4. Demand/Capacity Assessment and Facility Requirements

This chapter presents an evaluation of the existing airfield facilities, buildings, and other facilities at the Airport and an assessment of their potential use under the demand scenarios defined for the Airport. The airside and landside facility requirements for the Airport were developed for the planning activity and sensitivity levels (PAL 1, 2, 3 and SL 4) defined in Chapter 3, *Aviation Demand Forecasts*. In addition, because the PALs and SL represent a change in the character of traffic in terms of fleet mix, requirements for the Baseline Forecast at 2024 are also presented.

A review of the ability of existing Airport facilities to accommodate future demand is presented in the following sections:

- Airfield demand/capacity analysis
- Airfield requirements
- Passenger terminal area facilities
- General aviation facilities
- Support facilities

4.1 Airfield Demand/Capacity Analysis

Airfield capacity is defined as the maximum number of aircraft operations that an airfield configuration can accommodate during a specified interval of time when there is a continuous demand for service (i.e., an aircraft is always waiting to depart or land). This definition is referred to as the maximum throughput rate. The methodology used to assess airfield capacity focuses on both peak-hour capacity and annual operating capacity over the 20-year planning period. The Airport's annual service volume (ASV) is one quantifiable measure of capacity, and hourly (based on the peak hour) operating capacity is another measure used to determine specific facility needs compared to the forecast aviation demand for the Airport. In addition operational and safety factors can dictate the need for improvements.

4.1.1 Airfield Layout and Runway Configurations

The capacity of an airfield is a function of the number and location of exit taxiways, the runway configuration and runway combination(s) used, and wind and weather conditions.

Taxiway systems with an adequate number of and appropriately spaced exits from the runway enable landing aircraft to spend less time on the active runway. When aircraft exit the active runway, the runway is then cleared for other operations; thus, efficient runway clearing improves runway operational capacity. The Airport has two runways, primary Runway 13-31 and secondary Runway 5-23. Primary Runway 13-31 is 7,000 feet long and 150 feet wide. Secondary Runway 5-23 is 3,000 feet long and 75 feet wide. Runway 13-31 has a full-length parallel taxiway and a total of five exits: one at each runway end, two 90-degree exits, and one near-90-degree exit (which also serves as a parallel taxiway to Runway 5-23). This taxiway configuration maximizes the operational capacity of Runway 13-31. Runway 5-23 also has a full-length parallel taxiway and three exits. Additional taxiway exits would not significantly enhance the operational capacity of the airfield.

The operational configuration of the airfield depends on wind and weather conditions and the type of demand (aircraft fleet mix) being accommodated. Exhibit 2-6 shows the runway layout, and **Exhibit 4-1** depicts the preferred runway operating configurations at the Airport. As shown, the preferred runway operating configurations are categorized as visual flight rules (VFR) and instrument flight rules (IFR) operations. VFR conditions are typically in effect when weather conditions are such that pilots can maintain safe operations by visual means. IFR conditions prevail when the visibility or cloud ceiling falls below those minimums prescribed for VFR.

As shown, the runways at the Airport are basically operated independently of one another, in a single-runway configuration, with operations typically restricted to one runway at a time. Together, both runways provide 98.6 percent coverage with a 10.5-knot crosswind, 99.7 percent coverage with a 13-knot crosswind, and 99.9 percent coverage with a 16-knot crosswind. The FAA recommends that an airport's runways provide coverage during approximately 95 percent of all wind conditions; therefore, the existing runway configuration provides the required coverage.

It should be noted that the operational configurations illustrated on Exhibit 4-1 do not include all possible combinations; rather, they depict the configurations used most frequently, based on input from air traffic controllers. In addition, the illustrated configurations represent those used during high or peak demand periods, when the air traffic controller is required to queue aircraft and to operate well-defined configurations. During periods when demand is well below peak levels, runway use is often selected on the basis of convenience, depending on the direction from which the aircraft is arriving or to which it is departing.

4.1.2 Aircraft Fleet Mix

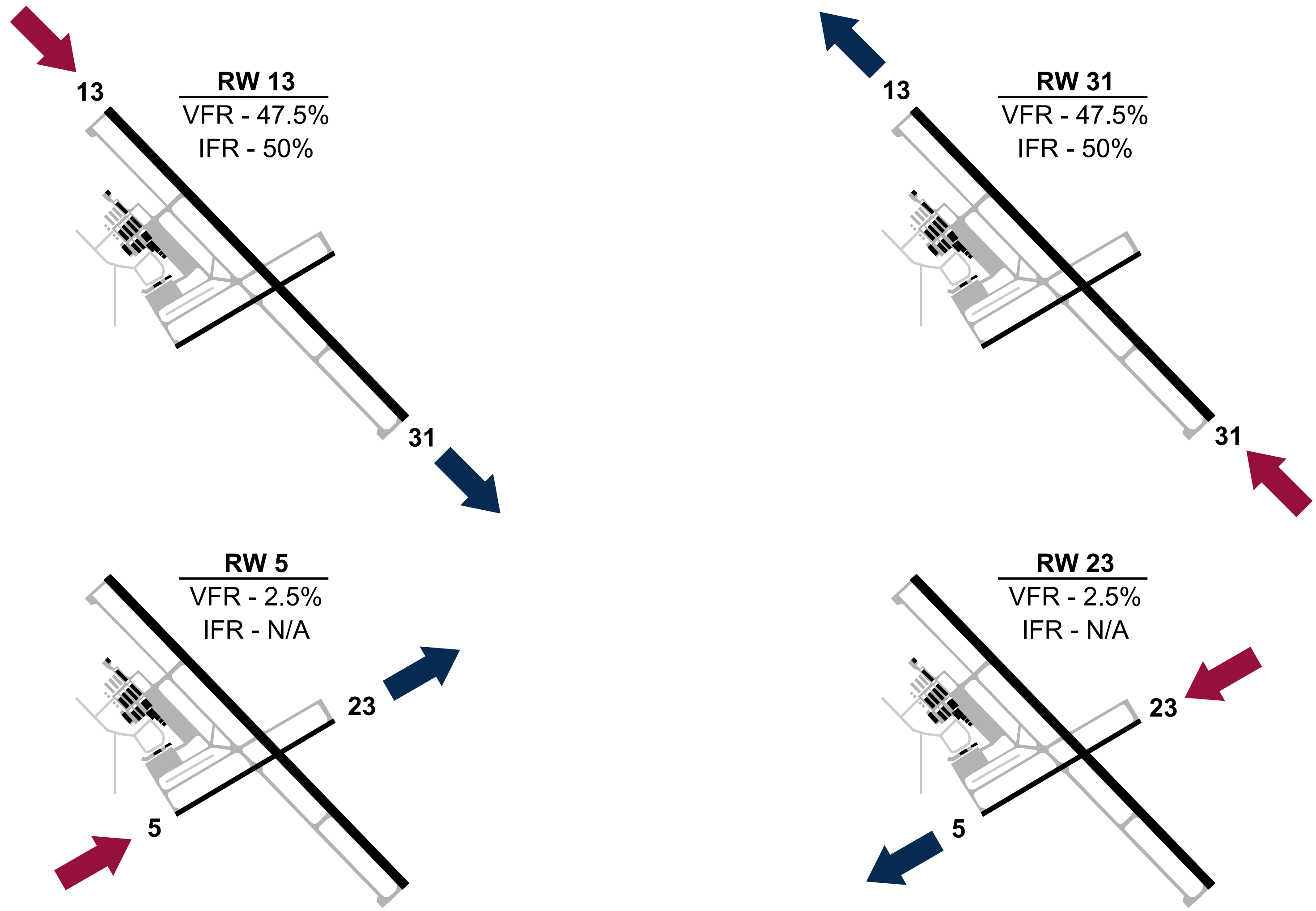
Aircraft fleet mix is an important factor in determining an airport's operational capacity. For the purpose of calculating capacity, aircraft are categorized according to their approach speed and weight. Operational capacity decreases as the diversity of approach speeds and aircraft weights increases because aircraft following each other, either on arrival or departure, are spaced according to the difference in their air speeds and weight. Heavy aircraft create wake vortices that require greater spacing between them and large and small aircraft. The greater the difference in aircraft size and speed, the greater the space required between aircraft and, therefore, the lower the operational capacity of the airfield.

FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay,* groups aircraft into four classes, as listed in **Table 4-1**.

Table 4-1
Aircraft Classifications for Airfield Capacity

Aircraft Classification	Takeoff Weight (pounds)	Types of Aircraft	Estimated Approach Speed (knots)
A	12,500 or less	Small single-engine aircraft (such as Piper PA-28, Cessna 152, and Cessna 210)	95
B	12,500 or less	Small twin-engine aircraft (such as Beechcraft Duchess, Cessna Citation II, and Learjet 35)	120
C	12,500 - 300,000	Large aircraft (such as B-737, Saab 340, and MD80)	130
D	over 300,000	Heavy aircraft (such as B-767, A300, B-777)	140

Source: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*
Prepared by: Ricondo & Associates, Inc.



Source: Airport Layout: ©Jeppesen Sanderson, Inc., 2001, 2004. All Rights Reserved;
Runway Use: Teleconference with Mel McBride, St. Cloud ATCT Manager, March 3, 2005
Prepared by: Ricondo & Associates, Inc.

Exhibit 4-1

north — **- Arrivals** — **- Departures**

Runway Operations Configurations

P:\STC\Phase 02 Inventory\STC Runway Configurations.ai

A projected aircraft fleet mix for the Airport was developed as part of the forecasting task for this Master Plan, as presented in Chapter 3, *Aviation Demand Forecasts*. These forecasts were used for a variety of different analyses conducted for the Master Plan (e.g., noise, capacity, and runway length and strength). **Table 4-2** presents the Airport's existing and projected fleet mix for each PAL and SL, based on the FAA aircraft classifications.

Table 4-2

Aircraft Fleet Mix for Airfield Capacity

		Activity Levels				
Aircraft Classification	Existing 2004	PAL 1	Baseline 2024	PAL 2	PAL 3	SL 4
A/B	93%	91%	92%	91%	91%	83%
C	7%	9%	8%	9%	9%	17%
D	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%
Mix Index	7	9	8	9	9	17

Sources: FAA Advisory Circular 150-5060-5, *Airport Capacity and Delay;* KRAMER aerotek, inc., and Ricondo & Associates, Inc., Projected Fleet Mix

Prepared by: Ricondo & Associates, Inc.

The majority of aircraft operating at the Airport are small single- and twin-engine general aviation (GA) aircraft. As can be seen in Table 4-2, the general mix of the fleet is not projected to change significantly over the 20-year planning period. The significant increase in Class C aircraft operations in SL 4 Scenario accounts for the additional forecast air carrier traffic.

The mix index included in Table 4-2 is calculated based on the percentage of aircraft classes C and D operating at, or projected to operate at, the Airport. The following equation illustrates this calculation.

$$\text{Mix Index} = \text{Percentage of Class C} + 3 * (\text{Percentage of Class D})$$

The mix index for St. Cloud Regional Airport reflects a fleet composition that is dominated by Class A and B aircraft. No aircraft over 300,000 pounds (Class D) are projected to conduct scheduled operations at the Airport during the planning period. The operating capacity of an airport does not decrease until the mix index exceeds 20. The mix index for St. Cloud Regional Airport remains under 20 for all forecast scenarios through the 20-year planning period.

4.1.3 Peak-Hour Airfield Capacity Analysis

The peak-hour airfield capacity is defined as the number and mix of aircraft arrivals and departures that can take place on the runway system in an hour with minimal capacity-related delay. In accordance with FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, the ultimate capacity was defined for operations in VFR and IFR conditions at the Airport, as the percentage of time that the Airport experiences Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC), which affects airfield capacity.

Table 4-3 depicts the hourly airfield capacity (i.e., number of operations) for each runway use configuration at the Airport. Peak hour capacity is influenced by the number of touch-and-go operations, which are operations by a single aircraft that lands and departs on a runway without stopping or exiting the runway. Pilots conducting touch-and-go operations usually stay in an airport's traffic pattern, as they are generally performing training exercises. Airport capacity increases with the ratio of touch-and-go operations to total operations because less time is required to perform this type of simultaneous landing and departure. Touch-and-go operations, however, may reduce the availability of the runway for other types of operations. Assumptions for up to 50 percent touch-and-go operations are included for hourly airfield capacity estimates in the FAA's *Airport Capacity and Delay* Advisory Circular. Due to the extensive flight training conducted at the Airport by St. Cloud State University (SCSU) and the St. Cloud Aviation flight school, touch-and-go traffic is significant. Based on historical operating data, it is estimated that touch-and-go operations account for approximately 50 percent of total annual operations at the Airport, and therefore are consistent with assumptions defined in the FAA's *Airport Capacity and Delay* Advisory Circular and its methodology for peak-hour capacity calculations.

Table 4-3

Peak Hour Airfield Capacity Estimates

	Airfield Capacity (operations/hour)	
Runway Use Configuration	VFR	IFR
Runway 13	98	59
Runway 31	98	59
Runway 5	98	n/a
Runway 23	98	n/a

Source: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*
Prepared by: Ricondo & Associates, Inc.

4.1.4 Annual Service Volume

Annual Service Volume (ASV) is defined as the maximum number of aircraft operations that can take place at an airport in a year. ASV can be used as a reference point for the general planning of capacity-related improvements. As the annual number of aircraft operations approaches the ASV of an airport, annual aircraft delays increase rapidly with relatively small increases in aircraft operations.

The ASV of St. Cloud Regional Airport was estimated using FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. The ASV estimation is based on the hourly capacity of the airfield and reflects fleet mix, runway use configurations, and weather condition fluctuations that occur on an annual basis. The Airport's ASV is estimated to be 230,000 aircraft operations.

Typically, when an airport's annual operations total exceeds 60 percent of its airfield capacity, some aircraft delay occurs. Therefore, when the airfield is operating at 60 percent of capacity, planning for new airfield facilities should be initiated. When airport activity reaches 80 percent of capacity, new airfield facilities should be constructed or demand management strategies should be implemented. The 60-percent planning ratio and 80-percent action ratio of capacity to service volume were applied to future peak-hour capacity and ASV for the Airport to determine a specific timeframe when achievement of these milestones could be expected. Based on the forecast operations presented in

Chapter 3, the Airport's annual demand is forecast to reach approximately 40 percent of the Airport's ASV at PAL 1; 43 percent at PAL 2; 50 percent at PAL 3; and nearly 54 percent at SL 4. None of the forecast scenarios presented in Chapter 3 would exceed 60 percent of the Airport's ASV over the 20-year planning period.

4.1.5 Aircraft Delay

Annual aircraft delay, expressed in minutes per aircraft operation, is also an important measure of an airport's ability to accommodate forecast aircraft operations. The "rule-of-thumb" relationships between the ratio of annual demand to ASV and average annual aircraft delays are shown in **Table 4-4.**

Table 4-4
Relationship between Annual Service Volume and Aircraft Delay

Ratio of Annual Demand to ASV	Estimated Average Annual Aircraft Delay (minutes/operation)
0.1	-
0.2	0.1
0.3	0.2
0.4	0.3
0.5	0.4
0.6	0.5
0.7	0.7
0.8	0.9
0.9	1.4
1.0	2.6

Source: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*
Prepared by: Ricondo & Associates, Inc.

These relationships, as set forth in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, were derived from traffic records for a number of high-capacity airports in the United States and a range of assumptions on likely operating conditions. As shown in Table 4-3, when the annual number of aircraft operations equals the Airport's ASV (ratio of 1.0), the average annual aircraft delay would be 2.6 minutes per aircraft operation. The actual delay at any given time for an individual aircraft operation depends on a number of conditions that can vary by a factor of 5 to 10 times the average delay. For example, when an airport's demand/capacity ratio reaches 1.0, individual aircraft could be delayed up to approximately 13 to 26 minutes.

The relationships between the ratio of annual demand to ASV and average annual aircraft delays for the Airport are shown in **Table 4-5** for existing conditions and the activity forecast scenarios.

As shown in Table 4-5, average aircraft delay is expected to be minimal at the Airport, increasing from 0.3 minute per aircraft operation to 0.4 minute per aircraft operation throughout the planning period.

Table 4-5

ASV, Annual Demand, and Estimated Average Annual Aircraft Delay

Forecast Scenario	ASV (aircraft operations)	Annual Demand (aircraft operations)	Ratio of Annual Demand to ASV	Estimated Average Annual Aircraft Delay (minute/operation)
Existing 2004	230,000	80,877	0.4	0.3
PAL 1	230,000	90,342	0.4	0.3
Baseline 2024	230,000	112,444	0.5	0.4
PAL 2	230,000	98,782	0.4	0.3
PAL 3	230,000	113,490	0.5	0.4
SL 4	230,000	124,003	0.5	0.4

Note: Airfield configuration was assumed to match existing conditions, with the operational equivalency of a single runway.

Source: Ricondo & Associates, Inc. derived from FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*
Prepared by: Ricondo & Associates, Inc.

4.1.6 Demand/Capacity Summary

The peak hour and annual capacity analyses indicate that, overall, the airfield has adequate capacity to efficiently accommodate forecast demand throughout the 20-year planning period. These analyses, however, did not take into account the unique operational needs of the Airport related to weather conditions and complex mix of activity. The crosswind runway's length cannot support air carrier operations.

As commercial operations increase in the future (under all forecast scenarios), consideration should be given to providing for operational redundancy to maintain Airport capacity during snow removal during heavy snowfall conditions as well as short-term runway maintenance. This redundancy would help maintain the level of service for air carrier and commuter passengers, which is critical to maintaining and increasing air service to the region.

Additionally, consideration should be given to the operational safety benefits of providing the ability to separate different types of airfield traffic given the mix of aircraft using the Airport. A significant component of the activity at the Airport is student pilot training in small aircraft to practicing take offs and landings. Larger, faster aircraft, such as corporate jets and turboprops and air carrier aircraft operating at the Airport must alter their approaches to mix with the slower, smaller aircraft in the same traffic patterns. Trying to blend this mix of traffic results in many go-arounds and extended or altered patterns, which make it difficult for pilots to keep track of each other and for the ATCT to maintain traffic separations. Operational safety would be considerably enhanced if training activity were segregated from larger, faster aircraft flying straight-in approaches, by the provision of a separate general aviation (GA) training runway.

In addition to the mix of traffic, the level of pilot training is also a consideration in defining the airfield requirements. A significant amount of instrument flight rules (IFR) training currently occurs at the Airport on a daily basis given that both Runway 13 and Runway 31 are equipped for precision instrument approaches. In fact, the IFR training activity at St. Cloud Regional Airport has been increasing as aircraft in the surrounding area opt to train at the Airport. For this reason, a future GA runway that would allow the segregation of traffic should be equipped with an instrument landing system (ILS) to ensure that all training activity can be accommodated on the future runway.

As there is increasing traffic in the pattern, both commercial and general aviation, the more potential there is for aircraft spacing and separation issues to arise. Providing the facilities to operationally separate the traffic will maximize the safety of both training/GA and commercial activity.

4.2 Airfield Requirements

The planning and design of an airport and its airfield facilities are typically based on the airport's role and the critical aircraft types using the airport. The FAA provides guidance for airport planning and design through Advisory Circulars that govern airport safety, economy, efficiency, and longevity. Airfield facilities must comply to design standards, such as those set forth in FAA Advisory Circular 150/5300-13, *Airport Design,* for runway and taxiway widths and clearances to ensure that the range of users projected to operate at the airport can be accommodated. Airfield facility requirements were developed for each of the following functional areas at the Airport:

- Runway length
- Runway width
- Pavement strength
- Taxiway system
- Airfield safety areas
- Navigational aids (NAVAIDs)

The Airport Reference Code (ARC) is used to relate airport design criteria to the operational and physical characteristics of the aircraft intended to operate at the airport and is calculated based on specifications in the *Airport Design* Advisory Circular. The ARC has two components relating to an airport's design aircraft. FAA planning guidelines, presented in, Advisory Circular 150/5325-4A, *Runway Length Requirements for Airport Design*, define the design aircraft for an airport as the aircraft that is used to conduct a minimum of 250 operations (arrivals and departures) per year at the airport.

The first component of the ARC, represented by a letter, is the Aircraft Approach Category, which is defined by aircraft approach speed. The second component, represented by a Roman numeral, is the Airplane Design Group (ADG), as determined by aircraft wingspan. Generally, aircraft approach speed applies to runways and runway dimensional clearances, while aircraft wingspan relates primarily to dimensional separation criteria involving taxiways and taxilanes. FAA aircraft classifications for determining ARC are presented in **Table 4-6**.

The current design aircraft at St. Cloud Regional Airport is the Saab 340, an ARC B-II aircraft, which operates at the Airport on a regularly scheduled basis, on short-range shuttle flights. In addition, the charter airlines at the Airport use B-737-800s and MD 80s, both ARC C-III aircraft, on a limited basis. Recognizing that the Airport's charter activity is expected to increase and the Airport is likely to be the future second large commercial service airport to serve the region, it is prudent, where possible to plan for larger passenger aircraft. Therefore, within the 20-year planning horizon the primary runway is planned to meet the dimensional and separation standards of ARC C-II, at a minimum. However, given the longer range growth projected for activity at STC, the primary runway will be planned to meet the dimensional and separation standards of ARC C-IV beyond the 20-year planning horizon (ultimate development horizon).

Table 4-6
FAA Aircraft Classifications for Determining Airport Reference Code

FAA Aircraft Approach Category

Approach Category	Approach Speed (knots)
A	Less than 91
B	91 or more, but less than 121
C	121 or more, but less than 141
D	141 or more, but less than 166
E	166 or greater

FAA Airplane Design Group Classification

Airplane Design Group (ADG)	Wingspan (feet)	Typical Aircraft
I	Less than 49	Piper PA-28, Learjet 35
II	49, up to but not including 79	Cessna Citation II, Saab 340
III	79, up to but not including 118	B-737, MD 80
IV	118, up to but not including 171	A300, B-757, B-767
V	171, up to but not including 214	B-747
VI	214, up to but not including 262	A-380

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.
Prepared by: Ricondo & Associates, Inc.

Because Runway 5-23 will continue to serve general aviation traffic in the near term, but serve to provide enhanced crosswind operational capability and redundancy within the 20-year planning horizon, this runway is planned to meet the dimensional and separation standards of C-III over the future planning scenario. Consistent with the ultimate upgrade of the primary runway to meet ARC C-IV criteria, Runway 5-23 is planned for ultimate upgrade, beyond the 20-year future planning horizon, to meet ARC C-IV. This ultimate upgrade will maintain the crosswind capability and operational redundancy relative to the primary runway.

Taxiways C and D, as well as the connector taxiways to Runway 5-23, provide access to the terminal area and therefore must meet C-III standards within the 20-year planning horizon and C-IV standards in the ultimate airport plan.

Table 4-7 presents a comparison of the existing dimensional characteristics of Runways 13-31 and 5-23 with the FAA design criteria for the ARCs for each runway. All proposed airfield improvements would incorporate the standards identified in Table 4-7, except when airline-specific requirements or existing conditions make it infeasible.

Table 4-7

FAA Airfield Design Criteria with Existing, Future, and Ultimate Conditions

	Runway 13-31			Runway 5-23			
	Design Standards			Design Standards			
Design Criteria	Existing Conditions (feet)	Existing and Future (ARC C-III) (feet)	Ultimate (ARC C-IV) (feet)	Existing Conditions (feet)	Existing (ARC-BII) (feet)	Future (ARC C-III) (feet)	Ultimate (ARC C-IV) (feet)
Runway Width							
- Width	150	100	150	75	75	100	150
- Shoulder Width	25	20	25	None	10	20	25
Runway Centerline to:							
- Taxiway Centerline	400	400	400	400	240	400	400
- Aircraft Parking Area	677	500	500	250	250	500	500
Runway Object Free Area (OFA)							
- Width	800	800	800	250	500[3/]	800	800
- Length beyond Runway End	1000	1000	1000	300	300[3/]	1000	1000
Runway Obstacle Free Zone							
- Width	400	400	400	250	400	400	400
- Length beyond Runway End	200	200	200	200	200	200	200
Runway Safety Area (RSA)							
- Width	500	500	500	150	150[2/]	500	500
- Length beyond Runway End	1000	1000	1000	300	300[2/]	1000	1000
Runway Blast Pad							
- Width	200	140	200	n/a	95	140	200
- Length beyond Runway End	200	200	200	n/a	150	200	200
Taxiway Width	60 (Taxiway A)	50[1/]	75	40/60 (Taxiways D/C)		50[1/]	75
Taxiway Centerline to:							
- Parallel Taxiway Centerline	n/a	152	215	n/a	105	152	215
- Fixed or Movable Object	277	93	129.5	272	65.5	93	129.5
Taxiway Object Free Area (width)	> 259	186	259	> 131	131	186	259
Taxiway Safety Area (width)	> 171	118	171	> 79	79	118	171

Notes: n/a = not applicable.

1/ ARC C-III minimum taxiway width is 50 feet. For facilities that accommodate ARC C-III aircraft with a wheelbase equal to or greater than 60 feet, the standard taxiway width is 60 feet.

2/ For ARC B-II runways with approach visibility minimums lower than ¾-statute miles, the required RSA width is 300 feet and the required RSA length is 600 feet.

3/ For ARC B-II runways with approach visibility minimums lower than ¾-statute miles, the required OFA width is 800 feet and the required OFA length is 600 feet.

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

Prepared by: Ricondo & Associates, Inc.

In addition to the dimensional characteristics associated with the airfield over the 20-year horizon (future), similar information is presented in Table 4-7 covering the long range development of the airfield beyond the 20-year horizon. These dimensional criteria are provided to allow planning of future facilities (within the 20-year horizon) to accommodate the separation standards associated with the ultimate configuration (beyond 20-year horizon). Doing so avoids the future need to relocate facilities and airfield components to meet dimensional and separation criteria to meet dimensional and separation criteria that would be applicable in the ultimate layout.

A training runway would also need to meet B-II requirements. However, if an Instrument Landing System (ILS) were to be installed on the runway, width would need to increase to 100 feet, per FAA AC 150/5300-13, *Airport Design*. To allow independent IFR arrivals, the future runway would need to be separated from existing Runway 13-31 by 4,300 feet.

4.2.1 Runway Length

The runway length available for aircraft arrivals and departures is governed by the location and dimensions of the runway safety area (RSA), runway object free area (ROFA), and runway protection zone (RPZ). The need for additional runway length can be determined by analyzing the runway length requirements for the design aircraft at St. Cloud Regional Airport.

Based on FAA criteria, to demonstrate the justification for additional runway length at an airport, the recommended length for the primary runway must be determined by considering either the family of aircraft having similar performance characteristics or a specific aircraft needing the longest runway. In either case, the choice should be based on aircraft that are projected to use the runway on a regular basis (i.e., 250 operations per year).

The required runway lengths for primary Runway 13-31, secondary Runway 5-23 and the future GA training runway are discussed in the following subsections.

4.2.1.1 Primary Runway 13-31

To estimate the length of the primary runway needed to accommodate aircraft operating at the Airport, FAA Advisory Circular 150/5325-4A, *Runway Length Requirements for Airport Design*, was used.

The runway length analysis contained in the FAA Advisory Circular relates to both arrivals and departures; however, departures normally require more runway length. The required departure distance can be defined as the longest of the following three distances:

- ***Accelerate-takeoff distance***: Assuming that one engine fails at the critical takeoff speed (V_1), the aircraft is required to be able to continue takeoff and climb to 35 feet above the runway elevation prior to the end of the runway (or clearway if present).
- ***Accelerate-stop distance***: The distance needed for the aircraft to accelerate to V_1 and then brake to a full stop.
- ***All-engine takeoff distance***: 115 percent of the distance needed to reach 35 feet above the runway elevation with all engines working.

It should be observed from these definitions that, as the critical takeoff speed increases, the accelerate-takeoff distance decreases while the accelerate-stop distance increases. The FAA Advisory Circular design methodology provides for a “balanced field length” runway design, or a runway length at which the tradeoff between reduced accelerate-takeoff distance approximately equals increased accelerate-stop distance.

To estimate the primary runway length needed to accommodate aircraft operating at St. Cloud Regional Airport, aircraft manufacturers' data for several aircraft expected to operate at the Airport were obtained. Runway length under the FAA Advisory Circular methodology is a function of the Airport's normal maximum operating temperature, elevation, aircraft loads, and the length of haul (stage length) performed by the aircraft.

As of 2003, the top five O&D markets for St. Cloud Regional Airport were Chicago, Illinois; Phoenix, Arizona; Washington, D.C.; Denver, Colorado; and Las Vegas, Nevada. The stage length for these flights ranges from 343 nautical miles (Chicago O'Hare) to 1,111 nautical miles (Las Vegas). Currently, the only direct destination with scheduled service from the Airport is Minneapolis-St. Paul International Airport (MSP), and all flights to the Airport's O&D markets are conducted through connections at MSP, a primary hub for Northwest Airlines. St. Cloud Regional Airport management has pursued efforts to increase air service at the Airport through access to a second airline hub in addition to MSP. Should second hub scheduled service be initiated, these cities would be likely destinations. As presented in Chapter 3 and determined through discussions with Airport staff, charter airlines that have previously served the Airport are interested in providing nonstop service to Las Vegas, Nevada (1,111 nautical miles); Orlando, Florida (1,191 nautical miles); St. Petersburg, Florida (1,188 nautical miles); and Cancun, Mexico (1,510 nautical miles) using B-737-800 aircraft.

Based on these various top O&D markets and hub locations of airlines that could initiate air service at the Airport, it is recommended that the length of the Airport's primary runway be designed to accommodate aircraft operating on stage lengths over 1,000 nautical miles at or near their maximum gross takeoff weight. While it is not uncommon for scheduled passenger flights to operate at less than maximum gross takeoff weight given load factors and stage lengths, it is more common for charter flights to depart at or near the aircraft's passenger capacity. Depending on stage length (destination), charter flights tend to operate closer to the aircraft's maximum gross takeoff weight.

Based on an analysis of the runway length requirements of representative air carrier aircraft that could be expected to operate at the Airport over the planning period under one or more of the forecast scenarios, extending the primary runway to 8,000 feet would accommodate almost the entire air carrier aircraft fleet at over 90 percent of the aircraft maximum gross takeoff weight, indicating that associated range and payload restrictions would be limited.

Based on the runway length analysis, a minimum runway length of 8,000 feet is recommended for the Airport's primary runway. This length would allow the Airport to meet the immediate needs of its existing charter airlines, as well as forecast needs. In summary:

- The charter airlines have clearly demonstrated a strong demand for growth in charter operations at the Airport, particularly through historical growth in numbers of passengers enplaned on charter flights and with existing flights to Laughlin, Nevada.
- The Airport's top O&D markets indicate that demand exists for nonstop service to markets farther than 1,000 nautical miles from the Airport.
- The charter airline currently operating at the Airport has indicated a strong desire to provide nonstop service to new markets, including Orlando, Las Vegas, and Cancun. The charter

airlines can now operate to these markets only by taking significant weight penalties or by making an intermediate stop to take on additional fuel.

- Following coordination with the airlines, it was determined that a runway extension to 8,000 feet would also provide an enhanced level of operational safety, particularly in winter and/or wet conditions.

The Airport's current Airport Layout Plan (ALP) depicts an ultimate 8,000-foot runway to accommodate more fully loaded, larger aircraft. As such, it is recommended that planning for this ultimate 8,000-foot runway length continue.

4.2.1.2 Secondary Runway 5-23

According to FAA Advisory Circular 150/5325-4A, *Runway Length Requirements for Airport Design*, it is recommended that the length of a crosswind runway average approximately 80 percent of the primary runway's length. This length provides an acceptable level of operational capability for the majority of current and future aircraft fleet using the Airport in the event that the primary runway is closed or otherwise unavailable for aircraft operations. Secondary Runway 5-23 is currently 3,000 feet long, or 43 percent of the primary runway's length. Lengthening the secondary runway would provide operational redundancy, including the use of Runway 5-23 by air carrier aircraft in crosswind conditions, additional capacity to accommodate growth in general aviation aircraft operations at the Airport and operational safety when used by aircraft larger than general aviation aircraft. A minimum length of 5,600 feet is recommended for Runway 5-23 based on the length of the existing primary runway. However, extension of the primary runway should be accompanied by consideration of commensurate extension to the planned length of Runway 5-23. For a future primary runway length of 8,000 feet, the recommended length for the crosswind runway would be 6,400 feet.

4.2.1.3 Future Runway 13R-31L

The future GA training runway is recommended to have a length of 4,200 feet. This would serve the majority of the pilot training activity that could be expected at the Airport, which is primarily ARC B-II aircraft.

4.2.2 Runway Width

FAA design criteria specify a width of 100 feet for ARC C-III runways, 150 feet for ARC C-IV runways and recommend a minimum width of 100 feet for runways with a precision instrument approach. In addition to the structural width of the runway, paved or otherwise, stabilized shoulders 25 feet in width for ARC C-IV facilities and 20 feet in width for ARC C-III facilities are recommended in FAA design standards.

Runway 13-31 was widened to 150 feet in 2001, giving the Airport the capability, in terms of runway width, to accommodate nearly all air carrier aircraft up to those in ADG V. Paved shoulders 25 feet wide were constructed when Runway 13-31 was widened, meeting FAA requirements to accommodate aircraft in ADG IV. Therefore, no modifications to runway or shoulder width are required for this runway.

Runway 5-23 is 75 feet wide and currently does not have paved shoulders. In conjunction with the future upgrade of this runway to meet ARC C-III standards (widening to 100 feet), paved shoulders should be constructed on Runway 5-23 to meet FAA criteria. The shoulder width should be 10 feet to fully comply with ARC C-III requirements over the planning horizon.

The future GA training runway should be a minimum of 75 feet wide to support ARC B-II traffic, however, if an ILS were installed to enhance training, the runway width would need to increase to 100 feet. The 100-foot width would also allow the runway to be used by charter and other commercial aircraft up to Group III (B-737, MD-80).

4.2.3 Pavement Strength

Runway pavement strength can be expressed as single-wheel loading, dual-wheel loading, and dual-tandem wheel loading. The aircraft gear type and configuration dictate how the aircraft weight is distributed on the pavement and determine pavement response to loading. Examination of typical gear configuration, tire contact areas, and tire pressure indicates that pavement strength is related to aircraft maximum takeoff weight.

The existing Runway 13-31 pavement consists of 12 inches of Portland Cement Concrete (PCC) over 12 inches of aggregate base course over 24 inches of granular subbase. The majority of the existing Runway 5-23 pavement consists of one inch of porous friction course, three inches of bituminous base course, and six to seven inches of aggregate base. The intersection of Runways 13-31 and 5-23, which was reconstructed when Runway 13-31 was widened, consists of the same pavement as Runway 13-31.

Runway 13-31 was designed to accommodate aircraft loadings of 75,000 pounds on single-wheel gear, 175,000 pounds on dual-wheel gear, and 280,000 pounds on dual tandem gear. Based on the aircraft gear loading, Runway 13-31 can accommodate the pavement loading imposed by those aircraft projected to use the runway over the planning period. Similarly, Runway 5-23 was designed to accommodate aircraft loadings of 50,000 pounds on single-wheel gear and 75,000 pounds on dual-wheel gear. This strength is adequate to accommodate nearly all general aviation and business aircraft that would be anticipated to use the runway over the planning period. It is also adequate for regional air carrier aircraft.

It should be emphasized that pavement design and assessment of structural capability require a detailed engineering analysis that includes consideration of forecast aviation activity and the projected aircraft fleet, including gear configuration and operating weights, among other variables. The need to strengthen and/or structurally rehabilitate aircraft pavement can be affected by a number of variables, including environmental conditions, actual activity/pavement loading relative to design assumptions, quality of initial construction, and materials used in construction. Pavement maintenance can also influence when strengthening or rehabilitation is required.

As presented in Chapter 2, *Airport Inventory*, maintenance costs for Runway 5-23 are projected to increase significantly based on the Pavement Condition Index, suggesting that rehabilitation of the runway will be necessary in the near future. This runway is not designed to accommodate significant levels of air carrier aircraft traffic. Consequently, if this runway were lengthened to accommodate additional and heavier aircraft, the pavement would require modification and strengthening to meet that demand.

The future GA training runway should serve small aircraft. The pavement section should be designed to accommodate that anticipated fleet, typically up to 12,500 pounds.

4.2.4 Taxiway System

The taxiway system at the Airport should provide for free movement of aircraft to and from the runways, terminal, and aircraft parking areas. It is desirable to maintain a smooth flow with a minimum number of changes required in an aircraft's taxiing speed.

FAA design criteria detailed in FAA Advisory Circular 150/5300-13, *Airport Design*, provide the basis for defining the taxiway system requirements. Specific criteria in the Advisory Circular include the need to provide a full-length parallel taxiway to allow for the most efficient and safe movement of aircraft from the runway to the terminal area, crossfield taxiing capability and sufficient queuing areas, and high-speed runway exit taxiways to allow for final approach spacing of 2.5 nautical miles between arriving aircraft. Additional taxiway design principles, as stated in the Advisory Circular, include the following:

- Build taxiways to provide as direct a route as possible,
- Provide bypass capability or multiple access to runway ends,
- Minimize runway crossings,
- Provide ample curve and fillet radii,
- Provide ATCT line of sight to the edge of pavement in the movement area, and
- Avoid traffic bottlenecks.

According to FAA design standards, taxiways are required to be 60 feet wide to accommodate ARC B-II aircraft (wheelbase greater than or equal to 60 feet) and 35-feet wide to accommodate ARC B-II aircraft.

Runway 13-31 has a full-length parallel taxiway (Taxiway A) with four exits. Taxiway A and the four exit/crossover taxiways are 60-feet wide with 20-foot shoulders, which meet FAA design criteria for facilities accommodating aircraft in ADG III that have a wheelbase greater than 60 feet. While the taxiways supporting Runway 13-31 meet FAA criteria, an additional taxiway exit should be provided at each of the new runway ends if the runway and taxiway are extended.

ARC C-III standards require taxiways to be 60-feet wide (for C-III aircraft with wheelbases equal to or greater than 60 feet). Runway 5-23 has a full-length parallel taxiway (Taxiway D) with two runway exits. Taxiway D serves the terminal area from Runway 13-31 and is 60-feet wide in this area. This is adequate for the Group III commercial passenger aircraft currently using the Airport. The exit taxiways, D1 and D2, are 50 feet and 60 feet wide, respectively. (These taxiways currently meet ARC B-II width standards which is adequate for aircraft using and exiting from Runway 5-23.) However, upgrade of this runway will require widening the taxiways to meet FAA criteria. Any extension to Runway 5-23 should be accompanied by an extension to Taxiway D, as well as by the addition of one or more taxiway exits from the runway, depending on the ultimate configuration of the airfield.

A parallel taxiway should be constructed to serve the future GA training runway at the time that the runway is constructed. It should meet B-II standards for width and ARC C-IV standards runway-to-taxiway separation in order to avoid facility relocations if this runway upgraded beyond the 20-year planning horizon.

4.2.5 Airfield Safety Areas

This subsection presents the FAA's and the Minnesota Department of Transportation's standards for the various airfield safety areas, as they relate to St. Cloud Regional Airport. The following airfield safety areas were evaluated (all are FAA requirements, except where noted):

- Runway safety area
- Runway object free area
- Obstacle free zone
- Runway protection zone
- FAR Part 77 surfaces
- MnDOT safety zones

4.2.5.1 Runway Safety Area

A Runway Safety Area (RSA) is a rectangular area centered on a runway centerline, and is defined by the FAA as "a surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot or excursion from the runway." The FAA has outlined strict guidelines on functions and criteria allowed within RSAs, which are defined as being (1) cleared and graded; (2) free of objects, except those that are required because of their function (approach lighting, navigational aids, etc.); (3) drained by grading or storm sewers to prevent water accumulation; (4) capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and fire fighting (ARFF) equipment, and an occasional aircraft without inflicting structural damage to the aircraft; and (5) free of underground fuel storage facilities. The most recent revisions to FAA Advisory Circular 150/5300-13, *Airport Design,* states that, "RSA standards cannot be modified or waived like other airport design standards. The dimensional standards remain in effect regardless of the presence of natural or man-made objects or surface conditions that might create a hazard to aircraft that leave the runway surface." The FAA provides different dimensional criteria for RSAs that are directly related to the critical ADG aircraft and the Aircraft Approach Category associated with each runway.

Based on FAA design criteria, the RSA for ARC C-III runway is required to be 500 feet wide, centered on the runway centerline, and to extend 1,000 feet beyond each runway end. The RSA for Runway 13-31 meets FAA dimensional criteria and remains within existing Airport boundaries.

The RSA for an ARC B-II visual runway is required to be 150 feet wide, centered on the runway centerline, and to extend 300 feet beyond each runway end. As a current B-II runway, the RSA for Runway 5-23 meets FAA dimensional criteria and remains within existing Airport boundaries. However, the future upgrade and extension of this runway to meet ARC C-III criteria will correspondingly increase the size of the RSA.

The future GA training runway should meet the criteria for a precision instrument approach runway since it would be equipped with an ILS. The RSA would need to be 300 feet wide, centered on the runway centerline, and extend 600 feet beyond the runway end.

4.2.5.2 Runway Object Free Area

A Runway Object Free Area (ROFA) is a rectangular area centered on a runway centerline, and is defined by the FAA as "an area on the ground provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located for air navigation or aircraft ground maneuvering purposes." Objects that are nonessential for either air navigation or aircraft ground maneuvering are not permitted within the ROFA. Similar to RSAs, the FAA provides different dimensional criteria for ROFAs based on the critical ADG aircraft and the Aircraft Approach Category associated with each runway.

As a current B-II runway with visual approaches. Runway 5-23 requires a ROFA that is 500 feet wide and extends 300 feet beyond the runway end. An upgrade of the ROFA is required because the existing is only 250 feet in width. Similarly, a future upgrade of this runway to meet ARC C-III standards will require a corresponding change in the ROFA dimensions to 800 feet wide and 1,000 feet beyond each end of the runway.

The future GA training runway, a B-II facility, with a precision approach, would require a ROFA that is 800 feet wide and extends 600 feet beyond the runway ends.

For runways that are visual and are categorized as B-II, the ROFA must be 500-feet wide, centered on the runway centerline, and extend 300 feet beyond each runway end. The ROFA for Runway 5-23 is 250-feet wide and needs to be increased to meet FAA criteria.

4.2.5.3 Obstacle Free Zone

An Obstacle Free Zone (OFZ) is a volume of airspace centered on a runway centerline, and is defined by the FAA as "the airspace below 150 feet above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible NAVAIDS that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from a runway, and for missed approaches." The OFZ is intended to protect an aircraft's transition from ground to airborne operations. Airports with non-precision runway approach procedures are only required to comply with the runway component of the OFZ criteria, while airports with precision instrument approach procedures or approach lighting systems are required to comply with additional area components. FAA criteria prohibit taxiing, parked aircraft, and object penetrations, except frangible NAVAIDs with fixed locations, within OFZs.

- ***Runway OFZ****:* The runway OFZ is a volume of airspace centered above the runway that supports the transition of ground to airborne aircraft. In general, the required runway OFZ is typically 400-feet wide for runways serving large aircraft and 250-feet wide for non-precision and visual approach runways serving smaller aircraft. All OFZs extend 200 feet beyond the runway ends lengthwise. Based on these factors, the runway OFZ for Runway 13-31, a precision instrument approach runway, should be 400 feet wide. The runway OFZ for Runway 5-23, a non-precision approach runway, should also be 400 feet wide, as this runway is not limited to small aircraft as defined by the FAA (less than 12,500 pounds takeoff weight). The future GA training runway would be limited to small aircraft training activity, but would be equipped with a precision instrument approach, thus the runway OFZ should be 400 feet wide.
- ***Precision OFZ****:* The precision OFZ is defined as a volume of airspace above an area beginning at the runway threshold, at the threshold elevation, and centered on the extended runway centerline, extending 200 feet beyond the runway end by 800 feet wide. The surface is only in effect when all of the following operations conditions are met (1) vertically guided approach; (2) reported ceiling below 250 feet and/or visibility less than ¾-statute mile; and (3) an aircraft on final approach within two miles of the runway threshold.

- ***Inner-Approach OFZ:*** The inner-approach OFZ is a volume of airspace centered on the approach area that applies only to runways with approach lighting. Thus, at St. Cloud Regional Airport, this currently only applies to Runway 13–31 (both ends). The inner-approach OFZ begins 200 feet from the runway threshold and extends 200 feet beyond the last unit in the approach lighting system. The inner approach OFZ has the same width as the runway OFZ and rises at a slope of 50:1 away from the runway end. If Runway 5-23 or the future training runway were to be equipped with approach lighting these would need to meet the same criteria.
- ***Inner-Transitional OFZ:*** The inner-transitional OFZ is a defined volume of airspace along the sides of the runway and inner-approach OFZs. It applies only to runways with approach visibility minimums lower than ¾-statute mile. The ILS for Runway 31 has a ½-statute-mile approach visibility minimum. The VOR/DME approach for Runway 13 has a ½-statute-mile approach visibility minimum. If the future GA training runway were to be equipped with a precision approach allowing approach visibility minimums lower than ¾ mile, it would need to meet these requirements.

4.2.5.4 Runway Protection Zone

A Runway Protection Zone (RPZ) is a trapezoidal area centered on an extended runway centerline, and is defined by the FAA as "an area off the end of a runway to enhance the protection of people and property on the ground." To achieve this goal, the FAA recommends that an airport operator either own or acquire the appropriate interest in the property in an RPZ through acquisition of an avigation easement to ensure control of the property within the RPZ. This area should be free of land uses that create glare and smoke that may interfere with pilots' view or cause distraction during approach procedures. Also, the FAA recommends that airport operators keep the RPZs clear of incompatible land uses, specifically residences and places of public assembly (e.g., churches, schools, office buildings, shopping centers) and fuel storage facilities. Similar to RSAs and ROFAs, the FAA provides dimensional criteria for RPZs that are based on runway approach visibility minimums and the ADG associated with each runway. All RPZ trapezoids begin 200 feet beyond the threshold of a runway.

For runways with approach visibility minimums lower than ¾-statute-mile, the RPZ dimensions are 1,000 feet wide at the closest end of the runway (inner width), 1,750 feet wide at the end farthest from the runway end (outer width), and 2,500 feet long. For runways with visual approaches and approach visibility minimums not lower than 1-statute mile, the RPZ dimensions for facilities expected to serve aircraft in Approach Categories C and D include an inner width of 500 feet, an outer width of 1,010 feet, and a length of 1,700 feet.

The RPZ for each runway end at the Airport, as well as any obstructions that may exist, are discussed below.

- ***Runway 13:*** The Runway 13 RPZ is based on the Airport's ½-statute-mile approach minimums to the runway, resulting in RPZ dimensions for a precision instrument approach to the runway. The majority of the existing RPZ is within Airport boundaries with the exception of a small piece of agricultural land north of the existing Airport property line. The City of St. Cloud currently owns an avigation easement for this property.
- ***Runway 31:*** The Runway 31 RPZ is based on the Airport's ½ statue-mile approach minimums to the runway, resulting in the same dimensions as the Runway 13 RPZ. The

majority of the RPZ is within Airport boundaries with the exception of small pieces of agricultural land southwest of the Airport. The City of St. Cloud currently owns an avigation easement for this property.

- ***Runway 5****:* The Runway 5 RPZ is based on the Airport's 1-statute mile approach minimum to the runway, resulting in RPZ dimensions for a non-precision instrument approach to the runway. The RPZ is wholly within Airport boundaries and under Airport control. The upgrade of this runway, if it involved an adjustment in approach minimums, would require the upgrade of the RPZ.
- ***Runway 23****:* The Runway 23 RPZ is based on the Airport's 1-statute mile approach minimum to the runway, requiring the same RPZ dimensions as the Runway 5 RPZ. The majority of the RPZ is within Airport boundaries with the exception of a small piece of agricultural land east of the Airport. The upgrade of this runway, if it involved an adjustment in approach minimums, would require the upgrade of the RPZ.
- ***Future GA training runway:*** The future GA training runway RPZ would be based on the approach minimums. For a visual approach it would be comparable to Runway 5-23; however, if an ILS were installed, it would need to meet the requirements for a precision instrument approach.

4.2.5.5 FAR Part 77 Primary, Transitional, and Approach Surfaces

The FAR Part 77 primary surface is longitudinally centered on a runway and extends 200 feet beyond each runway end. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.

The FAR Part 77 transitional surface extends upward and outward from the primary surface and approach surfaces perpendicular to the runway centerline. These surfaces rise at a slope of seven (horizontal) to one (vertical) to an elevation of 150 feet above the established Airport elevation of 1,031 feet above mean sea level.

The FAR Part 77 approach surface is longitudinally centered on the extended runway centerline and extends outward and upward from each end of the primary surface. An approach surface is applied to each end of each runway based on the type of approach available or planned for that runway end. The inner edge of the approach surface is the same width as the primary surface.

4.2.5.6 Minnesota Department of Transportation Safety Zones

In addition to FAA RPZ requirements, the Minnesota Department of Transportation specifies dimensions for land use safety zones. There are three safety zones with varying dimensions and land use restrictions, as defined by MnDOT in *Minnesota Aeronautical Rules*, Chapter 8800.

Safety Zone A extends outward from the end of the primary surface and is equal to a distance of two-thirds of the runway length or planned runway length. Zone A must not contain any buildings or temporary structures, and is restricted to those uses that will not create, attract, or bring together an assembly of persons. Typical uses for Zone A include agriculture, cemeteries, and automobile parking.

Safety Zone B extends outward from Safety Zone A to a distance equal to one-third of the runway length or planned runway length. Zone B land uses are restricted to a site with an area not less than three acres and that does not create, attract, or bring together a site population that would exceed 15 times that of the site acreage. Zone B sites cannot have more than one building plot on which any number of structures may be constructed.

Safety Zone C includes all the land enclosed within the horizontal zone of the Airport that is not included in Zone A or B. Zone C land use is limited to that which will not (1) create or cause interference with the operation of radio or electronic communications between the airport and aircraft, (2) make it difficult for pilots to distinguish between airport lights and other lights, (3) result in glare in the eyes of pilots using the airport, (4) impair visibility in the vicinity of the airport, or (5) otherwise endanger the landing, taking off, or maneuvering of aircraft.

4.2.6 Navigational Aids

Air-to-air and ground navigation or navigational aid requirements for St. Cloud Regional Airport are based on recommendations contained in FAA Advisory Circular 150/5300-13, *Airport Design*.

The distinction between a precision and non-precision NAVAID is that the former provide electronic descent (vertical) and alignment (horizontal) guidance, while the latter provide only alignment guidance. An airport is equipped with either precision or non-precision capability based on safety considerations and airport operational requirements. The type and volume of aeronautical activity used in association with meteorological airspace and capacity data determine an airport's eligibility and need for various NAVAIDs.

The existing instrumentation and lighting systems at St. Cloud Regional Airport are summarized in Chapter 2, *Airport Inventory*. For this Master Plan, required NAVAIDs are divided into three general categories: terminal area NAVAIDs, electronic approach NAVAIDs, and visual approach NAVAIDs. These three categories of NAVAIDs are discussed in the following sections.

4.2.6.1 Terminal Area NAVAIDS

NAVAIDs classified in this category provide positive control to aircraft and expedite and maintain an orderly flow of air traffic within a specified area. Terminal area NAVAIDs are provided to prevent collisions between aircraft in landing and takeoff configurations, as well as to allow for sufficient maneuvering time. Terminal area NAVAIDs at the Airport include the Airport traffic control tower (ATCT).

The ATCT is responsible for approach control for both arrivals and departures during its hours of operation. The Minneapolis Air Route Traffic Control Center (ARTCC) provides en route control for aircraft to and from St. Cloud Regional Airport. It is expected that the ATCT will be adequate to serve air traffic demand at St. Cloud Regional Airport through the planning period.

4.2.6.2 Electronic Approach NAVAIDs

This category of NAVAIDs assists the pilot performing instrument approaches to an airport. An instrument approach is a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight from the beginning of its initial approach to its landing, or to a point from which a landing may be made visually.

Electronic approach NAVAIDs include an ILS that allows pilots to land aircraft in poor visibility conditions. The ILS consists of a glide slope antenna that provides vertical guidance and a localizer antenna that provides horizontal alignment guidance to the pilot. During conditions of low visibility or low ceiling, delays can result because the aircraft arrival rate is reduced. As the Airport's operations continue to grow in the future, it will become more important to maintain high arrival rates and minimize delay during all weather conditions.

A Category I ILS is programmed for installation to support precision approaches to Runway 13. Installation of the localizer and glide slope antennas is tentatively planned in 2005, with commissioning of the ILS in 2006. Although a runway visual range (RVR) facility, which provides readings of horizontal visibility on the airfield, had been programmed for the Airport, to be funded with State airport funds, the facility has not been installed as of this time. To enhance pilot training the future training runway should be equipped with a precision approach and PAPIs.

4.2.6.3 Visual NAVAIDS

Visual NAVAIDs provide aircraft guidance once the pilot has sight of the Airport, and supports aircraft maneuvering on the ground. Numerous visual NAVAIDs are available at St. Cloud Regional Airport:

- Precision approach path indicator (PAPI) - Runways 13 and 31
- High intensity runway lighting (HIRL) - Runway 13-31
- Medium intensity runway lighting (MIRL) - Runway 5-23
- Runway end identifier lights (REILs) - Runways 13 and 31
- Medium intensity taxiway lighting (MITL) - Taxiways A, C, and F
- Lighted wind indicator
- Rotating beacon

Given that an ILS is programmed for Runway 13 and that an RVR facility is planned (although not currently programmed), the NAVAIDs at the Airport are generally adequate for the aviation activity anticipated over the planning period. The installation of a PAPI on Runways 5 and 23 is recommended as a safety enhancement, particularly given the level of training activity that occurs at the Airport. A PAPI provides a visual indication to a pilot of the aircraft's approach position relative to the runway's defined approach path. It is recommended that both ends of Runway 5-23 be equipped with a Category I ILS to allow full use of the runway for flight training and, after the runway is extended, for commercial activity.

4.3 Passenger Terminal Area Facilities

Terminal facility requirements are a function of the unique characteristics of an airport and the area it serves. These characteristics include passenger numbers, the airlines serving the airport, the airline operating requirements, and local factors, such as the number of visitors and area climate. Forecasts of scheduled enplaned passengers and aircraft operations were developed to estimate the need for and size of incremental expansions to the terminal building, to identify modifications to the terminal area, and to identify the time frames in which these developments should occur.

For this analysis, annualized forecast data were considered, with emphasis on the peak hour passenger activity, as discussed in Chapter 3, *Aviation Demand Forecasts*. These forecasts provide demand levels applicable for use in terminal area and terminal building planning.

For purposes of this analysis, terminal area facilities for St. Cloud Regional Airport are discussed for the following categories of use:

- Passenger terminal building
- Terminal aircraft parking and apron areas
- Terminal access roadway and curbfront
- Public parking
- Employee parking
- Rental car parking/staging

4.3.1 Passenger Terminal Building

Facility requirements analyses and general planning concepts are important elements in determining the ability of the existing passenger terminal building to accommodate current and increased future demand. The long-term plan for terminal building and surrounding area development should establish a workable infrastructure that will accommodate gate use and facilitate incremental expansion.

The existing passenger terminal building does not satisfy current peak-period demand because of changes in terminal design and operations criteria, and specifically, the need to accommodate a security checkpoint. Design of the existing terminal building was initiated in 1994. At that time, enplaning passengers at the Airport were not screened. Instead, passengers went through security screening when they deplaned at Minneapolis-St. Paul International Airport ("reverse screening"). The terminal building was designed to accommodate two airlines using 19-seat Metro III and 37-seat Dash 8 aircraft, by including mirror image passenger processing facilities in the terminal building. A central commons area was designed to accommodate passengers plus well-wishers and meeters/greeters (i.e., those accompanying departing passengers and meeting arriving passengers, respectively).

With the heightened security screening regulations in the early 2000s, the need to accommodate a security checkpoint at the Airport was met by establishing a screening area, which created a secured holdroom separate from the commons area that currently functions as a combined ticketing and baggage claim lobby. The area accommodating the security checkpoint has insufficient depth to accommodate the equipment and queuing space necessary to accommodate current security screening demand and consequently occupies a portion of the commons area. As a result, during peak-demand periods, such as the occasional charter departure, the security checkpoint queue backs up into the commons area and extends to the terminal entry door, severely compromising the ticketing lobby circulation area. As passenger traffic increases the Airport Manager should coordinate with the Transportation Security Administration's Federal Security Director to identify physical or operational modifications that can increase passenger screening throughout.

The existing terminal building was designed to accommodate incremental expansion through the addition of gates and holdrooms in areas now located behind the security checkpoint. The terminal building layout does not allow for improvements to the ticket lobby circulation area or to the security checkpoint to meet current landside space demands.

An initial analysis of terminal building space requirements was conducted based on gross space estimates in FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities.* For airports with less than 250,000 annual enplaned passengers, the FAA recommends a planning factor of 150 square feet per peak-hour passenger as an order-of-magnitude space planning factor; for airports with more than 250,000 annual enplaned passengers (as the Airport is forecast to have in the Low Cost Carrier Scenario by SL 4), the FAA recommends 0.08 to

0.12 square foot per annual enplaned passenger. The generalized terminal building space requirements based on these planning factors are summarized in **Table 4-8.**

Table 4-8

Generalized Terminal Building Space Requirements – Preliminary Assessment

Forecast Scenario	Terminal Building Space Requirements (square feet)
PAL 1	6,000 – 8,000 [1/]
Baseline 2024	6,000 – 8,000 [1/]
PAL 2	35,600
PAL 3	7,200
SL 4	61,900

Note:

1/ In accordance with FAA Advisory Circular 150/5360-9, *Planning and Design of Airport Terminal Facilities at Nonhub Locations*, the minimum building area for a terminal building is 6,000 to 8,000 square feet.

Sources: FAA Advisory Circulars 150/5360-9, *Planning and Design of Airport Terminal Facilities at Nonhub Locations* and 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities.*

Prepared by: Ricondo & Associates, Inc.

The existing terminal building occupies approximately 9,505 square feet. The various activity scenario forecasts all include growth in annual enplaned passengers over 2004 numbers. Because the existing terminal building space is currently insufficient to accommodate peak demand, it is clear that the methodologies summarized in Table 4-8 do not adequately capture the space requirements. Given security screening needs and resulting effects on passenger level of service at St. Cloud Regional Airport, additional terminal space and/or a reallocation of functional terminal space is needed to provide an acceptable level of service. The relationship between enplaned passengers and square footage requirements weakens at activity levels below 250,000 annual enplaned passengers, as evidenced in Table 4-8. Consequently, terminal requirements must be assessed using alternative methodologies. To assess the terminal building's potential space deficiencies, a more detailed facility requirements analysis of the internal components of the terminal building was conducted. This terminal space requirements analysis provides an understanding of the specific terminal space needs and a quantitative evaluation of current terminal space deficiencies and surpluses.

Functionally, the physical layout of an airport passenger terminal must accommodate a sequence of events that passengers encounter when traveling on commercial airlines, including charter and commuter flights (i.e., ticketing, security, holdroom, and aircraft gates). The key functional areas are appropriately located to separate passenger flow within the existing terminal building; however, the space allocated to these functional areas is insufficient given security screening queues that compromise public circulation in the ticketing lobby and the limited holdroom capacity beyond the security screening checkpoint.

Table 4-9 details the current functional areas of the terminal building and the space dedicated to those areas. The table also presents the forecast terminal space requirements by functional area, based on standard terminal planning factors and passenger forecast data (e.g., peak hour and annual passenger activity) specific to the area's function.

Table 4-9
Terminal Building Existing Area and Future Requirements by Functional Area

		Future Area Requirements (square feet)				
Activity	Existing Area (square feet)	PAL 1	Baseline 2024	PAL 2	PAL 3	SL 4
Airline						
Ticketing	525	380	380	950	570	3,800
Baggage Handling	510	500	1,500	1,200	3,000	4,500
Operations	345	700	700	1,000	1,300	3,500
Baggage Claim	590	700	700	1,260	700	7,500
Holding/Boarding Area	445	910	1,450	2,720	2,380	7,040
Subtotal	2,415	3,190	4,730	7,130	7,950	26,340
Public Area						
Circulation Area	1965	2,100	2,600	3,500	3,600	11,800
Restrooms	550	1,100	1,100	1,600	1,100	3,800
Subtotal	2,515	3,200	3,700	5,100	4,700	15,600
Concessions						
Food Service/Vending	1,055	700	700	700	700	5,300
News, Gift	0	0	0	150	150	300
Rental Car	1,580	520	520	520	520	1,030
Subtotal	2,635	1,220	1,220	1,370	1,370	6,630
Administrative						
Subtotal	860	860	860	860	860	1,010
Utilities						
Subtotal	705	1,500	1,700	2,300	2,400	7,900
Government – TSA						
Subtotal	375	760	760	1,120	760	1,480
Total Building Area	9,505	10,730	12,970	17,900	18,040	58,960

Sources: Activity Factors – KRAMER aerotek, inc.; Ricondo & Associates, Inc.;
Programming Factors – FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities;* FAA Advisory Circular 150/5360-9, *Planning and Design of Airport Terminal Facilities at Nonhub Locations;* Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

The terminal building facility requirements were based on the following planning factors and assumptions, consistent with FAA guidance and industry standards. The facility requirements analysis was based on the assumption that in the near term the terminal building will be maintained as a single-level facility; however, consideration should be given to the operational efficiency of developing a dual-level facility in future terminal planning analyses, particularly when flight schedules include regular activity by larger commercial jets.

- ***Airline Space – Ticketing:*** Peak-hour departing passengers were assumed to arrive during a 30-minute window (except under the Charter Scenario, in which a 60-minute arrival window was assumed given the nature of charter operations) and were assumed to be processed at a rate of eight passengers per ticketing position per 15 minutes. A minimum of two ticketing positions would be provided. Linear frontage of ticket counters was estimated by assuming five linear feet per ticketing position and a depth of 38 feet per linear foot of ticket counter to accommodate the ticketing facilities as well as area for ticketing queue and lobby circulation.

- ***Airline Space – Baggage Handling**:* The required area was estimated based on the aircraft operated by each airline during the peak hour, considering space for baggage equipment/carts, and space for a conveyance system was considered where activity indicates its viability.
- ***Airline Space – Airline Ticketing Office (ATO)/Outbound Baggage Operations**:* ATO space was estimated as a 20-foot depth for the length of the ticket counter. Outbound baggage operations space was estimated as 500 square feet per airline.
- ***Airline Space – Baggage Claim**:* Baggage claim counter length would be required to support peak-hour arriving passengers per FAA guidance, assuming a minimum length of 20 feet. Baggage claim area was estimated at a depth of 35 linear feet per linear foot of claim counter, which would consist of a five-foot depth for the claim shelf, a 10-foot depth for baggage claim circulation, and a 20-foot depth for baggage claim lobby circulation.
- ***Airline Space – Holdrooms**:* The maximum number of persons in the holdroom was estimated based on assignment of appropriate load factors to seats available on peak hour flights. It was assumed that all passengers would be in the holdroom and each passenger requires an area of 15 square feet. An additional 400 square feet for an internal enplaning and deplaning corridor and check-in facilities per gate was also assumed.
- ***Public Space– Circulation Area**:* Area was estimated as 30 percent of the gross terminal area space.
- ***Public Space– Restrooms**:* Area for a bank of restrooms was estimated based on a planning factor of 1,500 square feet per 500 peak-hour passengers. Restroom banks would be a minimum of 550 square feet, consistent with existing facilities at St. Cloud Regional Airport. Banks of restrooms would be provided in both the secure and nonsecure areas of the terminal building.
- ***Concessions Space – Food Service**:* During each planning activity level, it was assumed that 100 square feet of vending space would be required. Area for food service and common dining area was estimated based on providing 0.01 square foot per annual enplaned passenger, with a minimum of 600 square feet provided.
- ***Concessions Space – News, Gift**:* Provide 150 square feet per concession, where activity justifies provision of this amenity**.**
- ***Concessions Space – Car Rental**:* It was assumed that two rental car companies would provide rental car services at the Airport in the Baseline, Charter, and Second Hub Scenarios, and that four rental car companies would provide service in the Low Cost Carrier Scenario. Each rental car company was assumed to have six linear feet of counter space. Office space and counter/employee circulation area was estimated for each at an eight-foot depth per linear foot of counter assuming a minimum of 150 square feet per office, with a 10-foot deep queuing area per linear foot of counter space.
- ***Administrative Space* –** The terminal building was assumed to accommodate one manager office at 180 square feet, a reception area at 150 square feet, and a conference room at 430 square feet for each activity scenario. Additional space for a second office (100 square feet) and an operations manager office (150 square feet) would be provided when justified by activity.

- ***Utilities Space –*** Space for mechanical, electrical, and other similar utilities was estimated as 15 percent of the gross terminal area space. Space for janitorial, storage, structural building components, and other similar area was estimated as five percent of the gross terminal area space.
- ***Government/TSA Space –*** Space to accommodate TSA security screening was based on the number of security screening positions needed to accommodate peak-hour departing passengers. Processing rates of 120 passengers per hour per screening position and 360 square feet per screening position were assumed. Administrative support space was estimated at 400 square feet for all planning activity scenarios.

Based on this terminal programming analysis, space in the existing terminal building will be deficient to support future passenger activity at St. Cloud Regional Airport. While general categories such as airline and public space indicate the greatest need for increased area, special consideration should be given to security screening and circulation area to ensure that future area layouts address peaking activity and do not degrade level of service to passengers as currently occurs during charter flights. Interim security checkpoint solutions could include use of queuing ropes to clearly segregate ticket queuing from security checkpoint queuing. Additionally, depending on the number of security screening positions the Transportation Security Administration equips and staffs, an internal reallocation of space between the current public circulation space and the holdroom could occur to improve passenger screening operations.

The Low Cost Carrier Scenario (SL4) produces the greatest need for increased terminal space to accommodate the significant increase in enplaned passengers under this forecast scenario. Specific terminal facility enhancements, such as baggage claim carousels, baggage make-up conveyors, and increased food service concessions, would be viable at the level of activity in this scenario. Additionally, a dual-level terminal facility could be warranted to improve building efficiencies with this scenario.

Notably, the terminal space requirements for the Charter Scenario (PAL2) reflect unsustained peaking of passenger activity that would occur under this scenario. Special consideration should be given to the level of service to be provided in this scenario. It may not be reasonable to provide capacity to serve the peak-hour passenger demand, which would result in a largely underutilized facility at most other times.

4.3.2 Terminal Aircraft Parking and Apron Areas

The existing terminal area apron is immediately adjacent to the southeast face of the passenger terminal building. It provides approximately 13,200 square yards of apron for air carrier and charter aircraft parking. The apron is 605 feet long by 196 feet deep, assuming an ADG III taxilane along the airfield side of the apron. If the taxilane is reclassified to accommodate ADG IV aircraft in the future, the apron depth would be reduced to 165 feet, and the apron area would be reduced to 11,100 square yards.

All passengers board aircraft at ground level, with no passenger loading bridges. There are currently two regional/commuter aircraft parking positions adjacent to the terminal building. Additional aircraft parking area is available for off-schedule operations.

Future terminal area apron requirements are programmed based on the number of aircraft to be accommodated on the apron during the peak hour of operations. Some of the positions identified below would likely be hardstand positions rather than terminal contact gates. Allowance for wingtip clearance between parked aircraft is 25 feet with a 25-foot clearance for aircraft maneuvering provided from the edge of pavement to the aircraft nose. Additional dimensional assumptions include:

- Turboprop (assuming a Saab 340): wingspan of 70.3 feet and length of 64.7 feet
- Regional Jet (RJ) (assuming a CRJ700): wingspan of 76.3 feet and length of 106.7 feet
- Narrowbody (assuming the largest dimension of two aircraft projected to serve the Airport – B-737-700 for wingspan and MD-80 for length): wingspan of 112.6 feet and length of 147.8 feet

Given these dimensional criteria, the terminal apron facility requirements are summarized in **Table 4-10.**

Table 4-10

Terminal Apron Facility Requirements

Forecast Scenario	Turboprop	Regional Jet	Narrow-body	Total Pavement Length Required (linear feet)	Minimum Pavement Depth Required (linear feet)
PAL 1	2			215	90
Baseline 2024		2		230	132
PAL 2	2		1	303	173
PAL 3		3		330	132
SL 4		2	2	453	173

Sources: Aircraft dimensions – Bombardier Aerospace, *Airport Planning Manual, Model CL-600-2C10*, Copyright 2000; Boeing Commercial Airplanes, *737-600/700/800/900 Airplane Characteristics for Airport Planning*, December 2001; Saab Aircraft of America, Inc., *Saab 340B Performance Planning Guide*, August 1990;
Analysis – Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

While the taxilane at the edge of the apron area remains classified as ADG III, the existing apron pavement provides sufficient depth to accommodate the projected peak-hour fleet. However, if this taxilane is reclassified as ADG IV in the future, the resulting apron depth of 165 feet would not provide 25 feet of nose clearance to the face of the building if an MD-80 were positioned perpendicular to the building face; however, the resulting apron depth is adequate given the ability to orient the aircraft differently or reduce the aircraft nose clearance. The length of the existing apron would accommodate the peak-hour aircraft over the 20-year planning period.

Although the apron may be physically able to accommodate additional aircraft during much of the 20-year planning period, any additional aircraft positions would not “contact” the terminal building given that the building currently provides 144 linear feet of apron frontage. Terminal expansion should allow for building apron frontage growth consistent with existing apron area and the ability to add gate positions.

4.3.3 Terminal Access Roadway and Curbfront

Ground access to the passenger terminal area at the Airport is provided via Del Tone Road to the on-Airport terminal road. The public parking lot is located in the middle of the terminal access loop roadway. This parking lot can be accessed from multiple points along the terminal access loop roadway. Because there is currently no charge for parking, there is no revenue control system.

The terminal's linear configuration influences the way that passengers and vehicles are distributed along the curbfront. The existing curbfront is a single-level system with one through lane and one curb lane directly in front of the terminal building. The existing terminal curbfront consists of a single enplaning and deplaning common-use curb at approximately 135 linear feet. **Table 4-11** shows expected future terminal curb length requirements based on peak-hour passenger characteristics. It was assumed that half of the peak hour passengers access the curbfront during the peak hour. The remainder of the peak-hour departing and arriving passengers would proceed directly to the parking lot. Some departing passengers would arrive at the Airport before the peak hour, and some arriving passengers may depart the Airport after the peak hour. Vehicle occupancy rates were conservatively estimated at one passenger per vehicle, and vehicles were distributed over the peak hour. The number of vehicles assumed to be at the curb during each five-minute increment over the peak hour was multiplied by an average vehicle length to estimate the curb length requirements for each scenario.

Table 4-11

Terminal Curb Length Requirements

Activity Scenario	Curb Length (linear feet)	Additional Curbfront Required (feet)
Existing 2004	135	-
PAL 1	23	-
Baseline 2024	30	-
PAL 2	204	69
PAL 3	36	-
SL 4	468	333

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

The existing curb length is projected to accommodate demand under PAL 1, Baseline 2024, and PAL 3 activity levels. Future terminal expansion under PAL 2 and SL 4 to accommodate charter or low cost carrier activity could meet the increased curbfront needs; however, if the terminal is not expanded along the loop roadway, providing direct terminal-curb interface, a covered sidewalk extending beyond the terminal building, or other method of providing shelter from the weather, could provide functional curbfront length needed to meet demand.

4.3.4 Public Parking

Currently, 273 parking spaces are available for public use at the Airport: 213 in the main lot and 60 in the west lot. Although detailed records are not kept regarding the number of vehicles parked at the Airport, it was assumed by Airport staff that the parking lot is typically more than half full. For the purpose of this analysis, it was assumed that the lot is typically 60% full, and an additional factor of 15 percent was added to allow for circulation and turnover of vehicles. When growth factors reflecting the peak-month average day (PMAD) enplaned passengers were applied to the Baseline Forecast, existing stalls were determined to meet demand at PAL 1 and a deficit of 52 spaces would occur under the Baseline 2024 activity level, as presented in **Table 4-12**. Under PAL 3, the deficit would increase to 100 spaces, and at PAL 2, it increases significantly due to the charter activity. The demand forecast for SL 4 under this methodology seems to significantly overstate demand. FAA AC 150-5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, also offers an alternative method to estimate parking requirements based on facilities at a number of domestic airports. Under this methodology for approximately 516,000 annual enplanements, parking demand would range from about 950 to 1,100 spaces. As a comparison, Sarasota-Bradenton Airport with 593,127 annual enplaned passengers in 2004 has 1,450 public parking spaces. St. Petersburg-Clearwater International Airport, with 562,250 annual enplaned passengers in 2004 has 1,377 public parking spaces, and Lubbock Preston Smith International Airport, with 527,889 annual enplanements in 2004 has 1,365 public parking spaces. Therefore, a figure of 1,400 was deemed a more appropriate number of public parking spaces for which to plan under SL 4.

Table 4-12

Public Parking Demand-Capacity Assessment

Activity Scenario	PMAD Enplaned Passengers	Projected Growth	Parking Demand (spaces)	Additional Parking Spaces Required
Existing 2004	74		208	-
PAL 1	82	12%	234	-
Baseline 2024	114	56%	325	52
PAL 2	210	188%	598	325
PAL 3	131	79%	273	100
SL 4	1,731	2271%	4,932	4,659
SL 4 Adjusted	1,731		1,400	1,192

Sources: FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*; KRAMER aerotek, inc., Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

It should be noted that this methodology estimates demand for the average day of the peak month, which may not provide adequate capacity to accommodate the maximum parking demand experienced at a few peak travel times during the year such as Christmas and Thanksgiving. As such, it is prudent for the city to plan for temporary overflow parking to service those few peaks.

4.3.5 Employee Parking

As shown in **Table 4-13,** employee parking represents a small percentage of the overall parking spaces required. Currently nine spaces are dedicated to employee parking. Future employee parking demand is expected to grow proportionally with the number of enplaned passengers. At PAL 2, employees may require as many as 17 parking spaces, when ticketing agents, ground handlers, and additional security personnel are included. For SL 4, which represents regularly scheduled service by a low cost carrier, 204 additional parking spaces would be required to meet the total demand of 213 spaces.

Table 4-13

Employee Parking Demand-Capacity Assessment

Activity Scenario	PMAD Enplaned Passengers	Projected Growth[1/]	Parking Demand (spaces)	Additional Spaces Required[2/]
Existing 2004	74		9	-
PAL 1	82	12%	10	1
Baseline 2024	114	56%	14	5
PAL 2	210	188%	26	17
PAL 3	131	79%	16	7
SL 4	1,731	2271%	213	204

Notes:
1/ The increase in future spaces is based on forecast growth as determined in Chapter 3.
2/ Requirement was based on nine employee parking spaces and current use of approximately 100 percent.

Sources: FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities;* KRAMER aerotek, inc., Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

4.3.6 Rental Car Parking/Staging

The demand for rental car parking was forecast to increase at the same rate as the growth in PMAD enplaned passengers from the existing conditions to future conditions under the various forecast scenarios. It was assumed that the rental car parking area would continue to operate as a shared use area and that current parking use is 100 percent of the 25 spaces available. The results of the demand-capacity assessment for rental car parking/staging are provided in **Table 4-14.** The table shows that the required number of rental car parking spaces is expected to increase to 28 at PAL 1, 72 at PAL 2, 45 under PAL 3, and 593 under SL 4. Requirements under the Charter Scenario may be overstated, as the majority of charters would originate in St. Cloud and those passengers would not require a rental car. Similarly the requirements of SL 4 may be overstated. St. Petersburg-Clearwater International Airport, with slightly more enplaned passengers than projected for the Airport under SL 4, has 191 rental car ready return spaces. Therefore, the number of rental car spaces to plan for under SL 4 was reduced to 225.

Table 4-14

Rental Car Parking Demand-Capacity Assessment

Activity Scenario	PMAD Enplaned Passengers	Projected Growth[1/]	Parking Demand (spaces)	Additional Spaces Required[2/]
Existing 2004	74		25	-
PAL 1	82	12%	28	3
Baseline 2024	114	56%	39	14
PAL 2	210	188%	72	47
PAL 3	131	79%	45	20
SL 4	1,731	2271%	593	568
SL 4 Adjusted	1,731		225	200

Notes:
1/ The increase in future year spaces was based on growth determined in Chapter 3.
2/ Requirement was based on 25 rental car parking spaces and current use of 100%.

Sources: FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*; KRAMER aerotek, inc., Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

4.4 General Aviation Facilities

This Master Plan includes a single forecast for general aviation operations. The short-term, medium-term and long-term forecast periods (to 2009, 2014, and 2024, respectively) for general aviation activity are incorporated in the planning activity levels, as follows:

- PAL 1 incorporates the general aviation short-term forecast (2009)
- PAL 2 incorporates the general aviation medium-term forecast (2014)
- PAL 3 and SL 4 incorporate the general aviation long-term forecast (2024)

As the general aviation facilities are independent of the variables presented in the various forecast scenarios (i.e., Baseline Forecast and Second Hub, Charter, and Low Cost Carrier Scenarios), it is reasonable to present the general aviation requirements in terms of the short-, medium-, and long-term forecast horizons.

General aviation facilities at the Airport include aircraft storage buildings and aircraft apron. Storage requirements for general aviation aircraft reflect local climatic conditions and the size and sophistication of the Airport's based aircraft fleet. Two types of storage buildings are in use at St. Cloud Regional Airport: conventional hangars and T-hangars. Based aircraft are not stored at tiedown facilities; however, a tiedown ramp is provided for transient aircraft.

4.4.1 Conventional Hangars and Associated Apron

Conventional hangar storage requirements were estimated based on the area needed to support the forecast number of based aircraft by aircraft type, given the average dimensions of aircraft by type (i.e., wingspan plus 10 feet for clearance and average aircraft length plus 10 feet for clearance). The resulting footprint of average dimensions by aircraft type was increased by 20 percent to account for additional space within the hangars for offices, maintenance area, equipment storage, and other uses. In addition, a development area allowance was included to account for such requirements as automobile parking for employees and customers, landscaping, building setbacks, and open area surrounding the building.

Conventional hangar apron space is required to allow aircraft room to maneuver into and out of hangar facilities. An average footprint to support each hangar was calculated based on aircraft wingspan multiplied by aircraft length, including a 10-foot clearance and one half of the taxiway object free area for the full width of the apron, including clearances. This calculation included a development area allowance as well. It was assumed that conventional hangars would be positioned in rows that share a common taxiway.

Estimated hangar storage requirements and apron area are presented in **Table 4-15.** It should be noted, however, that if the fleet mix or operations at the Airport change significantly, additional conventional hangar space could be required.

Existing conventional hangar facilities at St. Cloud Regional Airport encompass approximately 5.7 acres. Given the forecast growth in corporate and general aviation activity, additional hangar and supporting aircraft parking ramp will be required over the planning period. Approximately 0.3, 0.7, and 1.2 acres of additional conventional/corporate hangar development would be required over the short-term, medium-term, and long-term, respectively. It should be noted that additional area could be required if new tenants opt to develop new hangars rather than store aircraft in existing facilities.

Table 4-15

Conventional Hangar and Apron Space Requirements

	PAL 1 (Short-Term)	PAL 2 (Medium-Term)	PAL 3/SL 4 (Long-Term)
	2009	2014	2024
Multi-engine Piston			
Number of Based Aircraft	9	10	11
Hangar Development Area (sq ft)[1/]	47,345	52,605	57,866
Apron Development Area (sq ft)	81,000	90,000	99,000
Subtotal (sq ft)	128,345	142,605	156,866
Subtotal (acres)	2.9	3.3	3.6
Jets			
Number of Based Aircraft	5	5	6
Hangar Development Area (sq ft) [1/]	41,175	43,597	48,038
Apron Development Area (sq ft)	63,240	66,860	73,780
Subtotal (sq ft)	104,415	110,457	116,818
Subtotal (acres)	2.4	2.5	2.7
Helicopters[21]			
Number of Based Aircraft	2	2	2
Hangar Development Area (sq ft) [1/]	11,314	11,314	11,314
Apron Development Area (sq ft)	16,000	16,000	16,000
Subtotal (sq ft)	27,314	27,314	27,314
Subtotal (acres)	0.6	0.6	0.6
Total (sq ft)	260,074	280,376	300,998
Total (acres)	6.0	6.4	6.9
Existing Acres	5.7	5.7	5.7
Additional Acres Required	0.3	0.7	1.2

Notes:

1/ Includes allowance for office space and for automobile parking, landscaping, building setbacks, and open area surrounding the building.

2/ Number of based helicopters does not include those projected at the future Minnesota Air National Guard base.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

4.4.2 T-Hangars and Associated Apron

Future T-hangar space requirements for the Airport were estimated based on the average square-footage per unit of existing T-hangars and their associated storage sheds by aircraft type. A development area allowance was included to account for such area requirements as automobile parking, landscaping, building setbacks, and open area surrounding the building.

T-hangar apron is required to allow aircraft room to maneuver into and out of hangar facilities. An average footprint to support each hangar was calculated based on aircraft wingspan and aircraft width, including a 10-foot clearance, out to one half of the taxilane object free area, and also includes a development area allowance. It was assumed that T-hangars would be positioned in rows that share a common taxilane.

Estimated T-hangar storage and apron requirements over the planning period are presented in **Table 4-16.**

Table 4-16

T-Hangar and Apron Space Requirements

	PAL 1 (Short- Term)	PAL 2 (Medium-Term)	PAL 3/SL 4 (Long-Term)
	2009	2014	2024
Single-engine Piston			
Number of Based Aircraft	87	92	101
Hangar Development Area (sq ft)[1/]	159,420	168,790	185,990
Apron Development Area (sq ft)	481,190	509,490	561,380
Subtotal (sq ft)	640,610	678,280	747,370
Subtotal (acres)	14.7	15.6	17.2
Multi-engine Piston			
Number of Based Aircraft	1	1	1
Hangar Development Area (sq ft)[1/]	1,840	1,840	1,840
Apron Development Area (sq ft)	6,750	6,750	6,750
Subtotal (sq ft)	8,590	8,590	8,590
Subtotal (acres)	0.2	0.2	0.2
Total (sq ft)	649,200	686,870	755,960
Total (acres)	14.9	15.8	17.4

Note:

1/ Includes allowance for office space and for automobile parking, landscaping, building setbacks, and open area surrounding the building.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Existing T-hangar development at the Airport encompasses approximately nine acres. Given the forecast growth in general aviation activity at the Airport, additional T-hangar development and associated aircraft taxilanes would be required over the planning period. Approximately 6, 7, and 8 acres of additional T-hangar development would be required over the short term, medium-term, and long-term, respectively.

4.4.3 Transient Aircraft Apron

Area businesses and industries and the availability of maintenance and FBO services attract transient aircraft to the Airport. The Airport accommodates transient aircraft with tie-down facilities at the FBO apron. The number of tie-down positions used by transient aircraft was calculated based on the existing relationship of itinerant operations to tie-down positions and the forecast of itinerant general aviation operations. Future transient aircraft apron requirements were estimated using a planning factor recommended for tie-down positions in FAA Advisory Circular 150/5300-13, *Airport Design*, plus 25 percent for aircraft circulation.

In addition to transient aircraft requirements, FAA guidelines recommend that tie-down positions be provided for all based aircraft not stored in hangar facilities. As a result of the climatic conditions at St. Cloud Regional Airport, all based aircraft at the Airport are currently stored in hangars.

Transient aircraft apron requirements are presented in **Table 4-17.**

Table 4-17
Transient Aircraft Apron Requirements

	PAL 1 (Short-Term)	PAL 2 (Medium-Term)	PAL 3/SL 4 (Long-Term)
	2009	2014	2024
Number of Transient Aircraft requiring Tie-down Facilities	46	50	57
Total Area Requirement (sq ft)	186,330	201,660	231,733
Total Area Requirement (acres)	4.3	4.6	5.3

Sources: FAA Advisory Circular 150/5300-13, *Airport Design;* Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

The existing transient aircraft parking apron encompasses approximately 70,000 square feet (1.6 acres). Forecast growth in activity by transient aircraft indicates that an additional 2.7, 3, and 3.7 acres of transient aircraft parking space would be required over the short-term, medium-term, and long-term, respectively.

4.5 Support Facilities

Ancillary facilities needed to support Airport operations were also identified. Requirements were developed for the following support areas:

- Aircraft rescue and fire fighting (ARFF)
- Airport traffic control tower
- Airport maintenance facility and snow removal equipment
- Fuel farm

4.5.1 Aircraft Rescue and Fire Fighting (ARFF)

The Airport is classified under the recently revised Federal Aviation Regulation (FAR) Part 139, *Certification of Airports*, as a Class I airport. A Class I airport serves scheduled large air carrier aircraft (30+ seats), unscheduled or charter large air carrier aircraft, and scheduled small air carrier aircraft (10-30 seats).

The ARFF Index (discussed in Chapter 2), which outlines the detailed requirements for fire-fighting equipment, is based on the length of the largest air carrier aircraft serving an airport with at least five daily departures. The Airport is an Index A facility, as the current primary air carrier aircraft is a Saab 340, which is less than 90 feet long. The ARFF Index defines certain requirements that must be met for fire fighting equipment and personnel.

To accommodate the increase in activity anticipated under the Baseline Forecast, either at PAL 1 or in 2024, there would be no change in the projected fleet mix, so the ARFF requirements would not change. No changes would be required for the PAL 3 because a similar fleet mix of aircraft (small air carrier) to those operating at the Airport today would be expected. At PAL 2, longer aircraft would serve the Airport, and therefore the ARFF Index may have to increase depending on the number of daily departures of larger aircraft. Most MD-80 and B-737 aircraft identified for use under the Charter Scenario are classified as Index B aircraft for FAR Part 139 purposes, so the ARFF Index would also have to be Index B. At SL 4 the Airport would require at least ARFF Index B, and potentially Index C, to meet the ARFF specifications for aircraft such as the A321, A310, and MD-

87. This Index would necessitate the acquisition or replacement of fire-fighting equipment to meet the ARFF operational requirements.

The other consideration is response times for emergency vehicles. At least one ARFF vehicle must be able to respond from the ARFF station to the mid-point of the furthest runway served by air carriers within three minutes of alarm. The proximity of the station currently provides adequate response times. It is anticipated that the ARFF station's centralized location on the terminal ramp will continue to be conducive to meeting ARFF vehicle response times throughout the 20-year planning period.

4.5.2 Airport Traffic Control Tower

The ATCT opened in November 2004. It is located southeast of the intersection of Runway 13-31 and Runway 5-23, and is open daily from 7:00 a.m. until 11:00 p.m. The ATCT currently has no radar. Radar would be desirable to serve increased activity particularly with the mix of flight school and commercial traffic that the Airport serves. The physical facility will meet the needs for air traffic control in the region well into the future. Increased flights, such as by charters, commuters, or low cost carriers associated with the forecast scenarios may dictate the need to extend the ATCT hours of operation.

4.5.3 Airport Maintenance Facility and Snow Removal Equipment

The Airport's maintenance facility and Snow Removal Equipment (SRE) building is located in the general aviation T-hangar area. This building houses snow removal and any other equipment necessary for the efficient and safe maintenance of the Airport. The building has recently been expanded to approximately 13,500 square feet.

Information on Airport maintenance buildings provided in FAA Advisory Circular 150/5220-15, *Buildings for Storage and Maintenance of Airport Snow Removal and Ice Equipment: A Guide*, indicates that maintenance building needs are related to paved areas, activity levels, and climate. Increases in runway, taxiway, and apron pavement, in addition to increased activity levels, would result in the need to provide additional maintenance building space. Additional space was estimated by providing an additional 4,500 square feet, comparable to the area of the recently completed expansion.

4.5.4 Fuel Farm

Fueling services are provided by the FBOs that own and operate two 12,000-gallon underground fuel storage tanks that fulfill the current fueling needs for aircraft activity. One tank stores Jet-A fuel for jet and turbo-prop aircraft, and the other tank stores 100LL avgas. As shown in **Table 4-18**, in 2004, 523 gallons of 100LL avgas were dispensed during an average day of the peak month, whereas 1,656 gallons of Jet A fuel were dispensed during the same period. As the consumption of Jet A fuel is more rapid, a full tank would provide approximately six days of fuel at existing demand and approximately two days of fuel for demand at SL 4. Typically, maintaining a five-day fuel supply is considered reasonable in facility planning.

Table 4-18

Fueling Demand and Requirements

	2004			PAL 1		Baseline 2024		PAL 2		PAL 3		SL 4	
	Operations	Planning Factors [1/]	Demand (gallons)	Operations	Demand (gallons)	Operations	Demand (gallons)	Operations	Demand (gallons)	Operations	Demand (gallons)	Operations	Demand (gallons)
Air Carrier (annual) [2/]	-	160	-	-	-	-	-	86	13,760	-	-	9,018	1,442,880
Air Carrier (PMAD) [2/]	-	160	-	-	-	-	-	1	160	-	-	30	4,800
Commuter/Regional (annual) [3/]	3,704	25	91,471	3,330	82,235	3,330	82,235	3,682	90,928	4,376	108,066	5,871	144,985
Commuter/Regional (PMAD)	12	25	303	11	278	11	278	12	303	15	379	20	505
General Aviation (annual)	76,873	6	483,073	85,800	539,171	106,990	672,329	92,890	583,724	106,990	672,329	106,990	672,329
General Aviation (PMAD) [4/]	283	8	2,179	316	2,434	393	3,027	342	2,634	393	3,027	393	3,027
100LL (24% of GA PMAD)		2	523		584		726		632		726		726
Jet-A (76% of GA PMAD)		6	1,656		1,850		2,300		2,002		2,300		2,300
Fuel Capacity (gallons)													
100LL	12,000												
Jet-A	12,000												
Fuel Demand (gallons in PMAD)													
100LL			523		584		726		632		726		726
Jet-A			1,959		2,127		2,578		2,465		2,679		7,605
Available Fuel Supply (days)													
100LL			23		21		17		19		17		17
Jet-A			6		6		5		5		4		2
Recommended Fuel Supply (days)			5		5		5		5		5		5

Notes:

1/ Planning factors for average fuel demand per operation were used for the analyses in gallons/operation.
2/ Planning factor of 160 gallons per operation was obtained from assumptions used for William P. Hobby Airport in Houston, where a low cost carrier is the primary air carrier on predominantly short- to medium-haul routes.
3/ Planning factor was based on Mesaba Jet A fuel records from November 2003 to October 2004.
4/ Split between 100LL and Jet A was calculated based on total fuel sales from November 2003 to October 2004.

Sources: KRAMER aerotek, inc.; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Over the planning period, it is anticipated that fuel storage capacity would need to increase in proportion to the number of operations and size of aircraft in the fleet. An additional storage supply will be necessary by PAL 1 and beyond to meet increased commuter/regional aircraft activity. The increase in charter flights under by PAL 2 and beyond, as well as the regularly scheduled service by larger jets at SL 4 and beyond, will significantly increase the demand for Jet-A fuel and the subsequent need for additional storage tanks, as shown in Table 4-18. Because FBOs provide fueling services for private and commercial aircraft, the tenants would add fueling facilities when future demand dictates.

4.6 Summary

Based on the facility requirements described in the previous sections, the following improvements are recommended for St. Cloud Regional Airport over the planning period through 2024:

- Extend Runway 13-31 by 1,000 feet to a total length of 8,000 feet to meet the demands of charter and air carrier operators, and to enhance safety during periods of snow/ice. At the same time, extend parallel Taxiway A and construct new runway exits.
- Extend and widen Runway 5-23 to provide operational capability and redundancy to accommodate commercial aircraft that currently operate solely on Runway 13-31. At the same time, extend parallel Taxiway D and construct new runway exits.
- Construct new 4,200-foot GA training runway and associated taxiways and instrumentation to segregate training activity from itinerant operations.
- Widen and strengthen Runway 5-23 to accommodate larger aircraft types that currently operate on Runway 13-31. These improvements would also include widening and strengthening the taxiways associated with Runway 5-23 and installing shoulders on Runway 5-23 to meet ARC C-III criteria at a minimum.
- Install PAPIs and a Category I ILS on both ends of Runway 5-23 to enhance safety for general aviation and student pilot training activity.
- Increase the object free area length beyond both ends of Runway 5-23, along with any clearing and/or grading that may be necessary to meet FAA standards.
- Mitigate off-Airport development and safety issues within the Runway 13 and Runway 31 arrival RPZs.
- Incrementally expand the terminal building to accommodate up to four aircraft gates, including two air carrier (narrowbody) gates and two regional jet gates.
- Lengthen the terminal curbside when the terminal building is expanded. Widen the curbside area and add another curb lane for passenger pickup and drop-off.
- Expand the terminal area public parking to meet forecast demand, between 29 and 5,585 spaces over the planning period, depending on the activity scenario that develops.
- Expand the terminal area employee parking to meet forecast demand, between 3 and 225 spaces over the planning period, depending on the activity scenario that develops
- Expand the terminal area rental car parking/staging to meet forecast demand, between 9 and 626 spaces over the planning period, depending on the activity scenario that develops (Baseline Forecast through Low Cost Carrier Scenarios).

- Expand the area of conventional hangar development by approximately 1.2 acres over the long-term planning period or as dictated by tenant development initiatives.
- Expand the area of T-hangar development by approximately eight acres over the long-term planning period.
- Expand the area of transient aircraft parking apron by approximately 3.7 acres over the long-term planning period.
- Expand the storage capacity for Jet-A fuel over the planning period by approximately 28,000 gallons (this would be a tenant-initiated activity).
- Acquire land to support long-range airfield development including the upgrade of Runway 5-23 and implementation of future GA training runway.
- Revise local zoning codes to implement positive land use controls to preclude development incompatible with airport operations.
- Expand utility network to provide infrastructure to proposed conceptual on-airport development areas.
- Expand Airport's maintenance facility and Snow Removal Equipment (SRE) building by approximately 4,500 square feet to meet equipment storage needs in support of increases in runway, taxiway, and apron pavement and increased activity levels.