ areas. The RPZ is trapezoidal in shape and centered about the extended runway centerline. It begins 200 feet beyond the end of the area usable for takeoff or landing. The RPZ dimensions are functions of the type of aircraft and approach visibility minimums associated with each runway end.

As noted previously in the *INVENTORY* chapter, the instrument approach procedures to the Minden-Tahoe Airport have specified visibility minimums of greater than 1 statute mile. Runway 16/34 serves large aircraft (over 12,500 pounds) including jet aircraft with Category C approach speeds. Runway 12/30 and 12G/30G both serve small aircraft only and are designed for aircraft with Category A and B approach speeds. The following table, entitled *RUNWAY PROTECTION ZONE DIMENSIONS*, lists existing RPZ dimensions along with the requirements for improved approach capabilities.

Table C7
RUNWAY PROTECTION ZONE DIMENSIONS
Minden-Tahoe Airport Master Plan

Item	Width at Runway End (feet)	Width at Outer End (feet)	Length (feet)
Existing RPZ Dimensions:			
Runway 16	500	1,010	1,700
Runway 34	500	1,010	1,700
Runway 12	250	450	1,000
Runway 30	250	450	1,000
Runway 12G	250	450	1,000
Runway 30G	250	450	1,000
Required RPZ Dimensions for Various Visibility Minimums:			
Visual and not lower than 1-mile, Small Aircraft Exclusively	250	450	1,000
Visual and not lower than 1-mile, Approach Categories A & B	500	700	1,000
Visual and not lower than 1-mile, Approach Categories C & D	500	1,010	1,700
Not lower than 3/4-mile, all aircraft	1,000	1,510	1,700
Lower than 3/4-mile, all aircraft	1,000	1,750	2,500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.

The potential for providing improved instrument approaches at airports throughout the country, at a reduced cost, is increased with the continued development of Global Positioning System (GPS) technology. This indicates that planning for enhanced approach capabilities, and the impact of the required Runway Protection Zones, should be incorporated in this study, primarily for Runway 16/34.

Objects Affecting Navigable Airspace. The criteria contained in Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*, apply to existing and proposed manmade objects and/or objects of natural growth and terrain (i.e., obstructions). These guidelines define the *critical* areas in the vicinity of airports that should be kept free of obstructions. *Secondary* areas may contain obstructions if they are determined to be non-hazardous by an aeronautical study and/or if they are marked and lighted as specified in the aeronautical study determination. Airfield navigational aids, as well as lighting and visual aids, by nature of their location, may constitute obstructions. However, these objects do not violate FAR Part 77 requirements, as they are essential to the operation of the airport. There are currently no known or identified FAR Part 77 obstructions on or in the vicinity of the Minden-Tahoe Airport.

Instrumentation and Lighting. Electronic landing aids, including instrument approach capabilities and associated equipment, airport lighting, and weather/airspace services, were detailed in the *INVENTORY* chapter of this document. The Airport is not presently equipped with a straight-in instrument approach procedure; however, based on the increased use of sophisticated business and corporate aircraft in the US general aviation fleet, and to increase safety and operational use of the Airport during adverse weather conditions, the ability to implement improved instrument approaches will be examined in the alternatives analysis chapter of the document. The impact of improved instrument approaches on the Airport's specified design and FAR Part 77 airspace criteria will also be considered.

Within the near future, Global Positioning System (GPS) approaches are expected to be the FAA's standard approach technology. With GPS, the cost of establishing new or improved instrument approaches at many airports has been significantly reduced. With respect to future instrument flight procedures (IFPs), the FAA's Aviation System Standards (AVN) branch designs and develops IFPs, as well as operates a fleet of flight inspection aircraft for airborne evaluation of electronic navigational signals. The Flight Procedures Division of AVN maintains production schedules for the IFPs, which include LNAV, LNAV/VNAV, LPV, ILS, etc.

Visual Landing Aids (lights). Presently, only Runway 16/34 is equipped with Medium Intensity Runway Lights (MIRLs). These lights should be maintained in conjunction with any proposed instrument approach procedure enhancements. Visual Approach Slope Indicators (VASI) are currently located at both ends of Runway 16/34. In conjunction with the examination of improved instrument approaches described previously, improved visual landing aids may also need to be evaluated. The type of airport lighting will be dependent on the type of instrument approach capabilities being proposed and will be examined in the following chapter.

Landside Facilities

Landside facilities are those facilities that support the airside facilities, but are not actually part of the aircraft operating surfaces. These consist of such facilities as passenger terminal buildings, aprons, access roads, hangars, and support facilities. Following an analysis of these existing facilities, current deficiencies can be noted in terms of accommodating both existing and future needs.

Aircraft Storage. Aircraft based at the Minden-Tahoe Airport are stored in one of five ways: private hangars, large storage hangars, T-hangars, apron tiedowns, or glider trailers. Currently, an average of 304 aircraft are based at the Airport (many gliders are only based at the Airport seasonally although glider operations are conducted year-round). Gliders can also be broken down in as little as 20 minutes and then stored on or off-airport property. Over the course of the twenty-year planning period, the number of based aircraft is forecast to increase to approximately 378, indicating that a likely increase in storage facilities to accommodate approximately 74 new aircraft will be required, with additional hangar facilities likely being needed to accommodate a portion of the existing based aircraft that are currently stored on the apron tiedowns. It is assumed that future storage spaces will reflect some of the characteristics of current storage patterns; however, it is anticipated that an increasing percentage of the based aircraft fleet will be stored in hangars.

Of the 304 based aircraft at the Minden-Tahoe Airport, 63 are gliders, many of which reside from April through October in the tiedown area of the main apron or at the tiedown area on the closed portion of Runway 21.

Tiedown Storage Requirements/Based Aircraft. Aircraft tiedowns are provided for those aircraft that do not require, or do not desire, to pay the cost for hangar storage. Space calculations for these areas are typically based on 360 square yards of apron for each aircraft to be stored on the apron. This amount of space allows for aircraft parking and circulation between the rows of parked aircraft. However, due to the large number of based gliders at the Airport, 500 square yards of apron was used as many of the gliders actually use two full aircraft tiedowns. Based upon existing aircraft storage practices and strong demand for new hangar facilities, it is projected that a significant number of existing based aircraft that are currently stored on the apron would prefer to have hangar storage. As a result, it is anticipated that the based aircraft apron requirements will generally decline through the planning period as additional hangar storage facilities are constructed at the Airport, with the excess apron then being available for transition to itinerant aircraft apron.

Tiedown Storage Requirements/Itinerant Aircraft. In addition to the needs of the based aircraft tiedown areas addressed in the preceding section, transient aircraft also require apron parking areas at the Minden-Tahoe Airport. This storage is provided in the form of transient aircraft tiedown space. In calculating the area requirements for these tiedowns, typically, an area of 400 square yards per aircraft is used. As previously described, it's projected that the forecast decreasing demand for based aircraft apron would be available for use to accommodate the forecast increase in demand for itinerant aircraft apron through the planning period.

The following table shows the type of facilities and the number of units or square yards needed for that facility in order to meet the forecast demand for each development phase. Currently, glider and sailplanes use up to 50% of the tiedowns on the primary and secondary apron. It is expected that if east side glider apron and tiedowns are constructed as currently programmed in the Airport's CIP, no additional apron expansion will be required for based and itinerant powered aircraft on the west side of the Airport.

It is also expected that most of the owners of aircraft that will be newly based at the Airport will desire some type of indoor storage facility. The actual type of hangar storage facility to accommodate based aircraft has been identified as T-hangars, executive hangars, and larger corporate and/or FBO type hangars, although the actual number, size, and location of these large hangars will depend on user needs and financial feasibility. Therefore, the quantity of future large FBO hangars has not been projected; however, potential development or expansion sites will be identified in the development plan for the Airport.

Access and perimeter roadway locations, auto parking requirements, and land requirements are not included in this tabulation because the amount of land necessary for these facilities will be a function of the location of other facilities, as well as the most effective routing of roadways. The following table, entitled *GENERAL AVIATION FACILITY REQUIREMENTS, 2006-2026*, depicts the area required for general aviation landside facilities during all stages of development. This will assist in the development of detailed facility staging discussed later.

Table C8
GENERAL AVIATION FACILITY REQUIREMENTS, 2006-2026
Minden-Tahoe Airport Master Plan

	Total Number Required (In Square Yard)				
Facility	**2006** (1)	**2011**(2)	**2016**(2)	**2021**(2)	**2026**(2)
Itinerant Apron					
(paved square yards)	9,680	9,955	10,232	10,509	10,786
Based Aircraft Apron					
(paved square yards)	32,818	31,801	30,762	29,040	27,720
Glider Aircraft Apron					
(paved square yards)	31,531	33,099	34,689	36,960	38,506
Hangar Spaces	187	203	220	239	258
T-hangar Spaces					
(no./square yards)	126/65,591	136/70,761	148/77,446	160/83,660	174/90,867
Exec./Corp. Spaces					
(no./square yards)	61/59,306	67/65,139	72/70,000	79/76,806	84/81,667
TOTAL SQUARE YARDS	198,926	210,755	223,127	236,975	249,320

Source: (1) Actual.
(2) Barnard Dunkelberg & Company, Inc. projections based on FAA AC 150/5300.

The future development of T-hangars and executive/corporate hangars at Minden-Tahoe Airport will be demand dictated (there are currently 25 aircraft owners with paid deposits on the hangar wait list). Therefore, the number, size, and location of these hangars will vary depending upon the demand for specific facilities. Additional aircraft storage facilities are currently required at the Airport and it is projected that additional aircraft storage facilities will continue to be required throughout the planning period to accommodate forecast increases in the number of based aircraft. In fact, two private firms are planning to construct additional hangar facilities in 2007.

There are several important guidelines, which the Airport Sponsor and airport management should consider when making hangar placement decisions within specified development areas. These guidelines include:

- Each executive/corporate hangar should be supplied with taxiway access, automobile access, and adjacent automobile parking. This is most efficiently accomplished when a row of hangars is developed and supplied with taxiway access on one side and automobile access and parking on the other side.

- Each T-hangar should be nested and developed with taxiway access to both sides of the hangar. Controlled automobile access should be provided to the taxiway/apron area near the T-hangars. In addition, a public access parking area should be provided near the T-hangars to accommodate both users and visitors.

- It is most efficient to "double load" both the taxiway access and the automobile access routes with hangars. In other words, the access taxiways are lined with hangars on both sides and the automobile roadways/parking areas are lined with hangars on both sides.

Vehicular Access. Ground access facility requirements, based upon the previously presented demand and capacity analysis, have been developed for the vehicular access roadway system that presently serves the Airport. The capacity analysis presented in the previous chapter indicated that the two-lane airport access road (Airport Road), which serves the west side of the Airport, would have adequate capacity to accommodate the anticipated airport-generated and background traffic through the planning period. It is also anticipated that anticipated that Firebrand Road and Bliss Road have adequate capacity to serve the demand for access to the northwest and east sides of the Airport. However, the demand placed on these roadways should be analyzed periodically to determine if facility improvements are needed. In addition, opportunities to provide a more direct access route to the southwest development area will be investigated in the forthcoming alternatives evaluation chapter of this Airport Master Plan.

Support Facilities Requirements

In addition to the aircraft storage facilities described above, there are several airport support facilities that have quantifiable requirements and that are vital to the efficient and safe operation of the Airport.

Fuel Storage Facility. Aviation fuel is currently stored in six aboveground storage tanks with a storage capacity of 12,000 gallons each, giving the Airport a total storage capacity of 72,000 gallons. Three of these tanks store 100 low-lead AvGas and three tanks store Jet-A fuel. All fuel at the Airport is dispensed by the FBO's from fuel trucks.

Typically, as operations increase, fuel storage requirements can be expected to increase proportionately. By applying typical AvGas and Jet-A ratios of gallons of fuel required per operation over the 20-year planning period, an estimate of future fuel storage needs can be calculated. Jet-A fuel operators typically take on more fuel than AvGas operators and as such, it is assumed the ratio of gallons per operation is higher. As can be seen in the following table, entitled *FUEL STORAGE REQUIREMENTS, 2006-2026*, it appears that the Airport's fuel storage capacity is adequate for the 20-year planning period as AvGas fuel deliveries are projected to reach five per year by 2026 and Jet-A fuel deliveries are projected to reach just over two per year in 2026.

Table C9
FUEL STORAGE REQUIREMENTS, 2006-2026
Minden-Tahoe Airport Master Plan

	2006[1]	2011	2016	2021	2026
Annual Operations	80,000	82,270	84,560	86,851	89,141
Annual Operations (AvGas)[2]	40,176	41,316	42,466	43,616	44,767
Average AvGas Ratio (Gal.)	4	4	4	4	4
Total Annual AvGas Storage Required (Gal.)	160,704	165,264	169,864	174,464	179,068
Storage Capacity (Gal.)	36,000	36,000	36,000	36,000	36,000
Minimum Delivery Frequency (Deliveries Per Year)	4.5	4.6	4.7	4.8	5.0
Annual Operations (Jet-A)[3]	7,824	8,046	8,270	8,495	8,718
Average Jet-A Ratio (Gal.)	10	10	10	10	10
Total Annual Jet-A Fuel Storage Required (Gal.)	78,240	80,460	82,700	84,950	87,180
Storage Capacity (Gal.)	36,000	36,000	36,000	36,000	36,000
Minimum Delivery Frequency (Deliveries Per Year)	2.2	2.2	2.3	2.4	2.4

(1) Base year estimates.
(2) Excludes glider operations.
(1) Jet-A Annual Operations include Jet, Turboprop, Helicopter and Military Operations Categories.

Planning Issues Identification/Verification

As referenced in the *INVENTORY OF EXISTING CONDITIONS* chapter of this document, identification of the current and future airport planning issues, which may influence the use of a public facility, is an important step in the planning process. A preliminary list of these issues was identified at the conclusion of that chapter, and that list has continued to evolve and expand in response to input that has been received throughout the planning process.

The following updated list identifies those issues that will be considered in the preparation of the airside and landside plan alternatives for the Minden-Tahoe Airport, and ultimately provide the basis for the formulation of the future plans for the facility. It should also be noted that some of the issues are referenced in more than one category due to their complexity or boundary relationships.

Airside Issues:

1. Safe and Efficient Airport Utilization
2. Verify Airport Design Standards
3. Runway Configuration
4. Evaluate Future Instrument Approach Procedure
5. Soaring/Glider Operations and Staging, Interim and Long-Term Solutions
6. General Aviation and Corporate Aircraft Operations

Landside Issues:

1. East Side Infrastructure and Utilities Extensions
2. Maintain Financial Self Sufficiency of the Airport
3. Verify Airport Design Standards
4. Improve Glider Staging Areas and Enhance Soaring Activities
5. Enhance General Aviation Security

Airport Operation Issues:

1. Reduce Runway Incursion Potential
2. East Side Infrastructure and Utilities Extensions
3. Airport Weight Ordinance and Prior Permission Required (PPR) Test
4. Stakeholder/Management Communication
5. Enhance General Aviation Security
6. Improve Glider Staging Areas and Enhance Soaring Activities
7. Maintain Financial Self Sufficiency of the Airport
8. Economic Development and Growth Management
9. Enhance Airport Compatibility with Surrounding Community

Summary

The need for facilities, which have been identified in this chapter, can now be utilized to formulate the overall future Conceptual Development Plan of the Airport. The following table summarizes the projected facility requirements necessary to accommodate the projected operational demands through 2026. The formulation of this plan will begin by establishing goals for future airport plans and an analysis of plan alternatives whereby demand for future airport facilities can be accommodated. These alternatives will be presented in the following chapter, entitled *ALTERNATIVES ANALYSIS*.

Table C10
FACILITY REQUIREMENTS SUMMARY, 2006-2026
Minden-Tahoe Airport Master Plan

Facility	2006(1)	2011	2016	2021	2026
Dimensional Standards					
Runway 16/34	ARC C-III	same	same	same	same
Runway 12/30	ARC B-I/Sm. Aircraft Only	same	same	same	same
Runway 12G/30G	ARC B-I/Sm. Aircraft Only	same	same	same	same
Runway 03/21	ARC B-I/Sm. Aircraft Only	same	same	same	same
Runway Length/Width					
Runway 16/34	100' x 7,400'	same	same	same	same
Runway 12/30	75' x 5,300'	same	same	same	same
Runway 12G/30G	60' x 2,200'	same	same	same	same
Runway 03/21	60' x 1,600'	same	same	same	same
General Aviation Apron Requirements (In yds.^{2})					
Itinerant (yd.^{2})	9,680	9,955	10,232	10,509	10,786
Based (yd.^{2})	32,818	31,801	30,762	29,040	27,720
Subtotal (yd.^{2})	42,498	41,756	40,994	39,549	38,506
Glider (yd.^{2})	31,531	33,099	34,689	36,960	38,280
General Aviation Aircraft Storage Facilities (No./yds.^{2})					
T-hangars (no./yd.^{2})	126/65,591	136/70,761	148/77,446	160/83,660	174/90,867
Exec./Corp. (no./yd.^{2})	61/59,306	67/65,139	72/70,000	79/76,806	84/7,81667
Aviation Fuel Storage Requirements					
AvGas (gallons)	36,000	same	same	same	same
Jet-A (gallons)	36,000	same	same	same	same

(1) Actual.