# Chapter 4: Facility Requirements

## Introduction

This chapter of the Airport Master Plan analyzes the existing and anticipated future facility needs at the Sioux Falls Regional Airport (FSD). This chapter is divided into sections that assess the needs of primary airport elements including airside facilities, passenger terminal complex, air cargo facilities, general aviation facilities, landside elements and support facilities.

Airside requirements are those necessary for the operation of aircraft. Landside requirements are those necessary to support airport, aircraft and passenger operations. Proposed requirements are based on a review of existing conditions, capacity levels, activity demand forecasts and airport design standards using FAA guidance and industry standards. Existing facility deficiencies are identified along with potential future facility needs. The level of review completed is sufficient to identify major airport elements that should be addressed in this comprehensive airport plan.

FSD is a growing airport facility as a result of continued increases in passenger enplanements, air cargo and corporate aviation. Since the last Master Plan, the airport has constructed various improvements to automobile parking, curbside, ticketing, baggage screening, concessions and concourse areas. The airport continues to upgrade the terminal complex to meet passenger demands. Recently they expanded the security checkpoint, added shuttle service to and from long term parking and added another concessioner inside the terminal.

Discussions with airport management, coupled with forecasts depicting growth in all areas of aviation led to areas of emphasis in this chapter which include identifying future terminal building and parking needs so an updated facility plan can be developed maximizing the utilization of the existing terminal site. Overall, airport facility development will be identified to adequately accommodate existing and expected activity levels in this Master Plan.

Potential solutions to address the facility needs through the planning period are discussed in this chapter. Specific alternatives that implement the recommendations are evaluated in **Chapter 5: Alternatives**.

## Planning Activity Levels

There are various airport activity measures used to determine facility requirements including passenger enplanements, peak hour and airport operations. Airport activity can be sensitive to industry changes, national and local economic conditions. This results in difficulty in identifying a specific calendar year for the airport to each demand levels associated recommended improvements. For this Master Plan, Planning Activity Levels (PALs) are used to identify demand thresholds for recommended facility improvements. If an activity level is approaching a PAL then the airport should prepare to implement the improvements. Alternatively, activity levels that are not approaching a PAL can allow improvements to be deferred. The demand forecasts developed in this Master Plan do correspond an anticipated planning level calendar year to each PAL (2018, 2023, 2028, 2033) from the preferred aviation forecasts.

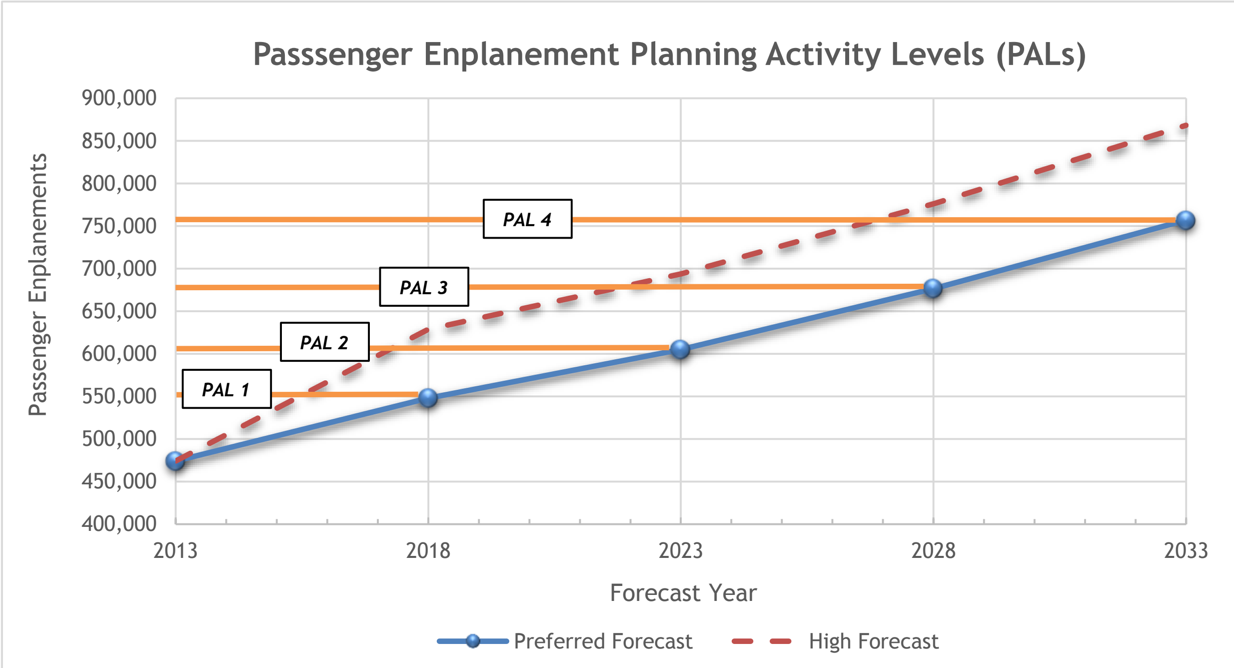
The following exhibits identify the PAL metrics for the Sioux Falls Regional Airport.

### *Exhibit 4-1 – Planning Activity Levels (PALs)*

| Planning Activity Levels | | | | | |
|---|---|---|---|---|---|
| **Metric** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Passengers** | | | | | |
| Annual Enplanements | 474,118 | 547,938 | 604,872 | 676,594 | 756,820 |
| Peak Month | 49,830 | 57,588 | 63,572 | 71,110 | 71,110 |
| Design Day | 1,827 | 2,112 | 2,331 | 2,608 | 2,917 |
| Design Hour Departing | 395 | 456 | 504 | 563 | 630 |
| Design Hour Arriving | 329 | 380 | 420 | 469 | 525 |
| Design Hour Total | 559 | 646 | 713 | 798 | 893 |
| **Passenger Airline Operations** | | | | | |
| Total Operations | 15,989 | 15,837 | 16,405 | 18,482 | 20,441 |
| Peak Month | 1,680 | 1,665 | 1,724 | 1,942 | 2,148 |
| Design Day | 58 | 58 | 60 | 68 | 75 |
| Design Hour Departures | 6 | 6 | 6 | 7 | 8 |
| Design Hour Arrivals | 5 | 5 | 5 | 6 | 6 |
| Design Hour Total | 8 | 8 | 8 | 9 | 10 |
| **Total Operations** | | | | | |
| Total Operations | 67,418 | 72,959 | 79,708 | 88,038 | 97,615 |
| Peak Month | 6,324 | 6,844 | 7,477 | 8,258 | 8,258 |
| Design Day | 266 | 287 | 314 | 347 | 385 |
| Design Hour | 27 | 29 | 31 | 35 | 38 |

*Source: KLJ Analysis*

*Exhibit 4-2 - Passenger Enplanement Planning Activity Levels (PALs)*




*Source: KLJ Analysis*

## Airside Facilities

### *Airfield Design Standards*

Guidance on airport design standards is found in FAA Advisory Circular 150/5300-13A, *Airport Design*. Change 1 to the Advisory Circular was issued February 26, 2014 and is incorporated into this chapter. Airport design standards provide basic guidelines for a safe, efficient, and economic airport system. Careful selection of basic aircraft characteristics for which the airport will be designed is important. Airport designs based only on existing aircraft can severely limit the ability to expand the airport to meet future requirements for larger, more demanding aircraft. Airport designs that are based on large aircraft unlikely to operate at the airport are not economical.

#### Design Aircraft

Aircraft characteristics relate directly to the design components on an airport. Planning a new airport or improvements to an existing airport requires the selection of one or more "design aircraft." FAA design standards for an airport are determined by a coding system that relates the physical and operational characteristics of an aircraft to the design and safety separation distances of the airfield facility. The design aircraft is the most demanding aircraft operating or forecast to operate at the airport on a regular basis, which is typically considered 500 annual operations. The design aircraft may be a single aircraft, or a grouping of aircraft. It is not the usual practice to base the airport design on an aircraft that uses the airport infrequently, thus some elements may be designed for a less demanding aircraft. The FAA typically only provides funding for the airport to be designed to existing and forecasted critical aircraft that are expected to exceed 500 annual operations.

### Airfield Design Classifications

The FAA has established aircraft classification systems that group aircraft types based on their performance and geometric characteristics. These classification systems, described and illustrated in **Exhibit 3 and 4**, are used to determine the appropriate airport design standards for specific runway, taxiway, apron, or other facilities, as described in FAA AC 150/5300-13A *Airport Design*.

- Aircraft Approach Category (AAC): a grouping of aircraft based on approach reference speed, typically 1.3 times the aerodynamic stall speed. Approach speed drives the dimensions and size of runway safety and object free areas.
- Airplane Design Group (ADG): a classification of aircraft based on wingspan and tail height. When the aircraft wingspan and tail height fall in different groups, the higher group is used. Wingspan drives the dimensions of taxiway and apron object free areas, as well as apron and parking configurations.
- Approach Visibility Minimums: relates to the visibility minimums expressed by Runway Visual Range (RVR) values in feet. These distances relate to the minimum distance pilots must be able to see the runway or lighting from the runway. Visibility categories include visual (V), non-precision (NPA), approach procedure with vertical guidance (APV) and precision (PA). Lower visibility minimums require more complex airfield infrastructure and enhanced protection areas including safety and object free areas as well as runway-to-taxiway separation distances.
- Taxiway Design Group (TDG): a classification of airplanes based on outer to outer Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance. TDG relates directly to taxiway/taxilane pavement width and fillet design at intersections.

Although not a classification, runway length is driven by the landing and departure performance characteristics of the most demanding design aircraft.

*Exhibit 4-3 – Airfield Classification Systems*

| Airfield Classification Systems | | |
|---|---|---|
| **Aircraft Approach Category (AAC)** | | |
| **AAC** | **Approach Speed** | |
| A | Approach speed less than 91 knots | |
| B | Approach speed 91 knots or more but less than 121 knots | |
| C | Approach speed 121 knots or more but less than 141 knots | |
| D | Approach speed 141 knots or more but less than 166 knots | |
| E | Approach speed 166 knots or more | |
| **Airplane Design Group (ADG)** | | |
| **ADG** | **Tail Height (ft.)** | **Wingspan (ft.)** |
| I | < 20’ | < 49’ |
| II | 20’ - < 30’ | 49’ - < 79’ |
| III | 30’ - < 45’ | 79’ - < 118’ |
| IV | 45’ - < 60’ | 118’ - < 171’ |
| V | 60’ - < 66’ | 171’ - < 214’ |
| IV | 66’ - < 80’ | 214’ - < 262’ |
| **Approach Visibility Minimums** | | |
| **RVR (ft)*** | **Instrument Flight Visibility Category (statue mile)** | |
| N/A (VIS) | Visual (V) | |
| 5000 | Not lower than 1 mile (NPA) | |
| 4000 | Lower than 1 mile but not lower than ¾ mile (APV) | |
| 2400 | Lower than ¾ mile but not lower than ½ mile (CAT-I PA) | |
| 1600 | Lower than ½ mile but not lower than ¼ mile (CAT-II PA) | |
| 1200 | Lower than ¼ mile (CAT-III PA) | |

*Source: FAA AC 150/5300-13A, Airport Design*
**RVR values are not exact equivalents*
*APV = Approach with Vertical Guidance, PA = Precision Approach*

### Airport Reference Code (ARC)
The Airport Reference Code (ARC) is an airport designation that represents the AAC and ADG of the aircraft that the entire airfield is intended to accommodate on a regular basis. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport.

### Runway Design Code (RDC)
RDC is a code signifying the design standards to which the overall runway is to be planned and built, typical based on the design aircraft and approach visibility minimums for a particular runway. RDC provides the information needed to determine the design standards that apply.

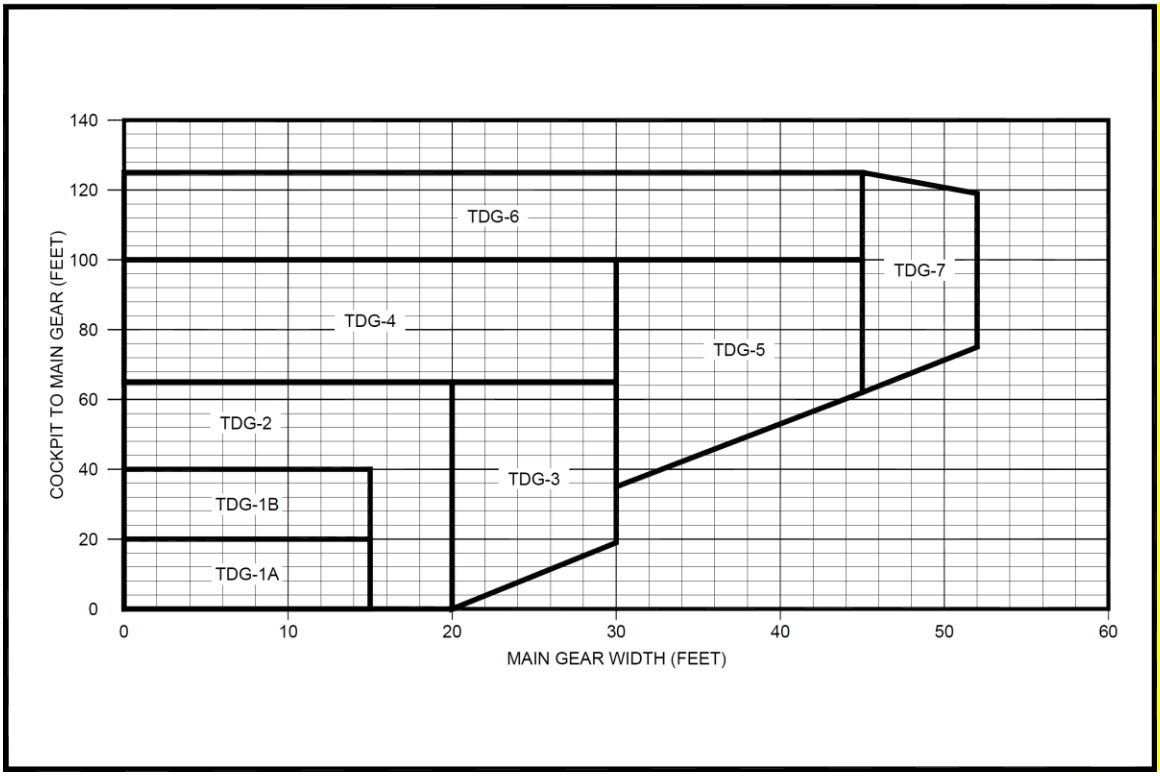
### Runway Reference Code (RRC)
RRC is a code signifying the current operational capabilities of each specific runway end and adjacent taxiways. RRC is split into Approach and Departure Reference Codes (APRC and

DPRC). APRC classifications are expressed in three components: AAC, ADG, and the lowest approach visibility minimums that either end of the runway is planned to provide. DPRC classifications utilize AAC and ADG components only. A runway end may have more than one RRC depending on the minimums available to a specific AAC.

### Taxiway Design Group (TDG)

TDG relates to the dimensions of the aircraft landing gear including distance from cockpit to main gear (CMG) and main gear width (MGW). These dimensions relate to an aircraft's ability to safely maneuver taxiways at an airport. Taxiways/taxilanes on an airport can be construct to a different TDG based on the expected use of that taxiway/taxilane by the design aircraft.

### *Exhibit 4-4 - Taxiway Design Group*




*Source: FAA AC 150/5300-13A, Airport Design*

### Other Design Considerations

Other airport design principles are important to consider for a safe and efficient airport design:

- Runway/Taxiway Configuration – The configuration of runways and taxiways affects the airport's capacity/delay, risk of incursions with other aircraft on the runway and overall operational safety. Airports with simultaneous operations on crossing runways can cause delay. Location of and type of taxiways connecting with runways correlates to minimizing runway occupancy time. The design of taxiway infrastructure should promote safety by minimizing confusing or complex geometry to reduce risk of an aircraft inadvertently entering the runway environment.

- Approach and Departure Airspace & Land Use – Runways each have imaginary surfaces that extend upward and outward from the runway end to protect normal flight operations. Runways also have land use standards beyond the runway end to protect the flying public as well as persons and property on the ground from potential operational hazards. Runways must meet grading and clearance standards considering natural and man-made obstacles that may obstruct these airspace surfaces. Surrounding land use should be compatible with airport operations. Airports should develop comprehensive land use controls to prevent new hazards outside the airport property line. Obstructions can limit the utility of a runway.
- Meteorological Conditions – An airport's runways should be designed so that aircraft land and takeoff into the prevailing wind. As wind conditions change, the addition of an additional runway may be needed to mitigate the effects of significant crosswind conditions that occur more than five percent of the year. Airports that experience lower cloud ceiling and/or visibility should also consider implementing an instrument procedures and related navigational aids to runways to maximize airport utility.
- Controller Line of Sight – The local Air Traffic Control Tower (ATCT) relies on a clear line of sight from the controller cab to the airport's movement areas which includes the runways, taxiways, aprons and arrival/departure corridors. Structures on an airport need to consider this design standard, and in some cases require the completion of a shadow study to demonstrate no adverse impact.
- Navigation Aids & Critical Areas – Visual navigational aids (NAVAIDs) to a runway or the airfield require necessary clear areas for these NAVAIDs to be effective for pilots. Instrument NAVAIDs on an airport require sufficient clear areas for the NAVAID to properly function without interference to provide guidance to pilots. These NAVAID protection areas restrict development.
- Airfield Line of Sight – Runways need to meet grading standards so that objects and aircraft can be seen along the entire runway. A clear line of sight is also required for intersecting runways within the Runway Visibility Zone to allow pilots to maintain visual contact with other objects and/or aircraft that may pose a hazard.
- Interface with Landside – The airfield configuration should be designed to provide for the safe and efficient operation of aircraft as they transition from the airfield to landside facilities such as hangars and terminals.
- Environmental Factors – Airport development must consider potential impacts in and around the airport environs through the National Environmental Policy Act (NEPA). Additionally, development should also reduce the risk of potential wildlife hazards such as deer and birds that may cause hazards to flight operations.

### *Design Aircraft*

The design aircraft types must be identified to determine the appropriate airport design standards to incorporate into airport planning. The design aircraft is the most demanding aircraft to operate at the airport at least 500 annual operations.

### Operational Analysis

Existing airport operations at FSD in FFY 2013 were analyzed considering potential changes to the design aircraft from the aviation forecasts developed in **Chapter 3** from local and national aviation trends. **Exhibit 5 and 6** summarize the existing FSD air cargo and passenger airline operations conducted by the most demanding or "critical" aircraft types based on FAA design standards.

### *Exhibit 4-5 - Critical Air Cargo Operations*

| Critical Air Cargo Operations | | | | |
|---|---|---|---|---|
| **Aircraft Type** | **AAC** | **ADG** | **TDG** | **2013 Operations** |
| **Air Cargo** | | | | |
| Airbus A300-600 | C | IV | 5 | 545 |
| ATR-42/72 | B | III | 2 | 507 |
| Beechcraft 1900 | B | II | 2 | 2,035 |
| Boeing 727-200 | C | III | 4 | 76 |
| Boeing 757-200 | C | IV | 5 | 1,340 |
| Boeing 767-300F | D | IV | 5 | 447 |
| Embraer EMB-120 | B | II | 3 | 48 |
| Swearingen Metro III | B | II | 2 | 3,434 |

*Source: FAA Enhanced Traffic Management Counts (FFY 2013), KLJ Analysis*
*NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.*

### *Exhibit 4-6 - Critical Passenger Airline Operations*

| Critical Passenger Airline Operations | | | | |
|---|---|---|---|---|
| **Aircraft Type** | **AAC** | **ADG** | **TDG** | **2013 Operations** |
| **Passenger Airlines** | | | | |
| Airbus A318/A319 | C | III | 3 | 933 |
| Airbus A320/A321 | C | III | 3 | 615 |
| Boeing 737-800 | D | III | 3 | 129 |
| Bombardier CRJ-200 | D | II | 2 | 4,074 |
| Bombardier CRJ-700 | D | II | 2 | 869 |
| Bombardier CRJ-900 | D | II | 2 | 88 |
| Bombardier Q400 | C | III | 5* | 573 |
| Embraer ERJ-135 | C | II | 2 | 1,549 |
| Embraer ERJ-145 | C | II | 2 | 3,359 |
| Embraer ERJ-145X | C | II | 2 | 2,182 |
| Embraer E170 | C | III | 1A | 568 |
| Embraer E190 | C | III | 1A | 287 |
| Boeing (Douglas) MD-83 | D | III | 4 | 1,004 |
| Boeing (Douglas) MD-88 | C | III | 4 | 55 |
| Boeing (Douglas) MD-90 | C | III | 4 | 152 |

*Source: FAA Enhanced Traffic Management Counts (FFY 2013), KLJ Analysis*
*NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.*
**Aircraft no longer has regular service to FSD*

The most demanding aircraft for the overall airport is the Boeing 767-300F, operated by UPS. The Boeing 767 is an AAC-D, ADG-IV, TDG-5 aircraft with a maximum takeoff weight of 414,000 pounds. This aircraft operates on both Runway 3/21 and Runway 15/33 depending on local wind conditions and ATCT arrival and departure flight patterns. There is also occasional use of a smaller EMB-120 aircraft with TDG-3. For commercial service aircraft, the design airplane is a family of aircraft with AAC-D, ADG-III, TDG-4. These aircraft have a maximum takeoff weight of up to 175,000 pounds. Occasional use by larger commercial service use including the Boeing 757 aircraft is expected.

The following exhibit depicts the critical general aviation aircraft operations.

*Exhibit 4-7 - Critical General Aviation Aircraft Operations*

| Critical General Aviation Aircraft Operations | | | | |
|---|---|---|---|---|
| **Aircraft Type** | **AAC** | **ADG** | **TDG** | **2013 Operations** |
| **General Aviation** | | | | |
| Raytheon BAe-125 | B | I | - | 16 |
| Cessna Citation CJ2/3/4 | B | I | 1A | 399 |
| Cessna Citation 500/501 | B | I | - | 28 |
| Cessna Citation Mustang | B | I | 2 | 629 |
| Beechcraft Beechjet 400 | B | I | - | 401 |
| Learjet 25 | C | I | 1A | 8 |
| Learjet 31/35 | C | I | - | 165 |
| Learjet 40/45 | C | I | - | 98 |
| Learjet 55/60 | C | I | - | 82 |
| IAI 1124 Westwind | C | I | - | 4 |
| IAI 1125 Astra | C | I | - | 14 |
| Pilatus PC-12 | A | II | - | 296 |
| Beechcraft King Air 350 | B | II | - | 373 |
| Beechcraft King Air 200/300 | B | II | 2 | 5,843 |
| Beechcraft King Air 90 | B | II | 1A | 2,445 |
| Cessna 525 CitationJet CJ1 | B | II | 2 | 80 |
| Cessna 550 Citation II | B | II | 2 | 283 |
| Cessna Citation 560 Ultra | B | II | 2 | 795 |
| Cessna Citation 560 Excel | B | II | 2 | 271 |
| Cessna Citation 650 | B | II | - | 169 |
| Cessna Citation 680 Sovereign | B | II | 1B | 59 |
| Bombardier Challenger 300 | B | II | - | 47 |
| Dassault Falcon 2000 | B | II | - | 32 |
| Dassault Falcon 900 | B | II | - | 22 |
| Dassault Falcon 10/20 | B | II | - | 167 |
| Dassault Falcon 50 | B | II | 1B | 112 |
| Bombardier Challenger 600 | C | II | - | 23 |
| Cessna Citation X | C | II | 1B | 119 |
| Gulfstream G200 | C | II | - | 42 |
| Gulfstream G280 | C | II | 1A | 4 |
| Gulfstream G400 | C | II | - | 39 |
| Raytheon Hawker 800 | C | II | - | 91 |
| Dassault Falcon 7X | B | III | - | 5 |
| Gulfstream G500 | C | III | 2 | 16 |
| Bombardier BD-700 | C | III | - | 4 |

*Source: FAA Enhanced Traffic Management Counts (FFY 2013), KLJ Analysis*
*NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.*

The most demanding general aviation aircraft is a family of airplanes with AAC-C, ADG-II and TDG-2. It should be noted there is occasional use by ADG-III aircraft. According to Landmark Aviation, there are additional operations in ADG-III and/or greater than 60,000 lbs. restricted by the current weight capacity and apron size along the east apron. Operations in these aircraft are expected to grow at FSD. A typical general aviation design aircraft will currently weigh up to 60,000 lbs. but future larger aircraft will be 90,000 lbs. Some passenger airline aircraft operated as unscheduled charter flights may also utilize the general aviation area with TDG-3. The proposed use of an EMB-120 may occur in the general aviation area with a TDG-3.

Small general aviation aircraft utilize Runway 9/27 during crosswind conditions on an occasional basis. It is only used a few days per year when wind conditions are limiting on the other two runways for small aircraft. Its location in the southern portion of the airfield is not in close proximity to general aviation facilities. Runway 9/27 classification should be limited to aircraft 12,500 pounds or less. An example design aircraft would be a Beechcraft King Air B-250 with AAC-B, ADG-II and TDG-2.

The most demanding family of aircraft to utilize FSD are summarized in **Exhibit 8.** This determination is consistent with the current classification of the airport as an AAC-D, ADG-IV, TDG-5 facility.

***Exhibit 4-8 – Design Aircraft Operations***

| Design Aircraft Operations | |
|---|---|
| **Design Component** | **2013 Operations** |
| AAC-D | 6,611 |
| ADG-IV | 2,332 |
| TDG-5 | 992* |
| **TOTAL** | **9,935** |

*Source: FAA Enhanced Traffic Management Counts (FFY 2013), KLJ Analysis*
**Does not include Bombardier Q400 operations as they have ceased from regular airport operation*

### Forecast Trends

The aviation forecasts predict the overall design aircraft should continue to be an AAC-D, ADG-IV and TDG-5 representing a mix of aircraft regularly serving FSD including the Boeing 767-300F airplane operated by UPS. Passenger airline service aircraft are forecast to maintain the same design aircraft with overall operations increasing. New aircraft types are anticipated to be introduced to FSD, however, these aircraft are not forecast change the design aircraft classification throughout the planning period.

Based on user input, the EMB-120 turboprop aircraft is anticipated to operate more from FSD for air cargo operations. This aircraft has a TDG-3 classification thus operational surfaces utilized by this aircraft type should be upgraded to meet this standard.

General aviation corporate aircraft of ADG-III classification are anticipated to utilize the airport more frequently. These aircraft have a maximum takeoff weight of up to 91,400 pounds. There is uncertainty as to when operations will increase to become the design aircraft, although a growing Sioux Falls business community will likely contribute to increased operations over time. Future general aviation airport facilities should plan to accommodate the design standards for ADG-III airplanes to provide flexibility.

### Summary

The design characteristics associated with the runways at FSD are summarized in the table below. Additional design aircraft information will be utilized to drive the design standards for taxiways, aprons and parking areas.

***Exhibit 4-9 – Airfield Design Aircraft Summary***

| Airfield Design Aircraft Summary | | |
|---|---|---|
| **Design Characteristics** | **Runway 3/21<br>Runway 15/33** | **Runway 9/27** |
| Aircraft Make/Model | Boeing 767-300F | Beechcraft King Air B-250 |
| Airplane Approach Category | D | B |
| Airplane Design Group | IV | II |
| Taxiway Design Group | 5 | 2 |
| Wingspan | 156’ 1” | 57’ 11” |
| Length | 176’ 1” | 43’ 10” |
| Tail Height | 52’ 0” | 14’ 10” |
| Approach Speed | 145 knots | 97 knots** |
| Maximum Takeoff Weight | 412,000 pounds | 12,500 pounds |
| Landing Gear Configuration | Dual Tandem | Dual Wheel |
| Aircraft Classification Number | 57 | 4** |
| FAR Takeoff Runway Length* | 10,500 feet | 4,200 feet** |
| FAR Landing Runway Length* | 6,700 feet | 2,500 feet** |

*Source: Boeing Airport Planning Manuals, Beechcraft, KLJ Analysis*
**Runway length is for planning purposes only and varies based on operation. Figure shown is based on maximum takeoff or landing weight, wet runway (if applicable) 90 degrees F at FSD.*
***Performance Characteristics for Beechcraft King Air B-200*

## *Airfield Capacity*

The total capacity of the airfield is the measure of the maximum number of aircraft arrivals and departures capable of being accommodated for a runway and taxiway configuration. Delay occurs when operations exceed the available capacity at an airport. Airports should plan to provide capacity enhancements well in advance to avoid undue operational delays. A master planning-level analysis was completed using the methods outlined in FAA Advisory Circular AC 150/5060-5, *Airport Capacity and Delay*.

Capacity is measured using various metrics:

- Hourly Capacity – The maximum throughput of arrivals and departures an airfield can safely accommodate in a one-hour period.
- Annual Service Volume – The maximum throughput of annual operations and airfield can safely accommodate in one-year with an acceptable level of delay.

- Aircraft Delay – The difference in time between a constrained and an unconstrained aircraft operation, measured in minutes.

### Input Factors

Measuring airfield capacity is driven by many factors including aircraft fleet mix, runway use configuration, meteorological flight conditions and runway operational procedures. Each is calculated to cumulatively determine the hourly capacity and annual service volume for an airport.

#### *Aircraft Fleet Mix*

Different types of aircraft operating on an airport impacts airport capacity. In addition to required arrival and departure flow separation requirements between similar aircraft types, aircraft with different speeds create the need additional spacing requirements to maintain minimum separation. Greater spacing is also required for small aircraft to avoid wake turbulence created by larger aircraft. The airport's fleet mix index is established using FAA guidelines.

***Exhibit 10 - Aircraft Fleet Mix Classifications***

| Aircraft Fleet Mix Classifications | | | |
|---|---|---|---|
| **Aircraft Classification** | **Maximum Takeoff Weight (MTOW)** | **Number of Engines** | **Wake Turbulence** |
| A | <12,500 lbs. | Single | Small (S) |
| B | | Multi | Small (S) |
| C | 12,500 – 300,000 lbs. | Multi | Large (L) |
| D | >300,000 | Multi | Heavy (H) |

*Source: FAA AC 150/5060-5, Airport Capacity and Delay*

The aircraft fleet mix percentage for capacity calculations is determined by the FAA's formula (C + 3D) using aircraft fleet mix classifications. Overall fleet mix calculations are summarized in the following table.

In reviewing the aviation forecasts for FSD, the fleet mix percentage for Instrument Flight Rules (IFR) operations and Visual Flight Rule (VFR) operations are summarized in the table below. Over 85 percent of the total operations under IFR are estimated to be conducted in Class C aircraft. Operations in Class D aircraft total about 1.5 percent.

***Exhibit 4-11 - Aircraft Fleet Mix Percentage***

| Aircraft Fleet Mix Percentage | | |
|---|---|---|
| **Metric** | **Base** | **PAL 4** |
| IFR Fleet Mix Percentage | 90.24% | 90.14% |
| VFR Fleet Mix Percentage | 81.39% | 79.90% |

*Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis*

#### *Runway Use*

The runway use configuration affects the operational efficiency and capacity of an airfield. An independent runway is one that can be operational and not affect arrivals and/or departures from other runways. A dependent runway is directly affected by the operations of another runway. Operations from another runway must be clear so operations on the other runway can safely occur. This dependent runway configuration increases wait time, reduces capacity and can increase overall delay. This is commonly seen for airfields with crossing runways.

At FSD, Runway 15/33 and 3/21 intersect at about the mid-point of each total runway length. Both of these runways can handle VFR and IFR operations, arrivals and departures. The estimated runway end utilization is identified in the table below.

### *Exhibit 4-12 - Runway Utilization*

| Runway Utilization | | |
|---|---|---|
| **Runway End** | **End Utilization** | **Runway Utilization** |
| 3 | 20% | 53% |
| 21 | 33% | |
| 15 | 15% | 46% |
| 33 | 31% | |
| 9 | 0.5% | 1% |
| 27 | 0.5% | |

*Source: KLJ Analysis (estimate)*

Based on weather observations and operational patterns, it is assumed a two runway scenario occurs 95 percent of the time during VFR conditions and 80 percent of the time during IFR conditions. This scenario assumes one runway is used for departures and the other is used for arrivals. Runway 9/27 is used periodically during high wind conditions as a general aviation runway.

### *Exhibit 4-13 – Runway Use Configuration*


*Source: KLJ Analysis*

#### *Other Considerations*

Meteorological conditions are a considerable consideration for capacity calculations. An analysis of the weather observations over the past 10 years show VFR conditions are experienced 90.59 percent of the time, IFR conditions within the capability of current approach minimums experienced 8.49 percent, and IFR conditions below current instrument approach minimums occurring 0.92 percent of the time.

The number and location of exit taxiways were considered. Ideally spaced exit taxiways allow aircraft to expediently leave the runway environment upon landing, thus increasing airfield capacity. Each assumes an average of two exit taxiways spaced between 3,500 and 6,500 feet from the landing threshold spaced at least 750 feet apart for VFR operations and one exit taxiway between 5,000 and 7,000 feet for IFR operations. FAA determines the exit factor to range from 0.86 to 0.97, depending on runway configuration and weather conditions.

Touch and go operation are or those that land then takeoff on the same runway without exiting the runway. These typically occur with small training aircraft and counts for two operations, thus increasing airfield capacity. There is no unusually higher percentage of touch-and-go operations at FSD as a result of flight training operations, thus a standard 1.00 exit factor was applied for capacity calculations.

A weighting factor is also applied per FAA guidance ranging from 1 to 25 for determining weighted hourly capacity. Arrivals are assumed to be 50 percent of total operations. Additional arrivals causes capacity to decrease due to separation requirements.

### Hourly Capacity

Hourly capacity is calculated during IFR and VFR conditions using FAA recommended equation based on runway configuration, touch-and-go and taxiway exit factors. Weighted hourly capacity is determined based on runway utilization, weather conditions and an FAA weighting factor. The results for the base and PAL 4 scenarios are identified below. Assuming no change to the airfield configuration, the results are similar for the base through PAL 4 due to a minimal change in fleet mix.

*Exhibit 4-14 - Hourly Capacity*

| Hourly Capacity | |
|---|---|
| **Factors** | **Base, PAL 1-4 Fleet Mix** |
| **Single Runway Use Scenario** | |
| VFR Hourly Capacity | 52.7 |
| IFR Hourly Capacity | 46.4 |
| **Dual Runway Use Scenario** | |
| VFR Hourly Capacity | 73.7 |
| IFR Hourly Capacity | 56.2 |
| **Weighted Hourly Capacity** | **58.7** |

*Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis*

### Annual Service Volume

Annual Service Volume (ASV) is an estimate of the total annual aircraft operations on an airfield annually. ASV is calculated based on the weighted hourly capacity multiplied by hourly and daily demand ratios. The ratio of the total operations to an airport's ASV determines if and when an airport should plan for capacity improvements to increase overall capacity.

*Exhibit 4-15 - Annual Service Volume (ASV)*

| Annual Service Volume (ASV) | | | | | |
|---|---|---|---|---|---|
| **Metric** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Annual Operations | 67,418 | 72,959 | 79,708 | 88,038 | 97,615 |
| Average Design Day | 266 | 287 | 314 | 347 | 385 |
| Average Design Hour | 27 | 29 | 31 | 35 | 38 |
| Annual Service Volume | 148,923 | 149,370 | 149,156 | 149,076 | 148,978 |
| **Capacity Level** | **45.3%** | **48.8%** | **53.4%** | **59.1%** | **65.5%** |

*Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis*

FAA recommended airports take action to implement capacity enhancement projects when an airport has reached 60 percent of its annual capacity. FSD should take steps starting after PAL

3 to implement capacity improvements. A re-evaluation of capacity calculations should be completed at that time. Specific infrastructure enhancements will be discussed further in this chapter.

#### Aircraft Delay

Aircraft delay exists because of local weather and operational conditions and cannot be entirely eliminated. Delay is measured in minutes per aircraft and hours per year. The FAA's assumptions identified in *Advisory Circular 150/5060-5, Airport Capacity and Delay* are used to identify delay measures and estimated cost. A four-to-six minute delay per aircraft is considered acceptable for normal airport operations. Delay consistently approaching 10 to 15 minutes per aircraft is a trigger for a new capacity-driven runway. Delay at FSD on average does not approach these thresholds. Delay is considered acceptable for operations into the planning period.

***Exhibit 4-16 – Aircraft Delay***

| Aircraft Delay | | |
|---|---|---|
| **Factors** | **Base** | **PAL 4** |
| Capacity Level | 45.3% | 65.5% |
| **Single Aircraft Delay (minutes)** | | |
| Average Aircraft Delay | 0.3 – 0.4 | 0.6 – 0.95 |
| Peak Aircraft Delay | 1.5 – 4.0 | 2.9 – 9.0 |
| **Annual Delay (hours)** | | |
| Average Aircraft Delay | 26,967 | 92,734 |
| **Delay Cost (2013 dollars)** | | |
| Average Aircraft Delay | $499,544 | $1,717,858 |

*Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis*

#### Summary

The purpose of this review is to provide a master planning-level review of airport capacity for long-range planning. FSD should plan for capacity enhancements after PAL 3. A review of the capacity assumptions is recommended at or before that level as operational patterns may change over time. If the capacity ratio of 60 percent is still reached, enhancements should be programmed into the capital improvement plan to enhance capacity, and reduce delay. Example improvements may include additional taxiway turnoffs or high-speed exits.

### *Meteorological Considerations*

Meteorological conditions that affect the facility requirements of an airport include wind coverage and weather condition encountered. Metrological data at FSD were reviewed using that past 10 years of data from the Sioux Falls Regional Airport AWOS facility from 2003-2012, available from the National Climatic Data Center (NCDC). This provides a comprehensive look into the average weather trends at an airport.

Wind coverage and weather conditions are evaluated based on the two different flight rules, VFR and IFR. Visual Meteorological Conditions (VMC) are encountered when the visibility is 3 nautical miles or greater, and the cloud ceiling height is 1,000 feet or greater. Conditions less than these weather minimums are considered Instrument Meteorological Conditions (IMC) requiring all flights to be operated under IFR.

### Wind Coverage

Wind coverage is important to airfield configuration and utilization. Aircraft ideally takeoff and land into headwinds alighted with the runway orientation. Aircraft are also designed and pilots are trained to land aircraft during crosswind conditions but there are limitations. Small, light aircraft are most affected by crosswinds. To mitigate the effect of crosswinds, runways on an airport are aligned so that they meet a minimum of 95 percent wind coverage where crosswind conditions are encountered 5 percent of the time or less. Each aircraft's ADG-ADG combination corresponds to a maximum crosswind wind speed component.

*Exhibit 4-17 - Wind Coverage Requirements*

| Wind Coverage Requirements | |
|---|---|
| **AAC-ADG** | **Maximum Crosswind Component** |
| A-I & B-I | 10.5 knots |
| A-II & B-II | 13.0 knots |
| A-III, B-III, C-I through D-III | 16.0 knots |
| A-IV through D-VI | 20.0 knots |

*Source: FAA AC 150/5300-13A, Airport Design*

Wind coverage for the airport is separated into all-weather (VMC and IMC) and IMC alone. All-weather analysis helps determine runway orientation and use. Local weather patterns commonly change in IMC. An IMC review helps determine the runway configuration for establishing instrument approaches.

*Exhibit 4-18 - All-Weather Wind Analysis*

| All-Weather Wind Analysis | | | | | |
|---|---|---|---|---|---|
| **Runway** | **AAC-ADG** | **Crosswind Component (Wind Speed)** | | | |
| | | **10.5 knots** | **13.0 knots** | **16.0 knots** | **20.0 knots** |
| Runway 3/21 | D-IV | 80.40% | 87.96% | 94.80% | 98.19% |
| Runway 15/33 | D-IV | 92.86% | 96.58% | 98.96% | 99.74% |
| Runway 9/27 | B-II | 82.08% | 89.38% | - | - |
| **Combined*** | **-** | **99.74%** | **99.97%** | **99.99%** | **100.00%** |
| 3/21, 15/33 | - | 96.77% | 98.87% | 99.67% | 99.94% |

**Combined assumes up to maximum design aircraft crosswind component for each runway*
*Source: National Climatic Data Center data from Sioux Falls Regional Airport ASOS (2003-2012)*

The design aircraft is accommodated on Runway 3/21 and 15/33 during all-weather conditions with airfield wind coverage exceeding 95 percent. Runway 15/33 has a better prevailing wind alignment than Runway 3/21 as evidenced by the increased wind coverage. For small aircraft that have a 10.5 knot crosswind threshold, these airplanes can be accommodated 99.74 percent of the time with the current three-runway configuration.

The wind coverage for Runway 3/21 and 15/33 combined still exceeds 95 percent for these small aircraft (96.77%). This means the weather observations for the past 10 years shows this runway exceeds FAA standards and may not be eligible for continued funding.

### *Exhibit 4-19 - IMC Wind Analysis*

| IMC Wind Analysis | | | | | |
|---|---|---|---|---|---|
| Runway | AAC-ADG | Crosswind Component (Wind Speed) | | | |
| | | 10.5 knots | 13.0 knots | 16.0 knots | 20.0 knots |
| Runway 3/21 | D-IV | 79.79% | 87.09% | 93.96% | 97.46% |
| Runway 15/33 | D-IV | 86.81% | 92.54% | 97.32% | 99.11% |
| Runway 9/27 | B-II | 82.34% | 89.72% | - | - |
| **Combined*** | **-** | **99.51%** | **99.92%** | **99.98%** | **99.99%** |
| 3/21, 15/33 | - | 95.48% | 98.41% | 99.54% | 99.93% |

**Combined assumes up to maximum design aircraft crosswind component for each runway*
*Source: National Climatic Data Center data from Sioux Falls Regional Airport ASOS (2003-2012)*

The design aircraft is accommodated on Runway 3/21 and 15/33 during IMC with airfield wind coverage exceeding 95 percent. Runway 15/33 has an advantage as a runway providing better wind coverage than 3/21. Without Runway 9/27 wind coverage still exceeds 95 percent for these small aircraft (95.48%).

When analyzed by runway end, Runway 3 is the preferred end by wind for IMC operations, followed by 15, 33 then 21. Runway 15/33 as a whole has better wind coverage than does Runway 3/21. The lowest published instrument approach minimums are available on Runway 21 followed by Runway 3. It is recommended to take steps to lower approach minimums to Runway 3 then 15/33 to maximize airfield utilization.

### *Exhibit 4-20 - IMC Wind Analysis by Runway End*

| IMC Wind Analysis by Runway End | | | | | |
|---|---|---|---|---|---|
| Runway End | AAC-ADG | Crosswind Component (Wind Speed) | | | |
| | | 10.5 knots | 13.0 knots | 16.0 knots | 20.0 knots |
| Runway 3 | D-IV | 54.28% | 58.83% | 63.08% | 65.61% |
| Runway 21 | D-IV | 33.34% | 36.10% | 38.71% | 39.70% |
| Runway 15 | D-IV | 48.11% | 50.36% | 52.24% | 52.84% |
| Runway 33 | D-IV | 46.54% | 50.02% | 52.93% | 54.12% |
| Runway 9 | B-II | 56.87% | 61.28% | - | - |
| Runway 27 | B-II | 33.32% | 36.28% | | |

*Source: National Climatic Data Center data from Sioux Falls Regional Airport ASOS (2003-2012)*

### Weather Conditions

When IMC weather conditions occur, aircraft must operate under IFR and utilize instrument approach procedures to an airfield. These IMC conditions drive the need to accommodate instrument approach procedures with sufficient weather minimums to continue airport operation and increase utilization.

Weather conditions are broken down into occurrence percentages based on current instrument approach minimums in the following table.

*Exhibit 4-21 – Meteorological Analysis*

| Meteorological Analysis | | | |
|---|---|---|---|
| Condition | Percent Occurrence | Description | |
| | | Ceiling | Visibility |
| VMC | 90.69% | ≥1,000’ | ≥3 mi. |
| IMC – Existing Capture | 8.39% | 1000’>and≥200’ | 3 mi.>and≥1800 RVR |
| IMC – Potential Capture | 0.76% | 200’>and≥100’ | 1800 RVR>and≥1200 RVR |
| IMC - Below Capture | 0.16% | <100’ | <1200 RVR |
| ALL | 100.0% | - | - |

*Source: National Climatic Data Center data from Sioux Falls Regional Airport ASOS (2003-2012)*

According to available weather data, FSD experiences conditions below current Category I landing weather minimums (1800 RVR for Runway 21). If an approach were enhanced to provide 1200 RVR in a Category II approach, then an additional 0.76% or 807 observations could be captured thus increasing airport utilization. Establishment of a Category II ILS approach for Runway 3/21 should be planned. Enhancement to the Runway 3 end is preferred based on weather observations. If enhancements are made to Runway 21, an enhanced approach with lower weather minimums to Runway 33 should be also reviewed because of the higher occurrence of northwest winds during IMC conditions at FSD.

Average high temperature data for the hottest month was reviewed from climate summaries available from the National Weather Service for Sioux Falls. The average high temperature in the hottest month from 2004-2013 was 85.6 degrees Fahrenheit.

### Runways

FSD has three runways, two air carrier runways and one general aviation runway. Runway 3/21 is the longest air carrier runway at 8,999 feet long and 150 feet wide. This runway is currently designed to accommodate precision approaches with lowest precision instrument approach minimums on the airfield of less than ½ mile (1800 RVR). Runway 15/33 is also an air carrier runway at 8,000 feet long and 150 feet wide designed to accommodate non-precision instrument approaches with visibility minimums as low as 1 mile. This runway is used to enhance capacity, provide a backup to the primary runway and operational benefits to reduce commercial airline ground taxiing time. Runway 9/27 is a secondary runway used by small general aviation aircraft. This runway is 3,151 feet long by 75 feet wide with non-precision instrument approaches with visibility minimums as low as 1 mile.

#### Runway Design Code

The existing design aircraft identifies the RDC for Runway 3/21 and 15/33 as D/IV/1600 (lower than ½ mile but no lower than ¼ mile). This is expected to change into the future to ¼ mile (1200 RVR) on Runway 3/21. Runway 15/33 currently has an RDC of D/IV/4000 but should be evaluated for reduction of approach minimums to ½ mile (2400 RVR). The RDC for Runway 9/27 is B/II/5000 accommodating small aircraft exclusively. This is not planned to change into the future.

## Design Standards

One primary purpose of this master plan is to review and achieve compliance with all FAA safety and design standards. The design standards vary based on the RDC and RRC as established by the design aircraft. In addition to the runway pavement width, some of the safety standards include:

- Runway Safety Area (RSA) – A defined graded surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot or excursion from the runway. The RSA must be free of objects, except those required to be located in the RSA to serve their function. The RSA should also be capable to supporting airport equipment and the occasional passage of aircraft.
- Runway Object Free Area (ROFA) – An area centered on the ground on a runway provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.
- Runway Obstacle Free Zone (ROFZ) – The OFZ is the three-dimensional volume of airspace along the runway and extended runway centerline that is required to be clear of taxiing or parked aircraft as well as other obstacles that do not need to be within the OFZ to function. The purpose of the OFZ is for protection of aircraft landing or taking off from the runway and for missed approaches.

Other design standards runway shoulder width to prevent soil erosion or debris ingestion for jet engines, blast pad to prevent soil erosion from jet blast, and required separation distances to markings, objects and other infrastructure for safety. Critical areas associated with navigational aids as well as airspace requirements are described further in this chapter.

### *Runway Protection Zone*

The Runway Protection Zone (RPZ) is a trapezoidal land use area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground. The land within the RPZ should be under airport control and cleared of incompatible land uses. FAA issued an interim policy on activities within an RPZ on September 27, 2012. Currently there are public roads within the approach RPZs to Runway 21 and 15, a railroad within the Runway 21 RPZ, at least portions of buildings within the RPZ for Runway 3, 15 and 21, and a recreational trail within the RPZ to Runway 15 and 21. FSD controls the RPZ for Runway 9, 27 and 15, has an avigation easement for the full Runway 3 RPZ, and only controls a portion of the Runway 33 and 21 RPZ.

New development discouraged within the RPZ includes new roads, structures and places of public assembly. New development within an RPZ or new RPZ size/location of an RPZ is subject to FAA review on a case-by-case basis to reduce risk to people on the ground. Mitigation tactics for new or existing land uses may include removal/relocation of the object or modifying usable runway length (declared distances) to relocate the RPZ outside of the land use. Tables identifying the runway design standards follow.

*Exhibit 4-22 - Runway 3/21 FAA Design Standard Matrix*

| Runway 3/21 FAA Design Standard Matrix | | |
|---|---|---|
| Design Standard | Actual | Runway Design Code (RDC) D/IV/1600 (Existing & Ultimate) |
| Approach Reference Code | D/VI/1600 | D/IV/1600 |
| Departure Reference Code | D/VI | D/IV |
| Runway Width | 150 feet | 150 feet |
| Shoulder Width | 0 feet | 25 feet |
| Blast Pad Width | 150' - RW 3<br>157' - RW 21 | 200 feet |
| Blast Pad Length | 150 feet | 200 feet |
| Line of Sight Requirements | Object | No Objects |
| RSA Width | 500 feet | 500 feet |
| RSA Length Past Departure End | 1,000 feet* | 1,000 feet |
| RSA Length Prior to Threshold | 600 feet | 600 feet |
| ROFA Width | 800 feet | 800 feet |
| ROFA Length Past Departure End | 1,000 feet* | 1,000 feet |
| ROFA Length Prior to Threshold | 600 feet* | 600 feet |
| ROFZ Length Past Runway | 200 feet | 200 feet |
| ROFZ Width | 400 feet | 400 feet |
| Inner Approach OFZ | 50:1 Slope* | 50:1 Slope |
| Inner Transitional OFZ | Varies* | Varies |
| Precision ROFZ Length | 200 feet | 200 feet |
| Precision ROFZ Width | 800 feet | 800 feet |
| Approach RPZ Start from Runway | Objects in RPZ | 200 feet |
| Approach RPZ Length | | 2,500 feet |
| Approach RPZ Inner Width | | 1,000 feet |
| Approach RPZ Outer Width | | 1,750 feet |
| Departure RPZ Start from Runway | Objects in RPZ | 200 feet |
| Departure RPZ Length | | 1,700 feet |
| Departure RPZ Inner Width | | 500 feet |
| Departure RPZ Outer Width | | 1,010 feet |
| Runway Centerline to Parallel Taxiway Centerline | 560' - RW 3<br>660' - RW 21 | 400 feet |
| Runway Centerline to Edge of Aircraft Parking | 850 feet | 500 feet |
| Runway Centerline to Helicopter Touchdown Pad | 830 feet | 700 feet |
| Runway Centerline to Hold Line | 257-320 feet | 265 feet |

*Note: RED indicates a deficiency to existing design standards*
**Facility improvements completed in 2014 through AIP funded project to meet design standards*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

*Exhibit 4-23 – Runway 15/33 FAA Design Standard Matrix*

| Runway 15/33 FAA Design Standard Matrix | | | | |
|---|---|---|---|---|
| **Design Standard** | **Actual** | **Runway Design Code (RDC)** | | |
| | | **D/IV/5000 (Existing)** | **D/IV/4000 (Future)** | **D/IV/2400 (Ultimate)** |
| Approach Reference Code | D/VI/1600 | D/IV/5000 | D/IV/4000 | D/IV/2400 |
| Departure Reference Code | D/VI | D/IV | D/IV | D/IV |
| Runway Width | 150 feet | 150 feet | 150 feet | 150 feet |
| Shoulder Width | 0 feet | 25 feet | 25 feet | 25 feet |
| Blast Pad Width | 150' – RW 33<br>200' – RW 15 | 200 feet | 200 feet | 200 feet |
| Blast Pad Length | 150' – RW 33<br>200' – RW 15 | 200 feet | 200 feet | 200 feet |
| Line of Sight Requirements | Object | No Objects | No Objects | No Objects |
| RSA Width | 500 feet | 500 feet | 500 feet | 500 feet |
| RSA Length Past Departure End | 1,000 feet | 1,000 feet | 1,000 feet | 1,000 feet |
| RSA Length Prior to Threshold | 600 feet | 600 feet | 600 feet | 600 feet |
| ROFA Width | 300 feet* | 800 feet | 800 feet | 800 feet |
| ROFA Length Past Departure End | 750' – RW 15* | 1,000 feet | 1,000 feet | 1,000 feet |
| ROFA Length Prior to Threshold | 600 feet | 600 feet | 600 feet | 600 feet |
| ROFZ Length Past Runway | 200 feet | 200 feet | 200 feet | 200 feet |
| ROFZ Width | 400 feet | 400 feet | 400 feet | 400 feet |
| Inner Approach OFZ | N/A | N/A | N/A | 50:1 Slope |
| Inner Transitional OFZ | N/A | N/A | N/A | Varies |
| Precision ROFZ Length | N/A | N/A | N/A | 200 feet |
| Precision ROFZ Width | N/A | N/A | N/A | 800 feet |
| Approach RPZ Start from Runway | Objects in RPZ | 200 feet | 200 feet | 200 feet |
| Approach RPZ Length | | 1,700 feet | 1,700 feet | 2,500 feet |
| Approach RPZ Inner Width | | 500 feet | 1,000 feet | 1,000 feet |
| Approach RPZ Outer Width | | 1,010 feet | 1,510 feet | 1,750 feet |
| Departure RPZ Start from Runway | Objects in RPZ | 200 feet | 200 feet | 200 feet |
| Departure RPZ Length | | 1,700 feet | 1,700 feet | 1,700 feet |
| Departure RPZ Inner Width | | 500 feet | 500 feet | 500 feet |
| Departure RPZ Outer Width | | 1,010 feet | 1,010 feet | 1,010 feet |
| Runway Centerline to Parallel Taxiway Centerline | 400 feet | 400 feet | 400 feet | 400 feet |
| Runway Centerline to Edge of Aircraft Parking | 700 feet | 500 feet | 500 feet | 500 feet |
| Runway Centerline to Helicopter Touchdown Pad | 1,100 feet | 700 feet | 700 feet | 700 feet |
| Runway Centerline to Hold Line | 255-300 feet | 265 feet | 265 feet | 265 feet |

*Note: RED indicates a deficiency to existing design standards*
**Facility improvements completed in 2014 through AIP funded project to mitigate, but not fully meet airport design standards.*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

*Exhibit 4-24 – Runway 9/27 FAA Design Standard Matrix*

| Runway 9/27 FAA Design Standard Matrix | | |
|---|---|---|
| **Design Standard** | **Actual** | **Runway Design Code (RDC)<br>B/II/5000 - Small Aircraft<br>(Existing & Future)** |
| Approach Reference Code | N/A | N/A |
| Departure Reference Code | N/A | N/A |
| Runway Width | 75 feet | 75 feet |
| Shoulder Width | 0 feet* | 10 feet |
| Blast Pad Width | 0 feet* | 150 feet |
| Blast Pad Length | 0 feet* | 95 feet |
| Line of Sight Requirements | No Objects | No Objects |
| RSA Width | 150 feet | 150 feet |
| RSA Length Past Departure End | 300 feet | 300 feet |
| RSA Length Prior to Threshold | 300 feet | 300 feet |
| ROFA Width | 500 feet | 500 feet |
| ROFA Length Past Departure End | 300 feet | 300 feet |
| ROFA Length Prior to Threshold | 300 feet | 300 feet |
| ROFZ Length Past Runway | 200 feet | 200 feet |
| ROFZ Width | 250 feet | 250 feet |
| Inner Approach OFZ | N/A | N/A |
| Inner Transitional OFZ | N/A | N/A |
| Precision ROFZ Length | N/A | N/A |
| Precision ROFZ Width | N/A | N/A |
| Approach RPZ Start from Runway | No Objects in RPZ | 200 feet |
| Approach RPZ Length | | 1,000 feet |
| Approach RPZ Inner Width | | 250 feet |
| Approach RPZ Outer Width | | 450 feet |
| Departure RPZ Start from Runway | No Objects in RPZ | 200 feet |
| Departure RPZ Length | | 1,000 feet |
| Departure RPZ Inner Width | | 250 feet |
| Departure RPZ Outer Width | | 450 feet |
| Runway Centerline to Parallel Taxiway Centerline | 670 feet | 240 feet |
| Runway Centerline to Edge of Aircraft Parking | 670 feet | 250 feet |
| Runway Centerline to Helicopter Touchdown Pad | N/A | 700 feet |
| Runway Centerline to Hold Line | 320 feet | 140 feet |

*Note: RED indicates a deficiency to existing design standards*
**Not required for aircraft operations type and RDC*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

***Recommendations***

Runway blast pads should be upgraded to standards for jet aircraft. A 25 foot wide paved runway shoulder should be implemented as it is required for ADG-IV aircraft. There is one runway holdline along Taxiway K that should be relocated to at least 265 feet from centerline. The parallel taxiway varies in distance from runway centerline, and actually exceeds the minimum requirement in all areas for the RDC.

Adequate runway line of sight requires a point five feet above the runway be visible five feet above any part of that runway, or within a certain area for crossing runways. The SDANG blast wall is within this Runway Visibility Zone. If it cannot be removed then it should otherwise be noted on the Airport Layout Plan.

The ROFA beyond the Runway 15 departure end (Runway 33 arrival end) does not meet current design standards. The airport perimeter fence and a portion of Minnesota Avenue is located within the ROFA. The fence relocated to maximize the ROFA. Any remaining deficiency should be mitigated with an FAA Modification of Standards request or the use of declared distances. Declared distances is an airport design method where operational restrictions are placed on a runway to reduce its usable length to meet a design standard. By relocating the fence, all but the last 250 feet of the Runway 15 departure end ROFA would meet standard without operational restrictions.

The blast pad for Runway 33 does not meet geometric standards and should be upgraded. A 25 foot wide paved runway shoulder should be implemented as it is required for ADG-IV aircraft. There are holdlines along Taxiway B that should be relocated to at least 265 feet from centerline.

Runway 9/27 has overlapping RSAs with Runway 3/21 and 15/33. This is not recommended per FAA design standards and should only remain at constrained airports where non-overlapping safety areas are impracticable. There are no other deficiencies to existing design standards for Runway 9/27.

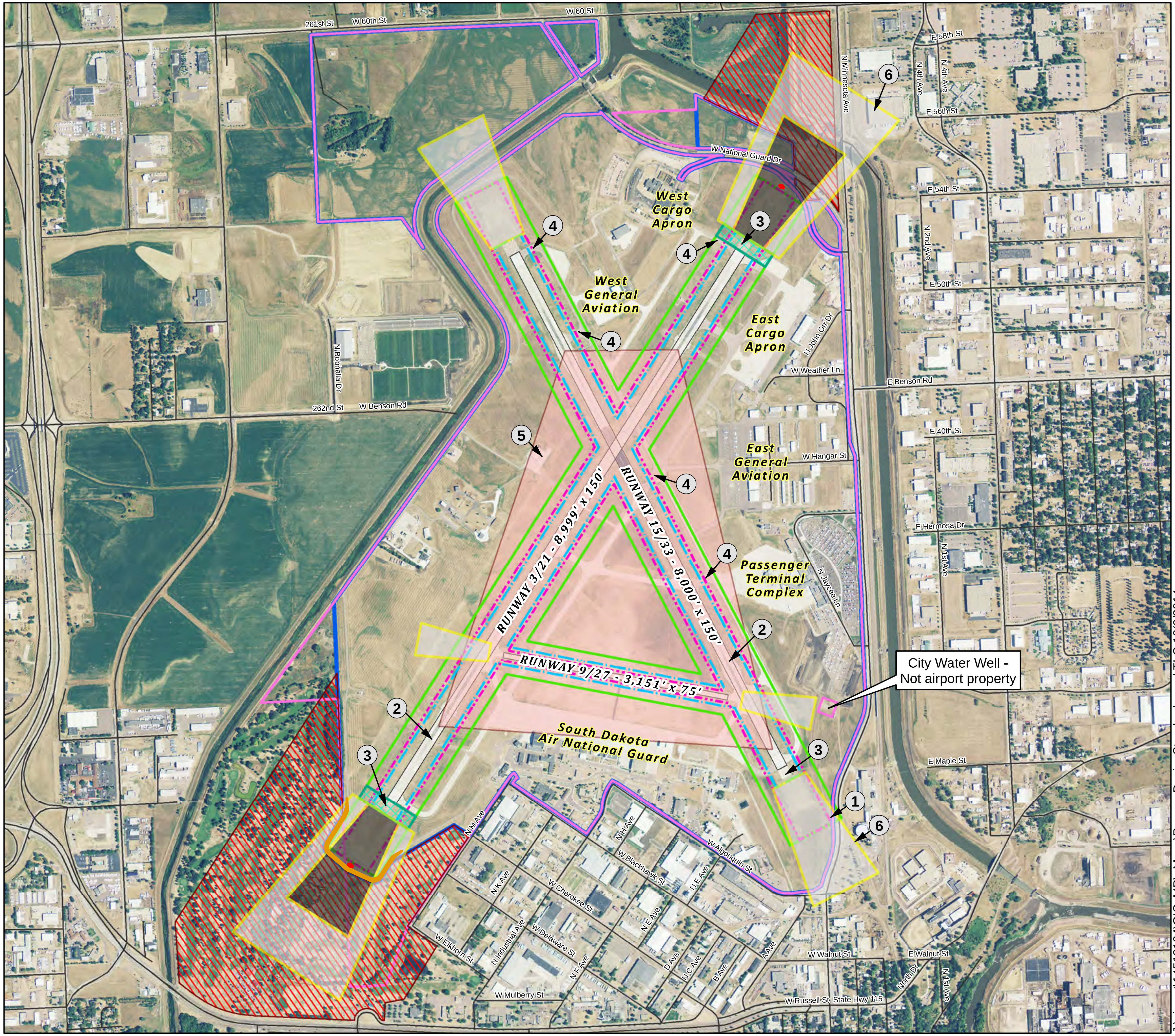
**Figure 4-1** depicts the existing runway design standards and deficiencies.

### Runway Length

The recommended runway length for an airport facility varies widely based on runway usage (number of operations per year), specific aircraft operational demands (aircraft type, weight/load) and local meteorological conditions (elevation, temperatures). Runway length should be suitable for the forecasted critical design aircraft.

#### *Design Aircraft*

A runway length analysis was performed using the manufacturer's Aircraft Planning Manuals and other available performance data. Sufficient runway length is important for the airport to maintain operational capability. It allows an aircraft operator to adequately serve their destinations. Restrictions on runway length may lead to reduced weight on a flight, which then translates in reduced fuel, passenger and/or cargo loads. The design approach identified in FAA Advisory Circular AC 150/5325-4B, *Runway Length Requirements for Airport Design* was used to determine runway length calculations for FSD.

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**Legend**

- Future Land Exchange Easements
- Precision Object Free Zone
- Runway Protection Zone(Approach)
- Runway Protection Zone(Departure)
- Runway Visibility Zone
- Existing Airport Property
- Future Airport Property
- Runway Object Free Area
- Runway Obstacle Free Zone
- Runway Safety Area
- Localizer
- New Road (2014)

**Existing Runway Design Code:**
**Runway 3/21:** D/IV/1600
**Runway 15/33:** D/IV/5000
**Runway 9/27:** B/II/5000 Small Aircraft

**Note:** Design Standards reflect FAA Advisory Circular 150/5300-13A, Change 1 (Febuary 2014)

**Runway Design Standard Deficiencies**

1. Objects within Object Free Area
2. No Runway Shoulder
3. Substandard Blast Pad
4. Substandard Runway-Taxiway Holdline Distance
5. Object within Runway Visibility Zone
6. No control over existing Runway Protection Zone

N

0 750 1,500 3,000 Feet

*Intended for Planning Purposes Only

PRELIMINARY

KLJ

**Sioux Falls Regional Airport**
**Joe Foss Field**
**Runway Design Standards**
**Figure 4-1**

It is very important to adequately plan for a future runway configuration as these projects tend to effect the community beyond the property line. Projects of these magnitude require many resources and long lead times for planning, environmental review and funding allocation.

A summary of the runway length requirements for various design aircraft types is outlined in the following exhibit.

### *Exhibit 4-25 - Design Aircraft Runway Length Requirements*

| Design Aircraft Runway Length Requirements | | | |
|---|---|---|---|
| **Aircraft Type** | **MTOW** | **Temp. (˚F)** | **Required Length @ 1,500' MSL** |
| Boeing 767-300F | 412,000 lbs. | 90 | 10,500 feet |
| Boeing (Douglas) MD-83 | 160,000 lbs. | 86 | 9,500 feet |
| Boeing 737-800 | 174,900 lbs. | 86 | 8,900 feet |
| Airbus A300F4-600R | 380,518 lbs. | 86 | 8,700 feet |
| Boeing 757-200 | 255,500 lbs. | 84 | 8,500 feet |
| Bombardier CRJ-900 | 82,500 lbs. | 86 | 7,900 feet |
| Airbus A-320 | 171,961 lbs. | 86 | 7,500 feet |
| Boeing 717-200 | 121,000 lbs. | 86 | 6,200 feet |
| Embraer E-195 | 115,280 lbs. | 86 | 6,200 feet |
| Mitsubishi MRJ-90 | 94,358 lbs. | 59 | 5,710 feet |

*Source: Aircraft Manufacturer Airport Planning Manuals and Specifications.*
*Note: Runway length requirements estimated based on charts for airport planning purposes only.*

Not all aircraft are operated at maximum takeoff weight at FSD. According to airport management, there have been no operators that currently have expressed a need for additional runway length to meet operational requirements including UPS or FedEx operating the Boeing 767, 757 and Airbus A-300. These aircraft on average have 30,000 pound cargo payloads which would be less than 50 percent of total maximum payload. Additionally stage lengths are only around 1,000 nautical miles which would further reduce runway length needs. These needs are met with the existing runway length. Domestic air cargo destinations are not expected to change however cargo per flight is forecast to increase but not to maximum payload weight limits.

During hot summer days, a few operators may be weight limited by the existing 8,999-foot runway length according to the Airport Planning Manuals. An example would be the MD-83 operated by Allegiant Airlines that requires 153,000 pounds to takeoff from the existing runway for a destination nearly 1,200 nautical miles away (Los Angeles). Takeoff weight is restricted when the temperature reaches 88 degrees Fahrenheit. These routes are planned to be replaced by a more efficient Airbus A-320 aircraft into the future.

The design aircraft not expected to change over time. Anticipated non-stop destinations in the most critical aircraft types are not expected to be beyond current state lengths, if at all. Further destinations in Mexico could be reached in Boeing 737-800 charter aircraft with the existing runway length. New aircraft types are also trending to have more efficient engines and improved takeoff performance. The existing length is sufficient for current and forecasted operations.

#### *Aircraft Less Than 60,000 Pounds*

A runway length analysis for other aircraft was performed using the FAA's methodology found in FAA Advisory Circular AC 150/5325-4B, *Runway Length Requirements for Airport Design*. These aircraft include business jets and other general aviation aircraft for identifying the recommended runway length for secondary runways accommodating aircraft less than 60,000 pounds. The FAA recommended runway length calculations for FSD are summarized in the following table:

### *Exhibit 4-26 - FAA Runway Length Requirements*

| FAA Runway Length Requirements | |
|---|---|
| **Airport and Runway Data** | |
| Airport Elevation | 1,430 feet |
| Mean Daily Maximum Temperature of Hottest Month | 85.6°F |
| Maximum Difference in Runway Centerline Elevation | 7 feet |
| Runway Condition | Wet and Slippery Runways |
| **Aircraft Classification** | **Recommended Runway Length** |
| **Large airplanes less than 60,000 lbs. but greater than 12,500 lbs.** | |
| 100 percent of fleet at 90 percent useful load | 8,560 feet |
| 100 percent of fleet at 60 percent useful load | 5,730 feet |
| 75 percent of fleet at 90 percent useful load | 7,000 feet |
| 75 percent of fleet at 60 percent useful load | 5,500 feet |
| **Small airplanes 12,500 lbs. or less** | |
| 10 or more passenger seats | 4,470 feet |
| Less than 10 passenger seats at 100 percent of fleet | 4,130 feet |
| Less than 10 passenger seats at 95 percent of fleet | 3,500 feet |

*Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design*
*Note: Runway length requirements estimated based on charts for airport planning purposes only.*

The existing length of 8,000 feet is sufficient for Runway 15/33 as it is sufficient to handle the vast majority of departures from FSD. Takeoff operations requiring a longer runway can utilize Runway 3/21. This may be needed for operations in aircraft greater than 60,000 pounds, and aircraft less than 60,000 pounds at 100 percent of fleet aircraft with 90 percent useful load. Local wind conditions allow this runway to accommodate aircraft over 96 percent of the time by corporate business jets. Common mid-sized business jets that operate at FSD including the Cessna Citation 650/750, Falcon 900 and Learjet 45/55/60 series aircraft. High load factors are common for aircraft that require passengers and cargo to be transported to destinations located thousands of miles away. These operations are common at an airport such as FSD with a high percentage of corporate general aviation traffic. Additionally, site constrains including terrain and environmental factors limit the expandability and improved utility of Runway 15/33 without significant development costs.

The design aircraft for Runway 9/27 is Beechcraft King Air B-200 general aviation turboprop aircraft with 10 or more passenger seats. While the ideal runway length is 4,500 feet, the runway is not anticipated to be lengthened due to the high constructions associated with a 1,400 foot extension coupled with the frequency of use.

### Pavement Strength

Airfield pavements should be adequately maintained, rehabilitated and reconstructed to meet the operational needs of the airport. Typical airport pavements have a 20-year design life. The published pavement strength is based on the construction materials, thickness, aircraft weight, gear configuration and operational frequency for the pavement to perform over its useful life. Larger aircraft could exceed the pavement strength but not on a regular basis.

The new FAA standard for measuring the reporting pavement strength is defined in Advisory Circular 150/5335-5B, *Standard Method of Reporting Airport Pavement Strength*. The Aircraft Classification Number – Pavement Classification Number (ACN-PCN) method is defined within this guidance. The PCN value must equal or exceed the ACN value assigned for the design aircraft. Public-use primary airports must report PCN figures by August 2014 to be eligible for federal funding. An ACN-PCN analysis for Runway 3/21 and Runway 15/33 for FSD was completed in February 2013.

The pavement strength for Runway 3/21 and Runway 15/33 should be sufficient to accommodate regular use by the design aircraft. The design aircraft for pavement strength calculations is the Airbus A300-600 freighter with an Aircraft Classification Number (ACN) of 60. The calculated Pavement Classification Number (PCN) of both runways is at least 60, thus no increases to pavement strength are necessary through the planning period. Runway 9/27 should be maintained to accommodate small aircraft of 12,500 pounds or less maximum takeoff weight.

*Exhibit 4-27 - Pavement Strength Requirements*

| Pavement Strength Requirements | | | | |
|---|---|---|---|---|
| Runway | Existing | | Future Need | |
| | Capacity | PCN | Capacity | PCN |
| Runway 3/21 | 200,000 lbs. - SW | 60 | 30,000 lbs. - SW | 60 |
| | 200,000 lbs. - DW | | 175,000 lbs. – DW | |
| | 444,000 lbs. - DT | | 412,000 lbs. - DT | |
| Runway 15/33 | 100,000 lbs. - SW | 70 | 30,000 lbs. - SW | 60 |
| | 180,000 lbs. - DW | | 175,000 lbs. – DW | |
| | 400,000 lbs. - DT | | 412,000 lbs. - DT | |
| Runway 9/27 | 30,000 lbs. – SW | N/A | 12,500 lbs. - SW | 3 |

*Source: FSD Airport Master Record (FAA Form 5010-1), KLJ Analysis*
*SW = Single Wheel, DW = Dual Wheel, DT = Dual Tandem landing gear configuration*

### *Instrument Procedures*

Instrument approach procedures to a runway end are used by landing aircraft to navigate to the airport during IMC when cloud ceiling is 1,000 feet of less and/or visibility is 3 miles or less. Establishing approaches with the lowest possible weather minimums allow the airport to maximize its operational capability. Each approach type requires differing infrastructure and navigational aids. Approaches with lower visibility minimums typically have additional infrastructure and navigational aids requirements. Types of approach procedures include non-precision approach (NPA), approach with vertical guidance (APV) and precision approach (PA).

As of May 2014, FSD has a Category I Instrument Landing System (ILS) established for Runway 3 and 21 ends each with a 200-foot cloud ceiling minimum. The Runway 21 approach has a published visibility minimum of 1800 RVR (less than ½ mile) while Runway 3 has a 2400 RVR (½ mile) published. All other runway ends are served by a non-precision RNAV (GPS) approach with the lowest design visibility minimums of 1 mile. Runway 15 and 33 ends are now also served by an approach with vertical guidance.

The existing approach procedures are considered adequate for the current facility. The goal for an airport is to enhance its approach procedures to increase its operational capability. At FSD, these include upgrading Runway 3/21 to accommodate a Category II ILS and upgrading Runway 15/33 to an approach with visibility minimums ¾ mile or less. A feasibility review for upgrading the existing approaches was completed.

### Upgraded Runway 3/21 Approach

Upgrading to a Category II ILS precision approach would allow for weather minimums as low as 100 foot cloud ceiling and 1200 RVR (¼ mile) visibility. The airport has experienced 807 weather observations in the past 10 years where the current approach minimums have closed the airport, or 0.7 percent of the time. With each observation is taken about every hour, this equates to about 3 days per year of lost airport utilization. The additional capacity would allow certified aircraft and crews of passenger, cargo and critical air ambulance flights to operate in and out of the airport during these periods of poor weather. Additionally, an upgrade of the Runway 3 approach in some form is recommended as this procedure aligns better with IMC wind conditions.

Upgrading to a Category II approach would require a Benefit-Cost Analysis (BCA) to be completed. As identified in FAA Report ASP-76-1, *Establishment Criteria for Category II Instrument Landing Systems (ILS)*, typically an airport with at least 2,500 certificated air carrier instrument approaches would be a candidate for an upgrade to a Category II ILS. When counting the large number of air taxi operations for passenger and air cargo aircraft, FSD is forecast to meet this threshold near PAL 3.

FAA Order 8400.2, *Procedures for the Evaluation and Approval of Facilities for…All Category II…Operations*, FAA Order 6750.16D, *Siting Criteria for Instrument Landing Systems* and FAA Advisory Circular 150/5300-13A, *Airport Design* all identify the facility requirements to accommodate a Category II ILS approach. Enhanced runway environment infrastructure is required to accommodate lower minimums on Runway 3/21. Runway 21 is currently equipped for reduced Category I ILS minimums through installation of Runway Visual Range (RVR) sensor at the touchdown zone, runway centerline and touchdown zone lighting. A Category II ILS approach would require the following infrastructure:

- Upgrade the existing MALSR approach lighting to Approach Lighting System with Sequenced Flashing Lights (ALSF) equipment
- FAA recommended land area of 2,600 feet long by 400-foot wide for ALSF equipment
- In-pavement runway centerline and touchdown zone lights
- ILS equipment with glideslope located at least 400 feet from runway centerline
- RVR equipment at the touchdown, midfield and rollout points located at least 400 feet from runway centerline
- Provide standby power to activate within 1 second of primary power failure
- Provide personnel instrument navigational aid monitoring

Other considerations include the Runway 3 end having approach lights that extend into an existing golf course. This golf course was reconfigured in 2013-2014 to meet airport design requirements.

The decision to upgrade the Runway 3 or 21 to a Category II ILS approach should be evaluated in the Alternatives chapter. The opposite runway end should be enhanced to lowest possible Category I ILS minimums.

### Upgraded Runway 15/33 Approach

As of May 2014, Runway 15 and 33 ends are served by an approach procedure with vertical guidance (LPV). The weather minimums are 301 foot cloud ceiling and 1 mile visibility for Runway 33 and 410 foot cloud ceiling and 1 and 3/8 mile visibility for Runway 15. For Runway 15/33, an upgrade to accommodate approaches with visibility minimums of ¾ mile or less was evaluated with the ARC D-IV design aircraft.

An approach with visibility minimums of no lower than ¾ mile triggers the following requirements:

- The FAA airport design approach surface is widened to 800 feet inner width expanding upward and outward at a 20:1 slope.
- The 14 CFR Part 77 Primary Surface expands from 500 feet to 1,000 feet wide centered on runway centerline. New development that penetrates this or its related 7:1 transitional surface is discouraged.
- The 14 CFR Part 77 Approach Surface is widened but the slope remains at 34:1 (34 horizontal feet for each 1 vertical foot).
- Approach Runway Protection Zone (RPZ) expands to 1,000 feet wide inner width and 1,510 feet for the outer width. The length remains the same at 1,700 feet.
- An approach lighting system may be needed to achieve ¾ mile visibility minimums depending on obstructions. An example is an Omni Directional Approach Lighting System (ODALS) which extends 1,400 feet from runway end.
- Typical lowest cloud ceiling is 250 feet depending on obstructions.

In addition to the requirements stated above, an approach with visibility minimums of less than ¾ mile will trigger these requirements:

- The FAA airport design approach surface expands upward and outward at a 34:1 slope.
- The 14 CFR Part 77 Approach Surface is widened and slope is reduced to 50:1 for the precision end of the runway.
- Typically requires a Category I Instrument Landing System which includes a localizer antenna, glide slope antenna and an upgraded approach lighting system.
- Approach Runway Protection Zone (RPZ) expands to 2,500 feet long, 1,000 feet wide inner width and 1,750 feet for the outer width.
- A 200-foot long and 800-foot wide Precision Obstacle Free Zone (OFZ) is required at the runway end.
- Typical lowest cloud ceiling is 200 feet depending on obstructions.
- Precision approach runway markings.

The decision to upgrade Runway 15/33 to accommodate lower instrument approach visibility minimums will be evaluated in the Alternatives chapter. Runway 33 is the preferred runway into the prevailing wind. Existing roadways, obstacles and land uses near the Runway 33 end appear to make upgrading this approach to accommodate visibility minimums below 1 mile less feasible than upgrading Runway 15. A more detailed FAA obstruction evaluation is recommended to review feasibility. An evaluation of passenger terminal expansion should also be completed as the 7:1 transitional surface for a ¾ mile approach should clear of buildings and aircraft tails. Upgrading to lower than ¾ mile would place terrain within the Part 77 50:1 approach surface which is not recommended.

#### Recommendations

Instrument procedure recommendations include the following:

- Maintain or remove any obstructions from existing approaches to maintain or improvement current minimums.
- Explore options to upgrade Runway 3 or 21 ends to a Category II ILS approach by PAL 3.
- Plan to upgrade the runway end opposite the Category II ILS approach to accommodate the lowest Category I ILS minimums as low as 1800 RVR.
- Explore options to upgrade Runway 15/33 with visibility minimums below 1 mile.

### *Airspace Protection*

Airspace is an important resource around airports that is very essential for safe flight operations. There are established standards to identify airspace obstructions around airports. FAA grant assurances (obligations) require the airport sponsor to take appropriate action to assure that airspace is adequately cleared to protect instrument and visual flight operations by removing, lowering, relocating, marking or lighting, or otherwise mitigating existing airport hazards and preventing the establishment or creating of future airport hazards. Sufficiently clear airspace near the approach and departure ends and along extended centerline are vitally important for safe airport operations.

An obstruction analysis is currently underway to identify obstruction to Part 77 and other airspace surfaces. The results of this analysis will be identified in the Airport Layout Plan drawing set.

### Area Airspace

The airspace classification including and within 5 nautical miles of FSD at 3,900 feet MSL and lower is Class D controlled airspace. Air Traffic Control Tower (ATCT) safely and efficiently handles all operations within this airspace. There is also Terminal Radar Control (TRACON) service provided beyond the limits of Class D airspace for IFR aircraft and available to VFR aircraft. The FAA is studying the need to establish Class C airspace out 20 nautical miles from FSD to control and safely separate traffic within the local area. Any implementation of Class C airspace is not anticipated to affect the immediate facility infrastructure needs at FSD, but will likely improve the safety and flow of aircraft operations within the local area.

### Part 77 Civil Airport Imaginary Surfaces

Title 14 CFR (Code of Federal Regulations) Part 77 *Safe, Efficient Use, and Preservation of the Navigable Airspace* is used to determine whether man-made or natural objects penetrate these “imaginary” three-dimensional airspace surfaces and become obstructions. Federal Aviation Regulation (FAR) Part 77 surfaces are the protective surfaces most often used to provide height restriction zoning protection around an airport. Sufficiently clear airspace is necessary for the safe and efficient use of aircraft arriving and departing an airport. Part 77 airspace standards are defined by the most demanding approach to a runway. These airspace surfaces include the primary, approach, transitional, horizontal and conical surfaces each with different standards. The slope of an airspace surface is defined as the horizontal distance traveled for every one vertical foot (i.e. 50:1).

Of note is the primary surfaces which should be kept clear of non-essential objects above the runway centerline elevation. The approach surface extends upward an outward from the runway a slope defined as the horizontal distance traveled for every one vertical foot (i.e. 50:1). The transitional surface is a 7:1 slope and extends to the size of the primary and approach surfaces. The following exhibit depicts the future approach airspace surfaces for FSD:

*Exhibit 4-28 – Future Part 77 Approach Airspace Requirements*

| Future Part 77 Approach Airspace Requirements | | | | | | |
|---|---|---|---|---|---|---|
| Runway End | Approach Standards | Part 77 Code | Inner Width* | Outer Width | Length | Slope |
| 3 | Precision | PIR | 1,000’ | 16,000’ | 50,000’ | 50:1/40:1 |
| 21 | Precision | PIR | 1,000’ | 16,000’ | 50,000’ | 50:1/40:1 |
| 15 | Non-Precision Other-Than-Utility As low as ¾ mile | D | 1,000’ | 4,000’ | 10,000’ | 34:1 |
| 33 | Non-Precision Other-Than-Utility As low as ¾ mile | D | 1,000’ | 4,000’ | 10,000’ | 34:1 |
| 9 | Non-Precision Utility | A(NP) | 500’ | 2,000’ | 5,000’ | 20:1 |
| 27 | Non-Precision Utility | A(NP) | 500’ | 2,000’ | 5,000’ | 20:1 |

*Source: 14 CFR Part 77, KLJ Analysis*
**Inner width is also the Primary Surface width driven by the most demanding approach to a runway.*
*Blue indicates change from existing standard.*

New development should be kept below the Part 77 surface elevation. Airspace surfaces must clear public roads by 15 feet, interstate highways by 17 feet, railroads by 23 feet, and private roads by 10 feet or the height of the most critical vehicle.

For existing obstructions that cannot easily be removed, an aeronautical study should be completed to determine the aeronautical effect and identify potential mitigation strategies (i.e. lighting, marking). There are various existing Part 77 obstructions located around FSD that will be identified on the Airport Layout Plan for evaluation.

### Runway Approach/Departures Surfaces

FAA identifies sloping approach surfaces that must be cleared at an absolute minimum for safety for landing aircraft. These surfaces are identified in Table 3-2 of FAA Advisory Circular 150/5300-13A, *Airport Design*. All objects must clear the surface for the applicable runway operational design standard to meet minimum aviation safety standards for a given runway landing threshold location. Approach airspace penetrations require mitigation which may include the removal of the object or the runway landing threshold to be shifted or displaced down the runway.

The departure surface applies to instrument departures. It begins at the end of the takeoff distance available and extends upward and outward at a 40:1 slope. Penetrations to the departure surface may simply require the obstacle to be published, or require mitigation including increasing the minimum aircraft climb rate or runway length operational restrictions.

An FAA aeronautical study should be completed to determine the operational impacts and necessary mitigation. When usable landing or takeoff distances do not match the runway length, then a special application of declared distances should be used to meet operational safety requirements. Declared distances can be used to mitigate approach/departure obstructions, land use incompatibilities, or incompatible airport design areas.

Per Table 3-2, the following approach/departure surface standards apply:

*Exhibit 4-29 - Approach/Departure Surface Requirements*

| Approach/Departure Surface Requirements | | | |
|---|---|---|---|
| Runway End(s) | Table 3-2 Row | Description | Slope |
| **Existing** | | | |
| 3, 21 | 7 | Instrument approaches having visibility minimums < ¾ statute mile | 34:1 |
| 15, 33 | 5 | Approaches supporting instrument night operations in greater than Category B aircraft | 20:1 |
| 15, 33 | 8 | Approach end of runways to accommodate approaches with vertical guidance | 30:1 |
| 9, 27 | 4, 8 | Approaches supporting instrument night operations in Category A and B aircraft only | 20:1 |
| All | 9 | Departure runway ends for all instrument operations | 40:1 |
| **Future** | | | |
| 15 | 6 | Instrument approaches having visibility minimums ≥ ¾ but <1 statute mile, day or night | 20:1 |
| 9, 27 | 8 | Approach end of runways to accommodate approaches with vertical guidance | 30:1 |

*Source: FAA Advisory Circular 150/5300-13A, KLJ Analysis*
*Note: Most critical row(s) shown. Only changes from existing shown in future.*

There are penetrations to the existing departure surfaces that should be evaluated by FAA for aeronautical effect. Critical obstructions to the existing approach exist along the Runway 33 end. Several objects including the airport perimeter fence and city water tank penetrate the 20:1 approach surface. Mitigation options to be reviewed to clear the approach include obstruction removal, lighting/marking, declared distances and/or adjustment of the visual guidance slope indicator angle.

### Terminal Instrument Procedures (TERPS)

The FAA has established standards to develop instrument procedures in the United States. FAA Order 8260.3B, *U.S. Standards for Terminal Instrument Procedures (TERPS)* and related orders outlines these complex standards to develop departure, climb, en-route, approach, missed approach and holding standards for aircraft operating along a published route with different navigational equipment. Some critical obstruction clearance standards are integrated into the approach/departure surfaces identified in Airport Design including many final approach segments and the 40:1 sloped departure surface. Other important obstacle clearance surfaces within the inner airport environment identified in TERPS include the precision obstacle clearance surfaces and the missed approach surfaces. Some TERPS surfaces may even be more restrictive that Part 77 standards. Penetrations to TERPS surfaces results in higher weather minimums or operations restrictions.

There are higher than typical approach minimums published for Runway 15 and 33 signifying an obstruction or several obstructions causing these higher minimums. A full TERPS study is not planned at this time, however coordination with FAA Flight Procedures Office is recommended to identify the critical obstruction within each approach.

Every three years the FAA will conduct a review of the most critical final approach "visual area" TERPS surfaces to verify compliance. There are existing penetrations to the Runway 33 visual area surface (20:1 slope) which may result in the loss of night minimums unless the obstacles are removed or obstruction(s) lighted. The airport should be proactive to address these obstructions or be prepared to lose operational capability from that runway end.

### One Engine Inoperative (OEI) Surfaces

One Engine Inoperative (OEI) procedures are developed by air carriers to clear obstacles in situations where one engine becomes inoperative. OEI obstacle surfaces have shallow slopes to provide object clearance when aircraft climb performance is reduced as a result of engine power loss. OEI procedures are developed by each airline. Critical obstructions effect the utility of the runway by these aircraft. The FAA had required a clear 62.5:1 sloped surface to be kept clear of obstacles from departure ends. The 62.5:1 OEI surface is no longer required by FAA because of the large area covered, the scope of obstructions found and inability for airport sponsors to clear these areas.

As of April 2014, the FAA published a Federal Register proposing to have airports develop individual OEI departure area in coordination with FAA. Submittal to FAA will enable the OEI surface to be consolidated so that the effects of new structure encroaching them can be evaluated under Part 77. In lieu of developing a new surface at this time, we recommend a standard 62.5:1 surface be used for future runway, airspace and land use planning. This should apply to the primary air carrier runway - Runway 3/21.

### Other Design Surfaces

Other airport design airspace surfaces considered protect navigational aids and identify airport data to populate FAA databases.

#### *Inner-Approach/Transitional Obstacle Free Zones*

If an approach lighting system is installed, a clear inner-approach and inner-transitional Obstacle Free Zone (OFZ) is necessary. The inner-approach OFZ is a 50:1 sloped surface begins 200 feet from the runway threshold and extends 200 feet beyond the last approach light. The inner-transitional OFZ airspace surface is along the sides of the ROFZ. No objects not necessary for airport operations, including aircraft tails can penetrate this surface. After improvements to Runway 3 are completed, no objects penetrate this surface at FSD but consideration should be made for a future installation on Runway 15.

#### *Precision Obstacle Free Zone (POFZ)*

If a precision instrument approach is established there exists as POFZ which begins at the runway threshold as a flat surface 800 feet wide centered on the runway centerline and extending 200 feet to connect to the inner-approach OFZ. As with the OFZ, no objects not necessary for airport operations including aircraft or vehicles on the ground can penetrate this surface. This surface is currently clear of all objects where it applies at Runway 3 and 21 ends.

#### *Airport Surveillance Radar (ASR)*

The Airport Surveillance Radar (ASR) provides primary radar coverage for terminal airspace areas in the vicinity of the airport. The ASR site at FSD is located west of Runway 3/21 and south of Runway 15/33. A 1,500 foot circular critical area from the radar site is typical. Any development within this area needs to be reviewed to protect the integrity of the ASR operation. Larger buildings and/or development is generally prohibited from this area.

### Visual Aids

Visual aids at an airport require clear Obstacle Clearance Surface (OCS) to provide sufficient guidance for pilots. These include approach lighting systems and visual guidance slope indicators. For a Precision Approach Path Indicator (PAPI) system, this surface begins 300 feet in front of the VGSI system and extends upward and outward at an angle 1 degree less than the lowest on-course aiming angle. For a standard 3 degree glide path this equates to a 31.29:1 sloped surface. The specific airspace standards for this and for approach lighting systems are defined in FAA Order 6850.2B. FAA is now highlighting the need to review this surface. The VGSI OCS to Runways 15 and 33 should be reviewed for compliance as it appears objects are close to this surface. The Runway 15 PAPI is published to be unusable beyond 6 degrees left and 5 degrees right of centerline.

### FAA Aeronautical Surveys

The FAA has implemented Aeronautical Survey requirements per Advisory Circular 150/5300-18B *General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards*. FAA airport survey requirements require obstruction data to be collected using assembled aerial imagery for the airport. This data is used in aeronautical publications and to develop instrument approach procedures.

An updated aeronautical survey is currently in progress with this planning effort. Imagery was acquired in 2013. As of FY 2013, all projects at this airport must now comply with Airports GIS standards. When runway ends change or an enhanced instrument approach is proposed then a new obstruction analysis is necessary. Obstructions that have been removed can be deleted from the database by coordinating with FAA Flight Procedures Office.

## *Navigational Aids*

Airfield NAVAIDs are any ground or satellite based electronic or visual device to assist pilots with airport operations. They provide for the safe and efficient operations of aircraft on an airport or within the vicinity of an airport. The type of NAVAIDS required are determined by FAA guidance based on an airport’s location, activity and usage type.

### Area Navigation

The FAA is updating the nation’s air transportation infrastructure through the Next Generation Air Transportation System (NextGen) program. New procedures and technology are to be implemented to improve the efficiency and safety of the national air transportation system. For area navigation, satellite-based NAVAIDs will primarily be used for air navigation with ground-based NAVAIDs used for secondary purposes. Other initiatives include implementing a new surveillance technology for tracking aircraft known as Automatic Dependent Surveillance-Broadcast (ADS-B) to improve position accuracy reporting and supplement ground radar data for air traffic control.

FSD should plan for the use of satellite-based area navigation by establishing satellite-based approaches rather than rely on ground-based NAVAIDs such as the existing Very-high Frequency Omni-directional Range (VOR). These ground based NAVAIDs are currently being decommissioned by FAA. Over time, the existing Airport Surveillance Radar will be replaced by ADS-B.

### Runway Approach

Other NAVAIDs are developed specifically to provide "approach" navigation guidance, which assists aircraft in landing at a specific airport or runway. These NAVAIDs are electronic or visual in type. FAA Order 6750.16D, *Siting Criteria for Instrument Landing Systems* and FAA Order 6850.2B, *Visual Guidance Lighting Systems* defines the standards for these lighting systems

#### *Instrument Landing System (ILS)*

An ILS is a ground-based system that provides precision instrument guidance to aircraft approaching and landing on a runway. ILS approaches enable a safe landing in IMC with low cloud ceiling and/or visibility. Major components of ILS include the localizer antenna for horizontal guidance, glide slope antenna for vertical guidance and an approach lighting system. The localizer and glide slope require critical areas that are sufficiently graded and do not contain certain objects.

There are three categories of ILS systems, each capable of supporting approaches in equipped aircraft with lower weather minimums. Each category also requires an increasing complexity of airport equipment as well as aircraft and flight crew certifications. Currently Runway 3 and 21 are equipped with Category I ILS approaches. It is proposed to plan for an upgraded Category II ILS into the future for either Runway 3 or 21 ends. A Category II ILS requires an enhanced approach lighting system among other facility requirements. Ultimately, the ground-based localizer and glideslope systems may eventually be replaced by precision GPS systems.

### *Exhibit 4-30 – Standard ILS Categories*

| Standard ILS Categories | | |
|---|---|---|
| **ILS Category** | **Decision Height (ft.)** | **Runway Visual Range (ft.)** |
| Category I | 200 | 2,400/1,800 |
| Category II | 100 | 1200 |
| Category IIIa | 0-100 | 700 |
| Category IIIb | 0-50 | 150 |
| Category IIIc | 0 | 0 |

*Source: FAA Aeronautical Information Manual*

#### *Visual Guidance Slope Indicator (VGSI)*

A VGSI system provides visual descent guidance to aircraft on approach to landing. There are several types of VGSI systems available including a Precision Approach Path Indicator (PAPI) system and a Visual Approach Slope Indicator (VASI). These systems are typically installed on runway ends with instrument approaches and co-located with the glideslope antenna, but are also installed for visual runways. PAPI systems, a newer technology, consist of a single row of two to four lights. The two light system is for non-jet runways and the four light system is for jet-capable runways.

FSD should upgrade the existing VASI system on Runway 21 to a 4-box PAPI when the existing system reaches the end of its useful life. The existing Runway 3, 15 and 33 PAPI should be maintained. A 2-box PAPI for Runway 9/27 should also be installed as a long-term need. All PAPIs should meet obstacle clearance requirements.

#### *Runway End Identifier Lights (REIL)*

REILs consist of high-intensity flashing white strobe lights located on the approach ends of runways to assist the pilot in early identification of the runway threshold. Additionally, these are typically installed on runways that are surrounded by a preponderance of other lights or if the runway lacks contrast with surrounding terrain. These are not installed with an approach lighting system.

The REILs for Runway 15/33 should be maintained through the long-term. If an approach lighting system is installed for Runway 15 then they should be replaced. REILs are currently unidirectional but should consider an omnidirectional installation to provide good circling guidance, especially for Runway 33 as this runway is aligned into the prevailing wind.

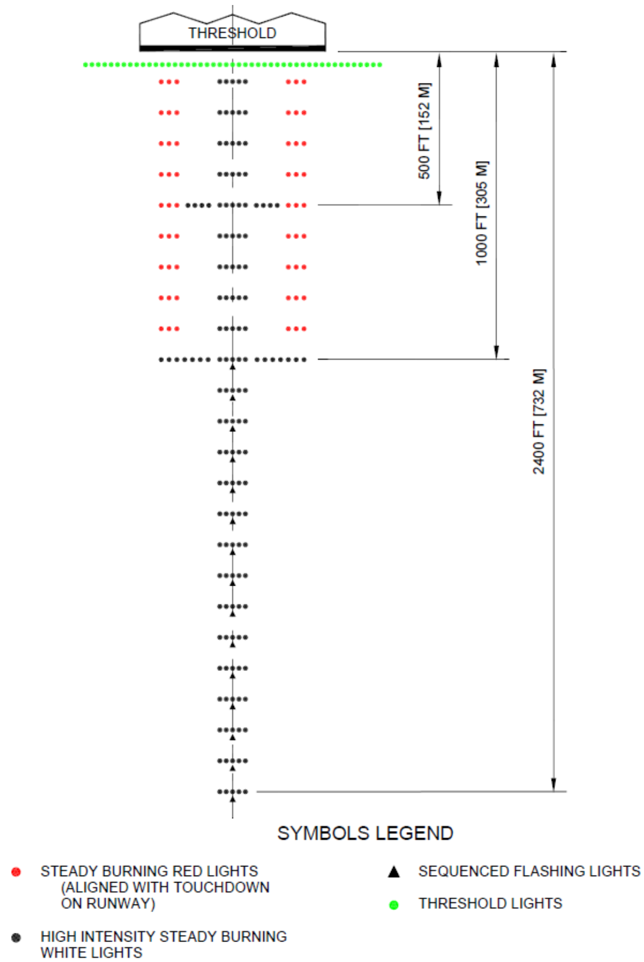
#### *Approach Lighting System (ALS)*

ALP help pilots transition from instrument flight to visual flight for landing. An ALS is required as part of an ILS. An ALS installed on non-precision approach runways can help provide ¼ mile visibility credit for instrument approach minimums. There are various configurations, lighting types and complexities to these systems. The requirement for an airport runway end is dependent upon the type of precision approach and visibility minimums of the approach.

Common types of ALS to consider at FSD include:

- Omnidirectional Approach Lighting System (ODALS) consisting of seven omnidirectional sequenced strobe lights along runway approach centerline providing visual guidance to non-precision runways. This is recommended to establish a future ¾ mile approach to Runway 15.
- Medium-intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) consists of seven rows of lights, five flashing lights and a row of steady burning green lights prior to runway threshold. The system is 2,400 feet in total length. This is required for a Category I approach for existing Runway 3/21.
- Approach Lighting System with Sequenced Flashing Lights (ALSF) is a more complex lighting system required for Category II precision approach. The system includes a green threshold bar, 15 total rows of white lights, nine side rows bars along centerline, and sequenced flashing white lights totaling 2,400 feet in length.

**Exhibit 4-31 – ALSF-2 Configuration**




*Source: FAA AC 150/5300-13A, Airport Design*

## Airfield Visual

Visual NAVAIDs provide airport users with visual references within the airport environment. They consist of lighting, signage and pavement markings on an airport. Visual NAVAIDS are necessary airport facility components on the airfield, promoting enhancing situational awareness, operational capability and safety. FAA Advisory Circular 150/5340-30E, *Design and Installation of Airport Visual Aids* defines the standards for these systems.

### *Airport Beacon*

The airport beacon serves as the airport identification light so approaching pilots can identify the airport location during night and IMC. The airport beacon's location at FSD is outside of any development areas and adequately serves the airport without known obstruction to its line of sight.

### *Runway Lighting*

Runway edge lights are placed off the edge of the runway surface to help pilots define the edges and end of the runway during night and low visibility conditions. Runway lights are classified according to the intensity of light they produce including high intensity (HIRL), medium intensity (MIRL) and low intensity (LIRL). The existing HIRL for Runway 3/21 is required for RVR based minimums. Runway 15/33 also has HIRL but only MIRL is required. HIRL is still recommended for air carrier operations. Runway 9/27 has MIRL and this system is recommended for continued night operations.

Other runway lights are installed at airports to facilitate the safe and efficient operation of aircraft. These include runway centerline lighting (RCL), touchdown zone lighting (TDZL), land and hold short lighting systems (LAHSO) and runway status light (RWSL). Runway 3/21 is equipped with RCL and Runway 3 has TDZL installed. An in-pavement TDZL system is needed for Runway 3 to achieve 1800 RVR minimums. A RWSL system may be installed by FAA to help prevent runway incursions. LAHSO operations are uncommon at FSD.

### *Taxiway Lighting*

Taxiway edge lighting delineates the taxiway and apron edges. The FAA standard taxiway edge lighting system is Medium Intensity Taxiway Lights (MITL). Taxiway edge lights are installed for all taxiways at FSD. Enhancements at intersections may be needed to meet low visibility (<1200 RVR) Surface Movement Guidance and Control System (SMGCS) operational requirements. Other taxiway lights are installed at airports to promote safe operations. These include taxiway centerline lighting, runway guard lights (RGL), runway stop bar and clearance bar. RGL are installed at all taxiway-runway intersections for Runway 3/21 and 15/33 as recommended by FAA. To facilitate low visibility operations down as low as 600 RVR, taxiway centerline lights should be installed along the preferred route(s) and to lead in to non-movement areas.

## Airfield Signage

Airfield signage is essential for the safe and efficient operation of aircraft and ground vehicles on the airport movement area. Common signs include mandatory instruction signs, location signs, boundary signs, direction/destination signs, information signs and distance remaining signs. Airports certificated under 14 CFR Part 139 such as FSD must have a sign plan developed and implemented to identify taxi routes and holding positions. This plan must be consistent with FAA Advisory Circular 150/5340-18F, *Standards for Airport Sign Systems*. This plan should be updated to meet current standards and operating procedures.

## Pavement Markings

Pavement markings help airport users visually identify important features on the airfield. FAA has defined numerous different pavement markings to promote safety and situational awareness as defined by FAA AC 150/5340-1L, *Standards for Airport Markings*.

### *Runway*

Runway pavement markings are white in color. The type and complexity of the markings are determined by the approach threshold category to the runway end. The minimum required runway markings for a standard runway are as follows:

- Visual (landing designator, centerline)
- Non-Precision (landing designator, centerline, threshold)
- Precision (landing designator, centerline, threshold, aiming point, touchdown zone, edge)

Additional runway markings for blast pad and runway shoulders are also required. Runway 3/21 and 15/33 should continue to have precision and non-precision markings maintained, respectively. Runway 9/27 now has a non-precision approach, thus non-precision approach markings should replace the basic runway markings.

### *Taxiway/Taxilane*

Taxiway and taxilane markings are important for directional guidance for taxiing aircraft and ground vehicles. Common taxiway and apron markings include taxiway/taxiway centerline, edge and non-movement area boundary. Enhanced taxiway markings are required along taxiway centerlines that lead to runway entrances. Taxiway/taxilane centerline markings should be used throughout to define a safe centerline with object clearance. Taxiway/taxilane edge markings should be used to delineate the taxiway edge from the shoulder, apron or some other contiguous paved surface. The non-movement area boundary should be marked appropriately per ATCT line of sight requirements.

### *Holding Position*

Holding position markings are a visual reference to prevent aircraft and vehicles from entering critical areas such as an active runway environment. These markings consist on yellow bars and dashes on a black background. The required setback is 265 feet from Runway 3/21 and 15/33 centerlines, and 140 feet for Runway 9/27. Deficiencies noted are at the Taxiway K & Runway 3/21 intersection (257 feet) and Taxiway B at Runway 15/33 (262 feet). These setbacks are not expected to change into the future.

## Low Visibility Operations

Taxiing occurring in visibility conditions less than 1,200 feet Runway Visual Range (RVR) require a Surface Movement Guidance Control System (SMGCS) developed for the airport. This program requires the creation of low visibility taxi plans and the development of enhanced infrastructure to help operators clearly identify taxi routes. Airport navigational aid enhancements may include stop bars, taxiway centerline lines, runway guard lights, geographic position markings and clearance bars.

Based on the planned visibility minimums at FSD, only departing aircraft would require SMGCS as landing operations prohibited below 1200 RVR. Takeoff operations must be specially authorized below 1200 RVR. Takeoff operations at 1000 RVR require two or more RVR reports, HIRL and runway centerline markings with 500 RVR possible with runway centerline lights. Specific taxi routes are defined as low visibility.

Requirements for low visibility are fully identified in FAA AC 120/57A, *Surface Movement Guidance and Control System*. Operations below 600 RVR require taxiway centerline lights with edge lights at curves, in-pavement runway guard lights at the runway and ILS holdine, and additional pavement markings.

FSD should consider identifying low visibility taxiing route(s) to Runway 3/21, upgrade infrastructure and coordinate to have low visibility departures approved.

### Meteorological

Aircraft operating to and from an airport require meteorological aids to provide current weather data. Weather information helps pilots make informed decision about flight operations. Airports have various aids installed providing local weather information.

#### *Surface Weather Observation*

The existing FAA-owned ASOS located west of the Runway 3 glideslope antenna is sufficient for the long-term. Weather observing systems are recommended to be kept clear of agricultural operations within 100 feet, clear of objects 15 feet below the sensor height within 500 feet, and clear of objects greater than 10 feet above the sensor within 1,000 feet. Trees are southwest of the ASOS system are located 680 feet from the system at a height of 36 feet above an assumed 30 foot sensor height, which is acceptable.

#### *Wind Cone*

Wind cones visually indicate the current wind direction and velocity on an airfield. The primary wind cone and segmented circle is located within all three runways in a central visible location, lighted for night operations. Lighted supplemental wind cones are installed around the airfield near Runway 3/21 and 15/33 ends to provide local surface wind direction information to pilots.

#### *Other*

Runway Visual Range (RVR) visibility sensor systems provide instant reporting of the visibility at targeted locations on the airfield. The existing Runway 3/21 system is installed to serve the touchdown zone for each runway end. An additional system at the mid-point is required to allow for Category II or lower operations.

A Low-Level Windshear Alert System (LLWAS) is installed at FSD to measure differences in wind conditions that may create operational hazards to flying known as “wind shear”. Pilots are notified via the ATCT. This system should be maintained at FSD.

### Communications & ATC

The ability for pilots to communicate with other pilots and air traffic control is critical for the safety and efficiency of the overall air transportation system.

FSD has an operating airport traffic control tower (ATCT) located north of the passenger terminal complex. ATCT provides clearances, radar advisories and safety alerts to IFR and VFR flights within the controlled Class D airspace. The ATCT facility also houses Terminal Radar Control (TRACON). ATCT and TRACON operate between 5 a.m. and 12 midnight daily. Airport communication frequencies are sufficient for Class D airport operation.

ATCT requires clear line of sight to the airfield. The tower cab controller eye height is 65 feet above ground level or 1487.7 feet MSL. Currently, the tower has limited visibility to Taxiways H, G and J between the east cargo ramp and Taxiway B as a result of east general aviation hangar development. Protection of ATCT line of sight restrict can building placement. The tower is approaching 50 years old and is currently being rehabilitated to extend its useful life. Within the planning period the structure may need to be replaced on the current site or at another location. The potential addition of public airport access to the west side of the airfield could open new ATCT site options not previously explored. FAA Order 6480.4A, *Airport Traffic Control Tower Siting Process* identifies the criteria used for considering a new tower location:

1. Visual performance
2. TERPS airspace surfaces
3. FAR Part 77 airspace
4. Sunlight/daylight
5. Airport/background lighting
6. Atmospheric Conditions
7. Industrial Municipal Discharge
8. Site Access
9. Interior Physical Barriers
10. Security

The Airport Layout Plan will show the preferred site location based on a preliminary analysis. Additional research and modeling will be required prior to actual site selection. An ATCT siting study would be initiated by the FAA.

## *Taxiways*

Taxiways provide for the safe and efficient movement of aircraft between the runway and other operational areas of the airport. The taxiway system should provide critical links to airside infrastructure, increase capacity and reduce the risk of an incursion with traffic on the runway. The taxiway system should meet the standards design requirements identified in FAA AC 150/5300-13A, *Airport Design*.

### System Design

FAA has placed a renewed emphasis on taxiway design in their updated airport design standards. Fundamental elements help develop and efficient system to meet demands, reduce pilot confusion and enhance safety. Considerations include:

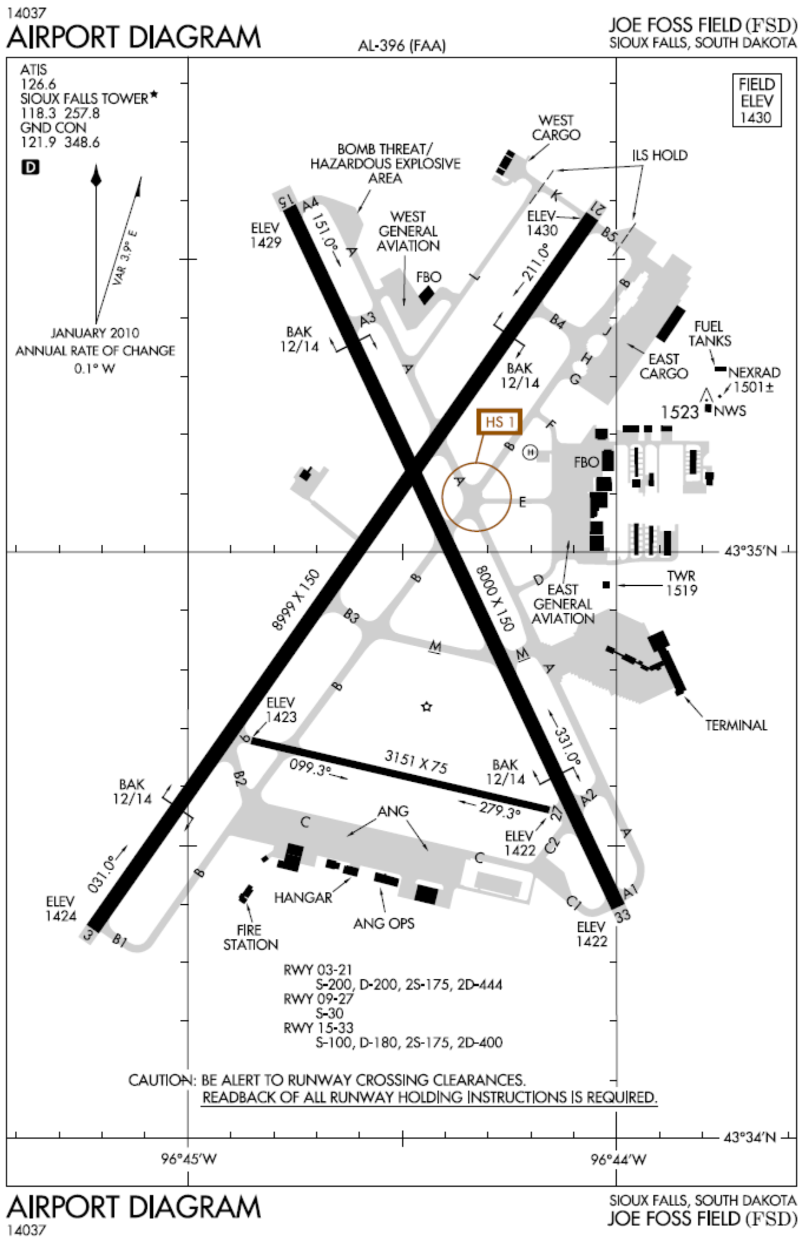
- Design taxiways to meet FAA design standards for existing and future users considering expandability of airport facilities.
- Design taxiway intersections so the cockpit is over the centerline with a sufficient taxiway edge safety margin.
- Simplify taxiway intersections to reduce pilot confusion using the three-node concept, where a pilot has no more than three choices at an intersection.
- Eliminate "hot spots" identified by the FAA Runway Safety Action Team where enhanced pilot awareness is encouraged.
- Minimize the number of runway crossings and avoid direct access from the apron to the runway.
- Eliminate aligned taxiways whose centerline coincides with a runway centerline.
- Other considerations include avoiding wide expanses of pavement and avoiding "high energy intersections" near the middle third of a runway.

FSD has an identified "hot spot" at the intersection of taxiway A, B and E. This is known locally as the "five corners" intersection. A pilot has four directional decisions to make with non-standard angles. This intersection should be corrected to meet design standards. One possible correction measure is to move the Taxiway E entrance to connect direct with Taxiway A or B.

Runway 9/27 has an aligned taxiway connected to each runway end. Additionally, these taxiways lead directly to Runway 3/21 and 15/33 that may lead to pilot confusion. This configuration should be corrected so that a taxiway provides perpendicular access to the runway ends.

There are exit taxiways at FSD that either are not a standard right-angle or acute-angled design, or not in a location to facilitate the efficient movement of aircraft from the runway to the taxiway system. These taxiways should be reevaluated for the efficient flow of aircraft to enhance capacity.

### *Exhibit 4-32 – FSD Airport Diagram*




*Source: FAA Terminal Procedures*

## Design Standards

FAA identifies the design requirements for taxiways. The design standards vary based on the Taxiway Design Group (TDG) and Airplane Design Group (ADG) identified for the design aircraft using a particular taxiway. In addition to taxiway/taxiway pavement width, some of the safety standards include:

- Taxiway/Taxilane Safety Area (TSA) – A defined graded and drained surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft deviating from the taxiway. The surface should be suitable to support equipment during dry conditions

- Taxiway Edge Safety Margin (TESM) – The minimum acceptable distance between the outside of the airplane wheels and the pavement edge.
- Taxiway/Taxilane Object Free Area (TOFA) – An area centered on the centerline to provide enhanced the safety for taxiing aircraft by prohibiting parked aircraft and above ground objects except for those objects that need to be located in the OFA for aircraft ground maneuvering purposes.

Other design standards include taxiway shoulder width to prevent jet blast soil erosion or debris ingestion for jet engines, and required separation distances to other taxiways/taxilanes. A table describing the specific FAA taxiway design standards for various ADG and TDG design aircraft is identified in the following tables.

*Exhibit 4-33 - FAA Taxiway Design Standards Matrix (ADG)*

| FAA Taxiway Design Standards Matrix (ADG) | | | |
|---|---|---|---|
| **Design Standard** | **Airplane Design Group (ADG)** | | |
| | **ADG II* (Existing)** | **ADG III* (Future)** | **ADG IV* (Existing)** |
| Taxiway Safety Area | 79 feet | 118 feet | 171 feet |
| Taxiway Object Free Area | 131 feet | 186 feet | 259 feet |
| Taxilane Object Free Area | 115 feet | 162 feet | 225 feet |
| Taxiway Centerline to Parallel Taxiway/Taxilane Centerline | 105 feet | 152 feet | 215 feet |
| Taxilane Centerline to Parallel Taxiway/Taxilane Centerline | 97 feet | 140 feet | 198 feet |
| Taxiway Centerline to Fixed or Movable Object | 65.5 feet | 93 feet | 129.5 feet |
| Taxilane Centerline to Fixed or Movable Object | 57.5 feet | 81 feet | 112.5 feet |
| Taxiway Wingtip Clearance | 26 feet | 34 feet | 44 feet |
| Taxilane Wingtip Clearance | 18 feet | 27 feet | 31 feet |

*ADG II applies to general aviation, ADG III applies to future general aviation and existing commercial service aircraft, ADG IV applies to overall airfield and air cargo area.*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

*Exhibit 4-34 – FAA Taxiway Design Standards Matrix (TDG)*

| FAA Taxiway Design Standards Matrix (TDG) | | | | |
|---|---|---|---|---|
| **Design Standard** | **Taxiway Design Group (TDG)** | | | |
| | **TDG 2* (Existing)** | **TDG 3* (Future)** | **TDG 4* (Existing)** | **TDG 5* (Existing)** |
| Taxiway Width | 35 feet | 50 feet | 50 feet | 75 feet |
| Taxiway Edge Safety Margin | 7.5 feet | 10 feet | 10 feet | 15 feet |
| Taxiway Shoulder Width | 10 feet | 20 feet | 20 feet | 25 feet |
| Runway to Taxiway Separation for Reverse Turns from a High-Speed Exit (Minimum) | 265 feet | 350 feet | 350 feet | 427 feet |

**TDG 2 applies to existing general aviation, TDG 3 applies to future general aviation, TDG-4 applies to existing commercial service aircraft, TDG 5 applies to overall airfield and air cargo area.*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

The existing airfield system serving Runway 15/33 and 3/21 has taxiways that are 75 feet in width sufficient to accommodate the existing and future design aircraft. Taxiways G, H, J as well as some runway turnoffs exceed this width standard. Taxiways D, E, F, K and L that serve the general aviation areas have a 50 foot width designed to TDG 3 standards sufficient through the planning period. As noted earlier, the parallel taxiway setback from Runway 3/21 exceeds the minimum setback distance standard and varies along its alignment. The recommended setback is 450 feet with a high-speed exit.

Deficiencies to the existing design standards include the taxiway shoulder. A paved taxiway shoulder width of 25 feet is required for taxiways supporting TDG-5, ADG-IV operations. A 20-foot paved shoulder is recommended for taxiways supporting TDG-3/4, ADG-III aircraft. The taxiways closest to the Runway 21 end along the east and west cargo aprons have direct access to the runway and should be corrected. Taxiway M is the only non-parallel taxiway runway crossing located at a high-energy location. During taxiway reconstruction, taxiway fillet geometry should be corrected to meet current standards.

Additionally, Taxiway K should be renamed L1 as it is a connector from parallel Taxiway L to Runway 3/21. Removal of the intersection with Runway 9/27 is recommended to avoid mistaking the pavement as a taxiway turnoff where it intersects with Runway 15/33 and 3/21.

### Exit Taxiways

Exit taxiways serve to reduce runway occupancy time which increases runway capacity. These taxiways are located along the runway in ideal aircraft deceleration and stop locations. High speed taxiways allow aircraft to exit a runway without having to decelerate to typical taxiway speed. Guidance from FAA AC 150/5300-13A, *Airport Design* and FAA AC 150/5060-5, *Airport Capacity and Delay* was used for this analysis.

As identified earlier in this chapter, total FSD hourly operations are forecast to exceed 30 per hour starting at PAL 2 thus capacity enhancements should be planned. Capacity can be enhanced when it is possible to use more than one runway simultaneously, however this is not always possible due to weather condition. Ideally located exit taxiway are important because each additional 100 feet of taxiway distance on runways causes 0.75 seconds of delay for the subsequent aircraft operation. This delay is computed during peak period when multiple aircraft are arriving.

The majority of the airline and air cargo landing operations occur on Runway 21 and 33. The fleet mix at FSD should maintain right-angled exits located between 6,500 and 8,000 feet from the landing threshold. The optimal high-speed exit location is between 5,000 and 5,500 feet down the runway. An acute-angled taxiway is for exit only operations and angled between 30 and 45 degrees. A high-speed exit angle is 30 degrees. Parallel taxiways are not considered dedicated exit taxiways but can be used. The following is a review of the current exit taxiways for the air carrier runways at FSD.

***Exhibit 4-35 – Exit Taxiway Utilization Percentages***

| Exit Taxiway Utilization Percentages | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Exit** | **Type** | **Distance from Threshold** | **Wet Runway** | | | | **Dry Runway** | | | |
| | | | **S** | **T** | **L** | **H** | **S** | **T** | **L** | **H** |
| **Runway 3** | | | | | | | | | | |
| Taxiway B3 | Right Angle | 4,200 feet | 100 | 80 | 1 | 0 | 100 | 98 | 8 | 0 |
| ***Future*** | ***High Speed*** | ***5,500 feet*** | ***100*** | ***100*** | ***27*** | ***0*** | ***100*** | ***100*** | ***92*** | ***81*** |
| Taxiway A | Acute Angle | 6,200 feet | 100 | 100 | 48 | 10 | 100 | 100 | 98 | 95 |
| Taxiway B4 | Right Angle | 7,800 feet | 100 | 100 | 97 | 84 | 100 | 100 | 100 | 100 |
| Taxiway B5 | Right Angle | 9,000 feet | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Runway 21** | | | | | | | | | | |
| Taxiway B4 | Right Angle | 1,200 feet | 4 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Taxiway A | Acute Angle | 2,800 feet | 84 | 1 | 0 | 0 | 99 | 10 | 0 | 0 |
| Taxiway B3 | Right Angle | 4,800 feet | 100 | 97 | 4 | 0 | 100 | 100 | 24 | 2 |
| ***Future*** | ***High Speed*** | ***5,500 feet*** | ***100*** | ***100*** | ***27*** | ***0*** | ***100*** | ***100*** | ***92*** | ***81*** |
| Taxiway B2 | Acute Angle | 6,700 feet | 100 | 100 | 71 | 35 | 100 | 100 | 100 | 99 |
| Taxiway B1 | Right Angle | 9,000 feet | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Runway 15** | | | | | | | | | | |
| Taxiway A3 | Right Angle | 1,400 feet | 4 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Taxiway B | Acute Angle | 3,700 feet | 99 | 41 | 0 | 0 | 100 | 82 | 9 | 0 |
| Taxiway M | Right Angle | 5,200 feet | 100 | 100 | 12 | 0 | 100 | 100 | 49 | 9 |
| ***Future*** | ***High Speed*** | ***5,500 feet*** | ***100*** | ***100*** | ***27*** | ***0*** | ***100*** | ***100*** | ***92*** | ***81*** |
| Taxiway A2 | Right Angle* | 6,900 feet | 100 | 100 | 71 | 35 | 100 | 100 | 100 | 99 |
| Taxiway A1 | Right Angle | 8,000 feet | 100 | 100 | 100 | 93 | 100 | 100 | 100 | 100 |
| **Runway 33** | | | | | | | | | | |
| Taxiway A2 | Acute Angle | 1,100 feet | 4 | 0 | 0 | 0 | 13 | 0 | 0 | 0 |
| Taxiway M | Right Angle | 2,800 feet | 84 | 1 | 0 | 0 | 99 | 10 | 0 | 0 |
| Taxiway B | Acute Angle | 4,200 feet | 100 | 80 | 1 | 0 | 100 | 98 | 26 | 3 |
| ***Future*** | ***High Speed*** | ***5,500 feet*** | ***100*** | ***100*** | ***27*** | ***0*** | ***100*** | ***100*** | ***92*** | ***81*** |
| Taxiway A3 | Right Angle | 6,600 feet | 100 | 100 | 71 | 35 | 100 | 100 | 98 | 90 |
| Taxiway A4 | Right Angle | 8,000 feet | 100 | 100 | 100 | 93 | 100 | 100 | 100 | 100 |

*S = Small, single engine, 12,500 lbs. or less; T = Small, twin engine, 12,500 lbs. or less;*
*L = Large, 12,500 lbs. to 300,000 lbs.; H = Heavy, 300,000 lbs.*
**Actual angle is greater than 90 degrees but is assumed to be 90 degrees for percentage purposes.*
*Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis*

Recommended improvements include considering high-speed taxiways for each of the air carrier runways. The impact of developing additional taxiways within the entire taxiway system should also be reviewed. High-speed taxiways that require traffic to complete a reverse turn results in traffic entering the taxiway at a slower speed reducing the runway capacity benefit. Specific recommendations will be evaluated in the Alternatives section.

Implementing a high-speed taxiway on Runway 3 would provide access to the air cargo apron and reduce taxiing time for other operations where destinations are on the east side of the airport. After Taxiway B3, the next right-angled exit with access to the east side of the airfield is another 2,800 feet down. For Runway 21, Taxiway B2 serves as an acute angled turnoff and is considered adequate for capacity purposes.

A high-speed exit along Runway 15 could also capture the vast majority of passenger operations at a location adjacent to the passenger terminal which would reduce taxiing time for those aircraft that cannot exit at Taxiway M. A reconfigured Taxiway A2 to a right-angle would allow for standard 90 degree angle and avoid taxiing confusion when interacting with Runway 9/27. A high-speed exit for Runway 33 is generally not needed with a right angled taxiway located 6,600 feet from the threshold. A connection with Taxiway M would provide direct, non-crossing taxiway access to the runway and is therefore is not recommended.

### Bypass Taxiways & Holding Bays

Runway departure delays can be caused by aircraft awaiting departure clearance or completing pre-flight checks. Bypass taxiways and holding bays provide the flexibility to allow runway use when an aircraft is not ready for takeoff and would otherwise block the taxiway. Bypass taxiways provide a secondary access to runways and can separate a mix of small and large aircraft at a runway end. Holding bays a provide space for aircraft away from the taxiway environment. Both bypass taxiways and holding bays improve capacity and overall flow. FAA recommends capacity enhancements when the peak hourly operations reach 30 which is expected by PAL 2. Typically either a holding bay or a bypass taxiway is needed. Constructing these improvements is particularly beneficial at runway ends that accommodate a mix of traffic such as FSD.

FSD has Taxiway B4 that could be used as a bypass taxiway within 1,200 feet of Runway 21. With the mix of large air carrier and small general aviation traffic, the construction of bypass taxiways should be considered at the most frequently used departing runways to separate this traffic to reduce potential departure delays. A bypass taxiway should be considered by PAL 2 for Runway 33 as it is a common departure runway.

FSD has holding bays installed along Runway 15 and 21 ends, designed for SDANG use by F-16 aircraft. These should be upgraded by the airport with setbacks to accommodate ADG-IV aircraft. Current FAA standards recommend holding bays with independent parking areas with adequate wingtip clearance. New holding bays should also be installed at or near the Runway 33 and 3 ends. Priority should be given to holding bays near Runway 21 and 33 as these runways are preferred air carrier departure runways.

### Recommendations

Taxiway recommendations include the following:

- Construct 25-foot wide paved shoulders for TDG-5/ADG-IV taxiways by PAL 1.
- Reconfigure taxiways near Runway 9/27 (no triggering date).
- Rename Taxiway K to L1 by PAL 1.
- Consider high-speed taxiway exits and implement by PAL 2 or when hourly operations exceed 30 per hour.
- Consider other exit taxiway improvements for Runway 15 landing operations.
- Correct direct access taxiways.
- Consider bypass taxiway development for Runway 33 by PAL 2.

- Expand existing holding bays for Runway 15 and 21 and construct new holding bays for Runway 33 and 3. Priority holding bays are Runway 21 and 33 with construction by PAL 2.

## Passenger Terminal

The requirements identified for the passenger terminal are identified to accommodate the travelling public with a sufficient level of service based on existing and projected growth. The airport has completed significant upgrades in the terminal building over the past several years including an expanded ticketing area, new in-line baggage handling system, expanded concourse holdrooms, gate upgrades and remodeled restaurant. The airport is currently upgrading their security checkpoint and airport administration offices.

Currently, the passenger terminal building and concourse consists of approximately 144,000 total usable square feet (SF) including offices, administration, ticketing, baggage, security, concessions, holdrooms/gates, storage and mechanical spaces. Public space open to everyone in non-secure areas is about 47,000 SF, and sterile areas for passengers that require security clearance is about 39,000 SF including the security checkpoint. FSD has seven gates in the concourse.

This section will identify key issues with the existing passenger terminal building and provide planning-level conceptual planning and space requirements. Landside requirements for passenger loading/unloading and automobile parking are evaluated separately. Requirements identified as based on the following references to FAA, Transportation Security Administration (TSA), International Air Transport Association (IATA) and industry standards:

- FAA Advisory Circular AC 150/5360-13A, *Planning and Design Guidelines for Airport Terminal Facilities* (2012)
- Airports Cooperative Research Program (ACRP), Report 25: *Airport Passenger Terminal Planning and Design Guidebook* (2010)

FSD needs to identify the terminal space needs to continue to provide a terminal building that meets passenger demands and exceeds expectations. Once the space needs are identified, future terminal building configuration alternatives will be developed in the next chapter. The airport will need to know how future expansion will be accommodated. Broad recommendations will be made in this study; details on a specific interior layout and engineering and architectural review would be identified in a separate terminal master planning study.

### *Terminal Design*

#### Overall Considerations

Terminals are designed to handle passenger volume and functions to interface between aircraft and ground transportation. Terminals must accommodate changes in the airline industry and passenger preferences. Factors that influence terminal design include:

- Total Passenger Volume – The annual number of passenger enplanements affects the total size and recommended configuration of a terminal building.
- Passenger Peaking Characteristics – Arriving or departing flights concentrated into a small timeframe require adequate space and throughput for surges in passenger ticketing, security, gates, baggage claim and concessions.
- Passenger Preferences – Business travelers typically are more experienced with airports, demand shorter wait times and efficiency. Leisure passengers require more time, attract meters/greeters and typically have more baggage to process. Airline fees also drive passenger preferences to check or carry-on baggage.
- Airline Station Characteristics – A spoke airport such as FSD has destinations as airline hubs. Spoke airports accommodate origin & destination (O&D) passengers rather than those using FSD to connect to another flight. Aircraft tend to remain overnight for the first flight out to a hub airport. Passengers have a requirement for check-in, security, baggage and parking.
- Aircraft Mix – The size and frequency of the aircraft affects the number and size of the gates, passenger waiting holdroom and the terminal apron configuration.
- International Service – Airports with international service require aircraft to have longer gate occupancy times and additional space for Federal Inspection Services (FIS)
- Industry Trends – Industry changes are affecting terminal design. Examples include reduced airline flight frequency, higher load factors, aircraft types, use of check-in kiosks, TSA pre-check program and airline fees affecting baggage.

### Level of Service

Terminal improvements are evaluated in their ability to serve passengers and provide a comfortable experience through the airport. A Level Of Service (LOS) concept uses a set of standards to measure the quality of the passenger experience. LOS standards are used to evaluate the efficiency of passenger flow, space requirements and wait time. Each LOS has a defined space planning standard to determine facility requirements.

*Exhibit 4-36 – Level of Service (LOS) Standards*

| Level of Service (LOS) Standards | |
|---|---|
| **LOS** | **Service Level** |
| Excellent | Conditions of free flow; no delays; direct routes; excellent level of comfort |
| High | Condition of stable flow; high level of comfort |
| Good | Condition of stable flow; provides acceptable throughput; related systems in balance |
| Adequate | Condition of unstable flow; delays for passengers; condition acceptable for short periods of time |
| Unacceptable | Condition of unstable flow; subsystems not in balance; represents limiting capacity in the system |
| System Breakdown | Unacceptable congestion and delays |

*Source: ACRP Report 25: Airport Passenger Terminal Planning and Design*

The assumption for this master plan is to obtain LOS C which peak wait times are 10 minutes or below. Delays and space requirements are typically considered acceptable. LOS C is considered reasonable balance between ideal size and economic considerations.

### FSD Considerations

There are specific space-planning considerations at FSD that need to be evaluated in this study. One consideration is determining the ideal terminal layout. The number of gates and the size of the design aircraft is critical in planning a future layout. The current terminal consists of a processing building and a pier-style concourse angled at 45 degrees. The original plan was to construct the ultimate concourse in a “Y” configuration with aircraft loading on both sides, but current airport design practices coupled with increased space requirements for automobile parking, Customs and Border Protection (CBP) and baggage claim coupled with the airport’s location over the Sioux Falls aquifer require this master planning effort to reevaluate this approach.

## *Demand Factors*

The primary function of a terminal is to provide adequate space to serve passengers. An evaluation of the passenger and gate demand is first completed to provide overall terminal space planning metrics at FSD.

### Passenger Activity Levels

The following planning activity levels (PAL) numbers are to be used for terminal building planning. These figures provide an estimate of the number of passengers to arrive, depart and generally flow through the terminal building. The figures are based on a percentage of total enplaned passengers the existing airline schedule. No surge factor is provided for irregular operations.

*Exhibit 4-37 – Terminal Passenger Activity Levels*

| Terminal Passenger Activity Levels | | | | | |
|---|---|---|---|---|---|
| **Metric** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Terminal Passengers** | | | | | |
| Annual Enplanements | 474,118 | 547,938 | 604,872 | 676,594 | 756,820 |
| Design Hour Departing | 395 | 456 | 504 | 563 | 630 |
| Design Hour Arriving | 329 | 380 | 420 | 469 | 525 |
| Design Hour Total | 559 | 646 | 713 | 798 | 893 |

*Source: KLJ Analysis*

### Design Hour & Fleet Mix

The aircraft fleet mix in the terminal area is determined using the total number of forecast departures as shown during the design hour. The design hour is the early morning block of flights where six flights depart FSD. Aircraft types are grouped in Airplane Design Group (ADG) and class. The design aircraft for FSD will evolve to become a narrowbody, ADG-III aircraft accommodating 110 to 177 passengers. The aviation forecasts project the average number of seats per aircraft will increase. As a result, the total number of flights is projected to increase 28 percent whereas the total number of passengers will increase nearly 60 percent through PAL 4.

*Exhibit 4-38 – Design Hour Departures*

| Design Hour Departures | | | | | | |
|---|---|---|---|---|---|---|
| **Design Aircraft** | **Seats** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Medium Regional Aircraft (ADG-II) | 50 | 4.6 | 2.7 | 2.2 | 2.5 | 2.7 |
| Large Regional Aircraft (ADG II/III) | 69-99 | 0.6 | 1.8 | 2.2 | 2.5 | 2.7 |
| Narrowbody Aircraft (ADG-III) | 110-177 | 1.0 | 1.7 | 2.1 | 2.0 | 2.0 |
| Boeing 757 (ADG-IV) | 181-215 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Design Hour Departures** | - | **6.3** | **6.2** | **6.4** | **7.2** | **8.0** |

*Source: KLJ Analysis*

### Gate Requirements

Gates are necessary for aircraft to adequately serve arriving and departing aircraft. The minimum number of gates at an airport is a function of the peak hour activity. Additional contingency metrics are also used to determine the required gates. At FSD the peak gate utilization period is the early morning departure block which exceeds the demand of the late evening arrival period. One contingency gate is added to accommodate unscheduled charter flights or long-term delayed flights.

*Exhibit 4-39 - Gate Requirements*

| Gate Space Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Design Aircraft** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Design Hour Departures | *6* | 6.3 | 6.2 | 6.4 | 7.2 | 8.0 |
| Contingency Gate | *1* | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Total Gates | *7* | 7.3 | 7.2 | 7.4 | 8.2 | 9.0 |
| **Total Required Gates** | ***7*** | **7** | **7** | **7** | **8** | **9** |

*Source: KLJ Analysis*

The total required gates is then split up into aircraft types using the fleet mix determinations to determine the total and equivalent number of gates for space planning. There are seven gates at FSD able to accommodate regional and narrowbody aircraft simultaneously with a passenger boarding bridge (PBB). The existing gates are designed to exceed the size of the design aircraft. Additional parking stands are available around the gate area for overnight parking. The contingency gates should accommodate the occasional use of a Design Group IV aircraft such as a Boeing 757 aircraft.

*Exhibit 4-40 - Gate Space Requirements*

| Gate Space Requirements | | | | | |
|---|---|---|---|---|---|
| **Design Aircraft** | **Existing /Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Medium Regional Aircraft (ADG-II) | 1 | 1 | 1 | 1 | 1 |
| Large Regional Aircraft (ADG-III) | 1 | 1 | 1 | 2 | 2 |
| Narrowbody Aircraft (ADG-III) | 4 | 4 | 4 | 4 | 5 |
| Boeing 757 (ADG-IV) | 1 | 1 | 1 | 1 | 1 |
| **Total Number of Gates** | **7** | **7** | **7** | **8** | **9** |
| **Narrowbody Equivalent Gate (NBEG)** | **6.8** | **6.8** | **6.8** | **7.8** | **8.8** |
| **Equivalent Aircraft (EQA)** | **6.2** | **6.2** | **6.2** | **6.7** | **7.7** |

*Source: KLJ Analysis*

FSD will require one additional gate by PAL 3 to accommodate a large regional ADG-III aircraft such as an Embraer E-190 carrying up to 99 passengers as operated by Frontier Airlines. Another gate is projected by PAL 4 to accommodate a narrowbody ADG-III aircraft similar to an Airbus A320 with a capacity up to 177 passengers as operated by Allegiant Airlines. Each gate should have a PBB. A terminal concourse with a total of nine gates should be planned.

### Building Areas

Individual functional areas of the terminal building have been evaluated to determine planning-level space needs to accommodate current and future demand. Space requirements will be a major consideration when evaluating terminal building alternatives.

#### Airline Space

There is currently 6,575 SF of area behind the ticketing counters dedicated for Airline Ticket Offices (ATO) and circulation. There are a total of six offices within this space. Average space per office is 1,095 SF. A common industry planning factor is 900 SF per office. The amount of space required is a function of the total number of airlines serving the airport rather than the total volume of passengers. There are five airlines serving FSD presently. If a new airline enters into the FSD market then existing ATO office space is available. There is sufficient ATO space to accommodate up to six airlines at FSD.

Other airline space considerations include airline ramp offices and support facilities on the airside portion of the airport. These are used for airline ground servicing functions. There is currently 8,500 SF of office and garage space provided on the concourse lower level used among the three service providers at FSD. Using a planning space metric of 1,300 SF per office and 2,500 SF for ramp services, there is a need for 11,400 SF of space. The airlines are able to adequately function with the existing space as some services are contracted to other providers. Additionally, lower level of the concourse has approximately 4,000 SF of space available for expansion to meet any future space needs, along with 5,600 SF of open parking. Additional space would become available if the terminal building is expanded in the future to accommodate additional gates. The total airline ramp space needs are forecast to be fully met into the future.

Baggage Service Offices (BSO) provide handling and storage for late or unclaimed bags. A 300 SF BSO facility is located adjacent to the baggage claim at FSD. Baggage is stored in a secure area and retrieved at the baggage claim office counter. This space is sufficient to meet current demands.

### Ticketing & Check-In

The passenger check-in process continues to change as new technologies and processes are implemented. These changes have reduced the space needed in the ticketing lobby space and staffed ticket counter positions. Waiting times are also reduced. Traditionally, all passengers checked in at the ticket counter to both receive boarding passes and check baggage. Now, remote self-service equipment allows individuals to obtain boarding passes online or at the airport without the need to use staffed ticket counters. Checked baggage is accommodated by a dedicated airline bag-drop representative at the counter. The use of self-service equipment continues to grow. Potential future trends include self-tagging stations and remote off-airport bag-drop facilities which would reduce the need to have staffed positions at the airport.

The passenger check-in assumptions are important to evaluate space and facility needs. For planning purposes the following assumptions are made:

- Passengers Checking Baggage: Average is 50 percent, 70 percent for leisure flights
- Checked Baggage Location: 100 percent within the terminal, 0 percent curbside, 0 percent remote location
- Passenger Check-In Location: 40 percent remote, 30 percent in-terminal kiosk, 40 percent in-terminal counter

The ticketing lobby at FSD currently consists of 10,500 SF for ticket counters, queuing and circulation with a total of 40 available check-in positions provided by the airport with 140 linear feet of counter space. The airlines lease 10 staffed counters and provide two positions per counter for a total of 20 positions. Most airline provide each position with their own self service kiosks. There are several check-in kiosks located in the corridor, owned by Delta Air Lines. There are no curbside check-in facilities provided. The ticketing lobby has a 10 foot queue depth which is less than the FAA's minimum recommendation of 15 feet.

*Exhibit 4-41 – Ticketing Requirements*

| Ticketing Requirements | | | | | | |
|---|---|---|---|---|---|---|
| Metric | *Existing* | Base | PAL 1 | PAL 2 | PAL 3 | PAL 4 |
| Staffed Ticketing Positions | *40* | 5 | 5 | 6 | 7 | 7 |
| Staffed Bag Drops | - | 2 | 2 | 3 | 3 | 3 |
| Number of Dedicated Kiosks | - | 4 | 4 | 5 | 5 | 6 |
| Total Staffed Positions | *40* | 7 | 7 | 9 | 10 | 10 |
| Total Equivalent Positions | *26* | 9 | 9 | 11 | 12 | 13 |
| Total Queue Area (SF) | *1,400* | 415 | 613 | 575 | 667 | 789 |

*Source: KLJ Analysis*

The total number of airport provided ticketing positions meets the needs through PAL 4. Each individual airline is responsible for leasing space and providing adequate space and check-in options for its customers. Additional positions may be provided for frequent fliers and/or first class customers. Most airlines at FSD require customers to proceed to a check-in position where an agent and a kiosk are available. It is recommended additional self-service kiosks be installed adjacent to ticketing areas with staffed bag drops. Kiosks reduce passenger waiting time and require minimal space.

A simple review shows there is sufficient total queuing space for passengers. There will be individual peak periods that may exceed leased space in front of each airline counter and queue area. The space is available from the airport but is it the responsibility of each airline to lease the space for passenger exclusive use. The ticket lobby has sufficient width to spread out queuing lines when necessary.

Curbside check-in is provided to enhance the LOS and reduce congestion within the ticketing lobby. FSD does not offer curbside check-in. There is adequate space and a high LOS within the existing ticketing lobby. Curbside check-in would require a 30-foot wide curb, check-in podiums and with either a baggage conveyor or baggage cart.

### Baggage Screening & Make-up

Baggage screening facilities are located behind the central portion of the ticketing lobby. This facility is operated by the Transportation Security Administration (TSA) to screen checked bags for explosives. An in-line baggage screening system was installed in 2009. The system features two baggage conveyors from the airline ticket counters and an additional third belt for larger bags to be inspected by hand. Bags are fed through one of four Explosive Detection System (EDS) machines for Level 1 screening. There are two primary EDS machines with two other machines providing inspection bypass if a bag triggers an alarm. Level 2 screening requires an on-screen resolution (OSR) by TSA personnel. If Level 3 inspection is required, workstations are provided to further inspect bags using Explosive Trace Detection (ETD) machines. Cleared bags are sent to the baggage make-up facility as one integrated baggage system. There is approximately 4,500 SF space for the existing screening area.

According to local TSA, the current in-line system assumes baggage can be processed through Level 1 screening at an estimated rate of 160-170 per hour with additional time needed for Level 2 and Level 3 screening. Newly upgraded units can accommodate up to 200 bags per hour. It is assumed 70 percent of passengers check bags to represent a peak percentage for leisure flights. The existing in-line system will not require any new space or units by PAL 4 provided throughput is increased to 200 per hour. The requirement by PAL 4 is for 4 EDS units, 2 staffed OSR stations and 2 ETD units.

Baggage make-up facilities are located directly behind the airline offices. After the security screening, bags are transported to one of two conveyors where bags are sorted and placed on baggage carts to deliver to the aircraft. Larger bags are delivered through a central collection area. The north conveyor serves Delta, Frontier and American Airlines while the south conveyor serves United and Allegiant Airlines. There is approximately 14,000 SF of space for equipment, conveyors and vehicle maneuvering.

Ideally each airline would have their own baggage carousel for sorting. The existing sharing arrangement works well as there are a limited number of ground handling operators at FSD. Using the number of equivalent narrow-body aircraft (EQA) and expected bags/carts per aircraft, there is a need for 13,200 SF of space by PAL 4. This existing space should meet the needs through the planning period if units are upgraded to process 200 bags per hour.

*Exhibit 4-42 – Baggage Screening & Make-Up Requirements*

| Baggage Screening & Make-Up Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Baggage Screening Area | *4,500* | 2,580 | 2,580 | 3,480 | 3,480 | 3,480 |
| Baggage Make-Up Area | *14,000* | 10,700 | 10,700 | 11,600 | 11,600 | 13,200 |

*Source: KLJ Analysis*

### Security Checkpoint

The Security Screening Checkpoint (SSCP) area is used by TSA to screen passengers and property prior to entering the sterile area of the terminal concourse. FSD is in process of designing an upgraded facility to meet the current and future demands. There are currently two x-ray machines for property search, one walk-through metal detector, and one Advanced Image Technology (AIT) scanner for personnel, all staggered in a narrow corridor. There is a small queue area in front of the screening equipment with a partitioned queue area extending into the corridor. The total security and queue area is about 2,000 SF in size. There is another 500 SF of TSA screening and 1,100 SF in TSA office space. The calculated maximum current wait time in queue is 17.3 minutes according to calculations using metrics from ACRP's terminal planning spreadsheet.

The proposed expansion would provide approximately 11,400 SF of total space featuring two TSA podiums, five bag x-ray machines and walk-through metal detectors, and two Advanced Imaging Technology (AIT) machines. This expansion meets TSA space guidelines for security checkpoints. The expansion is designed for an ultimate build-out for six x-ray machines and walk-through metal detectors as well as a third AIT machine. There will be 9,000 SF of total checkpoint screening, queuing and circulation area. The overall space incudes TSA offices.

SSCP space requirements are driven by equipment and queuing space from the number of passengers and estimated throughput rate. Actual throughput rates of 175 passengers per hour per lane are common nationally. To achieve a maximum 5 minute queue wait time, three security lanes are needed by PAL 1. A fourth lane is needed by PAL 2 with a fifth lane necessary when reaching PAL 5. The SSCP expansion will accommodate these needs through the planning period.

### *Exhibit 4-43 - Security Screening Checkpoint Requirements*

| Security Screening Checkpoint Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Security Screening Lanes | 2 | 3 | 4 | 4 | 4 | 5 |
| Maximum Wait Time (min.) | *17.3* | 4.9 | 1.5 | 3.8 | 1.3 | 3.8 |
| Security Queue Area* | *800* | 462 | 189 | 474 | 200 | 592 |
| Total Security Area | *2,000* | 4,956 | 6,608 | 6,608 | 8,260 | 8,260 |

*Source: KLJ Analysis*
*NOTE: Security Screening Checkpoint to be upgraded to 10,000 SF with 5 lanes by 2016.*
**Requirements upgraded security area dimensions*

Technology and processes will continue to evolve. According to local TSA, the pre-check program has increased throughput to approximately 300 passengers per hour which in the future may reduce the need for additional queuing areas. Specific lane expansion should be evaluated based on actual throughput, current processes and technological enhancements.

#### Passenger Holdrooms

Passenger holdrooms are designated areas in the sterile concourse area where passengers wait to board the aircraft at the gate. The size of the holdrooms are directly related to the aircraft size at each gate. The estimated fleet mix is used to determine holdroom sizing for each gate. Each holdroom is sized assuming 80 percent of the total number of passengers are seated and the remaining 20 percent are standing. Additional space requirement for the gate podium and podium queue are also taken into account. Recommended holdroom depth is 30 feet for circulation.

The terminal concourse was expanded in 2012 for a total of 12,500 SF of holdroom space for seven gates. Holdroom seating capacity is often shared among several gates or in separate areas of the terminal. Cumulatively, total existing seating capacity is 543 which provides seating for 80 percent of the peak hour departing passengers through the planning period.

The evaluation of holdroom requirements is based on the average number of passengers per aircraft per gate. The peak hour departure block requires six gates in the existing configuration with an additional two departures through PAL 4. This assumes six to eight gates are in use at the same time.

The analysis concludes additional holdrooms are needed by PAL 4 when additional gates are necessary. Existing individual holdrooms should be expanded however passengers must utilize other seating areas away from the gate which reduces LOS. Expansion to add additional gates will add necessary holdrooms to allow the capacity to meet the needs. Another issue to consider is the size of the Gate 2 holdroom which has a 90 person seating capacity but because of space constraints is limited to 50-seat CRJ-200 equipment. Other gates for larger aircraft must share seating capacity.

### *Exhibit 4-44 - Holdroom Requirements*

| Holdroom Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Design Aircraft** | | | | | | |
| 50 passengers (1,000 SF) | *4* | 4 | 3 | 2 | 2 | 2 |
| 76 passengers (1,400 SF) | *1* | 1 | 1 | 1 | 2 | 2 |
| 110 passengers (1,800 SF) | *0* | 0 | 1 | 1 | 1 | 2 |
| 138 passengers (2,200 SF) | *1* | 1 | 1 | 1 | 1 | 1 |
| 166 passengers (2,600 SF) | *0* | 0 | 0 | 1 | 1 | 1 |
| Total Airline Gates In Use | *6* | 6 | 6 | 6 | 7 | 8 |
| Total Holdroom Area | *12,500* | 8,000 | 10,000 | 10,000 | 11,400 | 13,200 |

*Source: KLJ Analysis*

#### Concourse Size & Circulation

The overall size of the terminal concourse was evaluated for future space planning. The exterior terminal frontage is based on the aircraft fleet mix parked at the gate with sufficient wingtip clearance between aircraft. The current concourse exterior frontage available to aircraft is 980 linear feet (LF) with a total length of 460 LF. The width of the terminal varies based on whether the terminal has gates on one or both sides (single vs. double loaded) and the corridor width. The current FSD terminal is double loaded with staggered gates. The current corridor width 20 feet for a walkway with the effective width of 15 feet when considering the installed columns. The suggested minimum width for a double-loaded terminal is 30 feet for a high LOS facility. The staggered gate configuration at FSD enhances circulation with a more narrow width, however a wider overall concourse width is needed to meet current standards.

*Exhibit 4-45 – Concourse Size & Requirements*

| Concourse Size & Circulation Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Exist.*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Narrowbody Equivalent Gate (NBEG) | 6.8 | 6.8 | 6.8 | 6.8 | 7.8 | 8.8 |
| Aircraft Frontage (LF) | *980* | 972 | 972 | 972 | 1,115 | 1,258 |
| Concourse Length* (LF) | *460* | 486 | 486 | 486 | 558 | 629 |
| Concourse Circulation Area (SF) | *9,200* | 14,600 | 14,600 | 14,600 | 16,700 | 18,900 |
| Concourse Width (ft.)* | *20* | 30 | 30 | 30 | 30 | 30 |

*Source: KLJ Analysis*

**Assumes double-loaded concourse; NOTE: Gross terminal area does not include open parking*

The reduced width of the FSD concourse contributes to the concourse circulation area not meeting recommended space standards. The concourse circulation areas are less than ideal. The overall concourse size will need to be expanded to accommodate the additional aircraft and gates. An additional 278 LF of double-loaded or 556 LF of single-loaded aircraft frontage is needed to meet demands through PAL 4.

### Baggage Claim & Handling

Baggage claim devices are provided for arriving passengers to retrieve their checked bags from the aircraft. Bags are offloaded from the aircraft, placed on baggage carts, transported to a baggage handling area and then offloaded onto the baggage belts in a secure area.

The baggage claim area at FSD has three flat-plate baggage claim devices each providing 73 LF of presentation frontage for a total baggage claim frontage space of 219 LF. The third device on the south is shared with CBP for dedicated use during international arrivals. This area becomes secure and is partitioned from domestic passengers during these operations. For space planning purposes, the use of two baggage claim devices for a total frontage of 146 LF is assumed while the third device is in use by CBP. This provides approximately 3,400 SF of baggage claim area away from the adjacent 16 foot wide corridor for passenger flow. There is limited space for circulation within the baggage claim area with actively claiming passengers, waiting passengers, visitors and activity at the adjacent rental car service counters. It is assumed 70 percent of passenger check bags.

Additional baggage claim frontage is needed to accommodate overall design hour baggage claim demands starting by PAL 1. The individual largest arriving aircraft will require additional frontage preferably using one claim device. Additional baggage claim area is needed for customer circulation and also to better separate the active baggage claim area from the corridor. An expansion of the baggage claim area is recommended.

*Exhibit 4-46 – Baggage Claim & Handling Requirements*

| Baggage Claim & Handling Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Exist.*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Peak People at Claim | - | 88 | 102 | 113 | 126 | 141 |
| Baggage Claim Frontage | *146* | 132 | 153 | 169 | 189 | 211 |
| Peak Single Aircraft Frontage | *73* | 134 | 134 | 134 | 134 | 134 |
| Total Baggage Claim Area | *3,400* | 5,280 | 6,120 | 6,760 | 7,560 | 8,440 |
| Total Baggage Handling Area | *3,600* | 4,800 | 4,800 | 4,800 | 4,800 | 4,800 |

*Source: KLJ Analysis*
*NOTE: Existing conditions assume two baggage claim devices and non-CBP areas are available for domestic use.*

The baggage handling area is approximately 3,600 SF in size when the third baggage device is secured by CBP. Currently there is no bypass access during these operations. The baggage handling area requires a baggage tug drive lane, offloading zone and bypass lane. Multiple flights arriving near the same time will also require additional space to drive around active unloading operations. An additional 1,200 SF of space is recommended for domestic operations. The existing depth is 26 feet where 30 feet is recommended. Separate access points for the domestic and international baggage handling areas is recommended which may require additional width.

Total percentage of passengers checking bags dramatically changes the baggage claim requirements. Baggage trends should continue to be monitored by the airport with space needs updated. Over the past several years airline fee structures have charged for checked bags reducing demand. The trend is for airlines to charge for carry-on bags as well which may cause the number of checked bags to increase again.

### Concessions

Concessions are area within the airport terminal used for retail space located in the public and sterile portions of the terminal. Airport industry trends demand more concessions in the sterile portion of the terminal as passengers have increased dwell times after the security checkpoint. Additionally liquids, aerosols and gels are heavily restricted through the checkpoint. Currently 60 percent of the concession area is located in the public area with 40 percent in the sterile concourse.

Concessions located in the public area include a 1,100 SF news/gift retail shop, a 7,900 food court/bar, kitchen and storage area. The food court was renovated in 2012. Within the sterile concourse concessions include a 750 SF news/gift retail shop and a 5,200 SF restaurant/bar, casino, kitchen and storage area. Other amenities such as display booths and vending machines are scattered throughout the terminal. Expansion of sterile area concessions should occur during terminal expansion to accommodate growing passenger needs. Possible concession types to consider include specialty food/retail, other passenger-focused services or other advertising.

An expressed concern and a facility need is access to the concourse for concession deliveries. Deliveries must travel through security or be delivered through an access elevation located on the far end of the terminal near Gate 6. An additional access point and elevator is recommended with a separate landside access to allow authorized vehicles to load/unload deliveries closer to concessions.

The airport also provides an 865 SF public business center for passenger use within the concourse. The space provides enhanced passenger experience. An expanded space of approximately 1,200 SF should be programmed for public use within the terminal concourse. A pay-per-use system could be considered a revenue-generating concession.

### Rental Car

Near baggage claim in the public area, there are four rental car counters at FSD totaling about 1,900. The size of the offices are sufficient. There is no dedicated queue area. The active queue area for each counter is essentially part of a narrow 13 foot wide circulation corridor leading to the south building exits. Bypass space can be utilized when CBP secure operations are not in use. The additional passenger activity and location of the south public parking lots require a dedicated access corridor is required to meet customer LOS needs. Additional rental car space is needed now to accommodate a clear corridor and queuing area. Additional counters should be planned to accommodate demand for additional providers.

***Exhibit 4-47 – Rental Car Requirements***

| Rental Car Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Metric** | ***Exist.*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Number of Providers | *4* | 4 | 4 | 5 | 5 | 6 |
| Rental Car Office Area (SF) | *1,872* | 1,760 | 1,760 | 2,200 | 2,200 | 2,640 |
| Rental Car Area (SF) | *1,872* | 2,560 | 2,560 | 3,200 | 3,200 | 3,840 |

*Source: KLJ Analysis*

*NOTE: Existing conditions assume two baggage claim devices are available for domestic use*

Any future rental car area expansion should consider accommodating offices for ground transportation providers. A terminal expansion for a dedicated ground transportation center could accommodate both rental car and other ground transportation services. There should be space for six rental car providers and three ground transportation service providers. A total space of approximately 5,000 SF would accommodate needs through PAL 4.

### Airport Administration

The Airport Administration terminal areas include staff operations, offices, conference rooms and security. Including the lower level conference room and recently added security office, there is currently 3,000 SF of space. The airport will be constructing new administration offices as part of the SSCP expansion project which will provide a total of 5,100 SF of administration space. This space should provide sufficient space into PAL 3. Additional space is necessary to accommodate future airport growth an increased staffing levels. Upgrades to the lower-level conference room should also be completed to provide an expanded space for

Airport Authority meetings. This space can also be used as a communication/incident control center.

### Public Spaces

Public spaces include non-revenue generating areas of the terminal building used for restrooms, circulation, as seating and waiting areas. Nearly 3,000 SF is dedicated to public restrooms. The number of restrooms is based on the design hour passengers in the public area, and on the number of equivalent aircraft within the secure area. Restrooms are located in adequate locations within the sterile and non-secure areas.

***Exhibit 4-48 - Restroom Requirements***

| Restroom Requirements | | | | | | |
|---|---|---|---|---|---|---|
| Metric | *Exist.* | Base | PAL 1 | PAL 2 | PAL 3 | PAL 4 |
| **Sterile Area** | | | | | | |
| Total Fixtures | *21* | 19 | 19 | 19 | 20 | 23 |
| Male Restrooms | *11* | 10 | 10 | 10 | 10 | 12 |
| Female Restrooms | *10* | 10 | 10 | 10 | 10 | 12 |
| **Public Area** | | | | | | |
| Total Fixtures | *20* | 16 | 18 | 20 | 23 | 26 |
| Male Restrooms | *12* | 8 | 9 | 10 | 11 | 13 |
| Female Restrooms | *8* | 8 | 9 | 10 | 11 | 13 |

*Source: KLJ Analysis*

There is a need for additional female restrooms in the public area starting in PAL 1. Additional total fixtures are needed by PAL 3. Additional male and female fixtures are needed once PAL 4 is reached.

The meet/greet areas has traditionally been on the first level in the lobby or the baggage claim area. This leads to the baggage claim area becoming congested. A small 1,200 SF upper level waiting lobby is located in the public area prior to security for arriving meeter/greeters and departing well-wishers. This area will be expanded to 1,800 SF with the security checkpoint project with seating for up to 63 people.

General circulation within the terminal is adequate but includes some particularly narrow corridors. A general minimum corridor width standard of 15 feet is considered minimally acceptable to clear of objects and queuing lines within the terminal, with a 30 foot wide corridor for a double-loaded terminal concourse. The corridor near the rental car counters only provides 13 feet of clear area and causes congestion with rental car queuing, CBP operations and baggage claim. This area should be addressed in the short-term. The 20 foot wide terminal concourse corridor does not meet the minimum width standard. Other public corridors in the terminal are 16 to 17 feet wide.

The lobby on the first floor of terminal is of sufficient size to accommodate current and future passenger circulation. The existing "moverator" will be replaced by a traditional escalator/stairs opening up additional space for meeter/greeter area on the second level. Circulation on the second level prior to security is poor during peak periods with the confluence of arriving passengers, departing passengers in the security line, meeters/greeters and well-wishers. The expanded second floor lobby will be sufficient to accommodate demand for the long-term.

Circulation efficiency is a product of good wayfinding signage. Additional wayfinding signs are needed in the terminal to direct the public to terminal building services.

### Recommendations

Below is a table summarizing the identified space requirements for the passenger terminal building:

*Exhibit 4-49 – Passenger Terminal Building Space Requirements*

| Passenger Terminal Building Space Requirements | | | | | | |
|---|---|---|---|---|---|---|
| Metric | *Exist.* | Base | PAL 1 | PAL 2 | PAL 3 | PAL 4 |
| **Demand** | | | | | | |
| Annual Enplanements | - | 474,118 | 547,938 | 604,872 | 676,594 | 756,820 |
| **Building Areas** | | | | | | |
| Total Required Gates | *7* | 7 | 7 | 7 | 8 | 9 |
| Airline Ticket Office (SF) | *6,600* | 5,000 | 5,000 | 5,000 | 5,000 | 6,000 |
| Airline Ramp/Support (SF) | *18,100** | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 |
| Staffed Equivalent Positions | *26* | 9 | 9 | 11 | 12 | 13 |
| Dedicated Kiosks | - | 4 | 4 | 5 | 5 | 6 |
| Baggage Screening Area (SF) | *4,500* | 2,580 | 2,580 | 3,480 | 3,480 | 3,480 |
| Baggage Makeup Area (SF) | *14,000* | 10,700 | 10,700 | 11,600 | 11,600 | 13,200 |
| Security Screening Lanes | *2*** | 3 | 4 | 4 | 4 | 5 |
| Total Security Area (SF) | *2,000*** | 4,956 | 6,608 | 6,608 | 8,260 | 8,260 |
| Total Holdroom Area (SF) | *12,500* | 8,000 | 10,000 | 10,000 | 11,400 | 13,200 |
| Aircraft Frontage (LF) | *980* | 972 | 972 | 972 | 1,115 | 1,258 |
| Concourse Circulation (SF) | *9,200* | 14,600 | 14,600 | 14,600 | 16,700 | 18,900 |
| Baggage Claim Frontage (LF) | *146* | 132 | 153 | 169 | 189 | 211 |
| Baggage Claim Area (SF) | *3,400* | 5,280 | 6,120 | 6,760 | 7,560 | 8,440 |
| Baggage Handling Area (SF) | *3,600* | 4,800 | 4,800 | 4,800 | 4,800 | 4,800 |
| Rental Car Area (SF) | *1,872* | 2,560 | 2,560 | 3,200 | 3,200 | 3,840 |
| Sterile Area Restrooms | *21* | 19 | 19 | 19 | 20 | 23 |
| Public Area Restroom | *20* | 16 | 18 | 20 | 23 | 26 |

*Source: KLJ Analysis*
**Includes 4,000 SF of dedicated open space and 5,600 SF of parking space not dedicated to airlines for exclusive use, ** Security Screening Checkpoint to be upgraded to 10,000 SF with five lanes by 2016.*

Passenger terminal building facility recommendations include the following:

- Expand the baggage claim lobby, baggage handling area and provide additional baggage presentation frontage by PAL 1. Construct a baggage carousel accommodating the peak single aircraft (134 LF). Provide additional baggage service offices as needed.
- Provide an adequate rental car queuing area outside of the public corridor. Construct additional rental car offices to accommodate additional providers.
- Construct one additional gate accommodating ADG-III aircraft by PAL 3 with another gate by PAL 4. Total terminal frontage should increase by 270 LF by PAL 4.

- Construct the SSCP and expanded second floor meeter/greeter lobby in the short-term to alleviate existing delays.
- Construct additional hold rooms for additional gates by PAL 3. Consider widening existing corridors during major construction.
- Construct additional public area female restrooms by PAL 1, additional public area restrooms fixtures by PAL 3 and total sterile area restrooms by PAL 4.
- Provide additional self-service check-in kiosks in the ticketing lobby for added customer convenience.
- Expand concessions into the sterile area as major improvements or expansion of the concourse is made.

### *Apron*

#### Terminal Apron

The primary purpose of the terminal apron is to provide parking for commercial passenger aircraft at the terminal gate and provide circulation space for aircraft and airline support functions. There are 7 passenger boarding bridges and 12 parking positions around the terminal gate. There is demand for two additional gates.

The primary driver for the size of a terminal apron is the terminal building. The building layout and configuration will drive the size and space needs for the apron. The terminal apron size and configuration is a function of the total number of gates, building configuration, aircraft type, airfield configuration, aircraft maneuvering and FAA design standards including wingtip clearances. As the terminal building concepts are developed, software will be utilized to model gate configuration which will help identify the required terminal apron size. Gates should be designed to provide adequate space for taxi-in and pushback-out operations.

The terminal apron should be sized to accommodate regular use of larger aircraft as identified in the gate space requirements. Space will need to be accommodate for a terminal building expansion for the additional two gates needed through PAL 4 in Design Group III/IV aircraft. Known existing considerations to the terminal apron size include deicing and overnight parking operations, snow removal, aircraft maneuvering space/wingtip clearances, proximity to existing terminal building, a proposed hotel development near the terminal, existing automobile parking and a city water well located about 400 feet south of the existing apron pavement.

#### Remain Overnight Parking (RON)

There is currently no designated RON parking apron at FSD. Commercial aircraft typically park overnight at the terminal gates. There are currently 12 aircraft parking stands surrounding the terminal building accommodating aircraft ranging from a CRJ-200 to a Boeing 757. Up to 11 aircraft can connect to a passenger boarding bridge depending on aircraft size. An additional parking position is accessed through a hardstand. The December 2013 flight schedule shows there are 9 RON aircraft (3 Airbus A-319, 3 Embraer ERJ-145 and two CRJ-200 aircraft) during weekdays. With these aircraft types the existing terminal is full.

RON needs are based largely on the flight schedule of individual airlines. It is projected additional parking will be needed in the future. The number of passenger airline flights is forecast to increase 24 percent through PAL 4 with a reduction in the use of smaller regional jets such as the ERJ-145 and CRJ-200. This will cause larger aircraft to park and, as a result, fewer parking positions available around the terminal. Additional RON parking should be considered.

It is a recommendation that three RON parking positions be provided by PAL 1 with an additional two spaces by PAL 3. The spaces should accommodate aircraft as large as ADG-IV. A consolidated RON and deicing facility should be considered.

### Deicing Apron

Aircraft deicing is necessary prior to departure in cold weather conditions. Deicing operations are currently accomplished on the existing aircraft apron along the taxilane. Operations in this area limits aircraft circulation as a result of blocking the only taxilane to that particular side of the terminal. This creates delay as aircraft gate pushback and deicing operations can last approximately to 15 minutes.

Aircraft deicing pads should be located in reasonable proximity to the departure runway. A location north of the terminal apron should be explored. A deicing pad able to accommodate three aircraft is recommended in PAL 1 for FSD to provide sufficient throughput. An expandable site for up to four pads should be planned. Two positions should accommodate up to ADG-III aircraft with the third and fourth position accommodating ADG-IV aircraft.

Deicing facilities need to have space for aircraft and wingtip clearance, as well as space for mobile equipment maneuvering, a bypass taxiway, appropriate runoff mitigation to meet environmental requirements, lighting and support facilities. A consolidated RON apron and deicing facility should also be considered.

### Ground Equipment Storage

Airlines operate their own ground service equipment (GSE), including a variety of aircraft tugs, pushbacks, service vehicles, deicers, ground power units (GPUs), baggage belt-loaders, and other support vehicles. GSE is currently stored outdoors clear of critical areas or under the concourse in open and garaged space. Additional covered parking should be planned with any terminal building and apron expansion to house existing and future needs.

## Air Cargo

FSD is a regional hub for air cargo flights. FedEx and UPS are integrated carriers that serve the airport along with various feeder airlines. Cargo is processed through building processing, apron area and landside facilities located east of Runway 3/21. Total enplaned and deplaned air cargo is forecasted to grow a total of 51 percent through PAL 4. This forecast is expected to be realized if FSD continues to be a regional hub for FedEx and UPS. There is minimal belly cargo carried by the airlines.

The majority of air cargo operations at FSD are concentrated during the early morning to meet delivery schedules. Cargo is loaded and unloaded on the apron and sorted in a processing and storage building. UPS sorts cargo outdoors. Cargo is sorted and processed so that it can reach its final destination through ground or air transport.

### *Processing and Storage Building*

A dedicated 40,000 square foot multi-use cargo sorting facility is used to support air and ground operations. One half of building is leased to FedEx and the other local ground cargo company. UPS completes sorting outdoors and stores equipment in a separate 9,300 square foot building in the east general aviation area. The airport's goal is to have UPS relocate their facilities to the east cargo apron, thus additional space within this area is required now. This would concentrate all activities into one area and eliminate the need for equipment and personnel to traverse an active general aviation apron at night to complete cargo activities.

The estimated size of air cargo facilities is a product of the total cargo processed and space utilization. Currently, FSD has 1.39 square feet of building space for every annual ton of cargo processed. The average building utilization rate at U.S. airports is between 1.50 and 1.75 square feet per annual cargo ton. A utilization factor of 1.50 will be used for this master planning analysis.

A new facility should be constructed as soon as possible to accommodate UPS operations along the east cargo apron. A new 20,000 square foot facility should be constructed to accommodate demand through PAL 2. By PAL 4, an additional 30,000 square feet of space should be developed. Actual building area development will be subject to local demand.

Any belly cargo transported by the airlines is fully supported by the airlines with their own facilities.

*Exhibit 4-50 – Air Cargo Building Requirements*

| Air Cargo Building Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Air Cargo Building** | | | | | | |
| Total Cargo (tons) | *35,363* | 35,363 | 39,963 | 44,049 | 48,554 | 53,518 |
| Building size per ton | *1.39* | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Building Size (SF) | *49,300* | 53,045 | 59,945 | 66,074 | 72,830 | 80,273 |
| **Capacity/Deficiency (SF)** | **-** | **3,745** | **10,645** | **16,774** | **23,530** | **30,978** |

*Note: RED indicates a deficiency to existing capacity*
*Source: KLJ Analysis*

### Apron

Sufficient apron space is necessary to accommodate peak activity. The air cargo apron is full during peak morning operations with air carrier and multiple smaller feeder aircraft. Additionally, there are several aircraft along the east general aviation apron that are used for air cargo. The airport has a goal to consolidate all cargo operations to the east cargo apron. The existing apron space is too small to accommodate both larger air carrier aircraft and small feeder aircraft and maintain adequate maneuvering space. Many small freight aircraft park on the north side of the general aviation apron.

The necessary cargo apron size is driven by the number and size of the air cargo aircraft on the ramp at one time. The purpose of this analysis is to determine the triggering point for additional air cargo apron space by determining an estimated fleet mix based on FAA Airplane Design Group (ADG) classification. Fleet mix assumptions include:

- Five ADG-I air cargo aircraft currently on the east general aviation apron
- 14 ADG-II air cargo aircraft on the apron at one time (10 UPS, 4 FedEx)
- One ADG-III FedEx ATR-72 air cargo aircraft
- One FedEx ADG-IV aircraft
- One UPS ADG-IV aircraft

It is estimated cargo aircraft will increase at PAL 4 about 35 percent over the base scenario. Size requirements were calculated for each design aircraft using calculated clearances from other aircraft, objects and an assumed taxilane. An additional 10 percent is added for Ground Support Equipment (GSE).

- Airplane Design Group I – 1,000 square yards per aircraft
- Airplane Design Group II – 2,400 square yards per aircraft
- Airplane Design Group III – 3,300 square yards per aircraft
- Airplane Design Group IV – 8,300 square yards per aircraft

Based on this assessment, the existing cargo apron will need additional apron space now to accommodate 23 aircraft on the apron at one time. An expansion of 30,000 square yards will be needed by PAL 4. Actual apron space will vary based on demand on the apron at one time.

For example, the existing apron provides a taxilane that is counted toward apron space. This may require additional space over the existing to maintain proper setbacks. The apron should be designed to FAA standards so that sufficient space for parking, circulation and ground operations. Expansion concepts will be developed in the following chapter.

*Exhibit 4-51 - Air Cargo Apron Requirements*

| Air Cargo Apron Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Cargo Aircraft** | | | | | | |
| Design Group I | *5* | 5 | 5 | 5 | 4 | 4 |
| Design Group II | *14* | 14 | 16 | 18 | 20 | 22 |
| Design Group III | ***1*** | 1 | 1 | 1 | 2 | 2 |
| Design Group IV | ***3*** | 3 | 3 | 3 | 3 | 4 |
| **TOTAL** | ***23*** | 23 | 25 | 27 | 29 | 32 |
| **Deficiency** | **-** | **0** | **2** | **4** | **6** | **9** |
| **Cargo Apron Space (SY)** | | | | | | |
| Design Group I | - | 5,000 | 5,000 | 5,000 | 4,000 | 4,000 |
| Design Group II | - | 33,600 | 38,400 | 43,200 | 48,000 | 52,800 |
| Design Group III | **-** | 3,300 | 3,300 | 3,300 | 6,600 | 6,600 |
| Design Group IV | **-** | 24,900 | 24,900 | 24,900 | 24,900 | 33,200 |
| **Total Space** | *66,000* | 66,800 | 71,600 | 76,400 | 83,500 | 96,600 |
| **Capacity/Deficiency** | **-** | **800** | **5,600** | **10,400** | **17,500** | **30,600** |

*Source: KLJ Analysis*

Deicing operations were also evaluated. Currently deicing operations are conducted remotely along the east cargo apron using mobile equipment. A dedicated deicing pad for air cargo aircraft should be located along the east air cargo apron with space for up one ADG-IV aircraft and bypass capability.

## General Aviation

General includes all civil aviation activities except for commercial service. GA covers a much broader portion of the aviation community. GA activities found at FSD include corporate travel, medical transport, flight training, personal and business flights as well as recreational flying. These types of aeronautical activates serve the public in a capacity that may be less noticeable to the average citizen. Providing facilities and access for GA users at FSD will continue to be vital for the vitality of the Sioux Falls community.

FSD continues to serve as the primary GA facility for the community handling the vast majority of corporate business traffic. There are 93 based aircraft and over 26,000 annual flight operations classified as GA. Based aircraft is projected to grow 36 percent with operations growing by 66 percent through the planning period. GA facilities are necessary to support these operations on the airfield. On-airport businesses providing aeronautical services known as Fixed-Base Operators (FBOs) provide aircraft maintenance, fueling and other and pilot and passenger services.

### *Aircraft Storage*

Aircraft storage requirements are driven by the aircraft size, local climate and owner preferences. Aircraft are becoming increasing more complex and expensive. The overall trend is for larger turboprop and corporate business jet aircraft to operate at the Sioux Falls airport. The harsh winters in the upper Midwest drive all owners to seek aircraft storage facilities rather than outdoor parking on an aircraft parking apron. Owners prefer to have covered, secure storage for their aircraft with space for other aeronautical facilities including an office or maintenance/storage areas. All FSD nearly all the based aircraft are stored in covered storage facilities.

A facility space model was developed using the based aircraft forecast, estimating a hangar type preference and applying space per aircraft. The FSD based aircraft forecasts estimate another 34 based aircraft through the planning period (PAL 4) consisting of 10 single-engine, 18 multi-engine and 6 turbojet aircraft.

Aircraft are currently stored is approximately 263,400 square feet of aircraft storage space. There are three main hangar types identified:

- T-Hangar: Nested small aircraft storage units
- Corporate Hangar: Private/corporate aircraft storage of 10,000 square feet or less
- Conventional Hangar: Commercial aeronautical use and aircraft storage of greater than 10,000 square feet.

The following assumptions were made about aircraft storage space requirements:

- T-Hangar: 1,200 square feet per aircraft; 85% single-engine, 15% multi-engine aircraft
- Corporate: 3,000 square feet per aircraft; 15% single-engine, 40% multi-engine, 25% turbojet aircraft
- Conventional: 3,600 square feet per aircraft; 45% multi-engine, 75% jet aircraft
- An additional 20 percent of the building is added for hangar to be used for other aeronautical purposes including transient aircraft storage.

Using these assumptions with based aircraft forecasts, a projected need for aircraft storage space is determined. It is important to understand that this projection provides a broad estimate of needed space into the future for facility planning. Actual space needs are demand-driven.

*Exhibit 4-52 – Aircraft Storage Requirements*

| Aircraft Storage Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Aircraft Storage** | | | | | | |
| T-Hangar | *52* | 52 | 53 | 55 | 60 | 63 |
| Corporate Hangar | *23* | 23 | 24 | 27 | 30 | 33 |
| Conventional Hangar | *18* | 18 | 20 | 23 | 27 | 31 |
| **TOTAL** | ***93*** | **93** | **98** | **105** | **117** | **127** |
| **Hangar Space** | | | | | | |
| T-Hangar | *61,800* | 62,220 | 63,780 | 66,540 | 71,700 | 75,660 |
| Corporate Hangar | *71,600* | 68,550 | 73,350 | 79,800 | 90,300 | 99,150 |
| Conventional Hangar | *130,000* | 65,880 | 73,440 | 82,620 | 97,740 | 111,240 |
| Maintenance Space | | 39,330 | 42,114 | 45,792 | 51,948 | 57,210 |
| **TOTAL** | ***263,400*** | **235,980** | **252,648** | **274,752** | **311,688** | **343,260** |
| **Capacity/Deficiency** | **-** | **-27,420** | **-10,752** | **11,352** | **48,288** | **79,860** |

*Note: RED indicates a deficiency to existing capacity*
*Source: KLJ Analysis*

This facility requirement analysis shows there is a need for about 30 percent more hangar space at FSD through PAL 4.

### *Aircraft Parking Apron*

GA aircraft parking is utilized by transient or based aircraft. With nearly all the based aircraft at FSD stored in hangars, most of the aircraft parking necessary is for transient aircraft at FSD requiring parking for a short period of time ranging from a few minutes to a few days. Many small freight aircraft at FSD park on the north side of the general aviation apron where they should be using the east cargo apron. The design day GA and Part 135 commercial aircraft operations that utilize GA facilities were evaluated to determine the total apron size requirements at FSD during the peak month. Itinerant aircraft require apron parking space. The apron size is driven by the number and size of aircraft. The purpose of this analysis is to determine the triggering point for additional GA apron space using the aviation activity demand forecasts.

Assumptions include:

- Transient operations are 70 percent of itinerant operations, conducted by non-local users.
- Peak month (10.42 percent of annual operations) and design day (4.41 percent of monthly operations) are based on the aviation forecasts.
- An operation is an arrival and a departure.
- Apron space will be needed by 80 percent of arriving transient aircraft, with the remaining 20 percent requiring hangars.

PAL 4 will see demand increase 62.5 percent for apron space at FSD.

*Exhibit 4-53 – Transient Apron Aircraft Requirements*

| Transient Apron Aircraft Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Operations** | | | | | | |
| GA Itinerant | - | 20,378 | 23,022 | 25,702 | 28,948 | 33,050 |
| Part 135 Commercial | - | 4,819 | 5,439 | 6,138 | 6,926 | 7,817 |
| **TOTAL** | **-** | **25,197** | **28,461** | **31,840** | **35,874** | **40,867** |
| **Apron Aircraft** | | | | | | |
| Transient Operations | - | 17,638 | 19,923 | 22,288 | 25,112 | 28,607 |
| Peak Month Ops. | - | 1,813 | 2,048 | 2,291 | 2,581 | 2,941 |
| Design Day Ops. | - | 80 | 90 | 101 | 114 | 130 |
| Design Day Arrivals | - | 40 | 45 | 51 | 57 | 65 |
| **Apron Aircraft** | **-** | **32** | **36** | **40** | **46** | **52** |

*Source: KLJ Analysis*

Itinerant airport operations included 26.6 percent single/multi-engine piston and helicopters, 54.2 percent turboprop and 19.2 percent business jet. The aviation forecasts were utilized to project future fleet mix. Aircraft types were then split by Airplane Design Group (ADG) classification to determine the necessary parking area with required FAA setbacks. Size requirements were calculated for each design aircraft:

- Single/Multi-Engine Piston (ADG-I) – 800 square yards per aircraft
- Turboprop (ADG-II) – 2,000 square yards per aircraft
- Business Jet (ADG-II) – 2,000 square yards per aircraft (2% of business jet operations)
- Business Jet (ADG-III) – 4,100 square yards per aircraft (98% of business jet operations)

Additionally, total space requirements also assume 10 percent of the based aircraft are located on the apron for transient purposes.

Based on this assessment, the existing apron is sufficient to accommodate the project needed through PAL 2. The combined GA apron space will require additional parking spaces and total space just after PAL 3 is achieved. Any future apron should be designed to FAA standards so that sufficient space for the design aircraft (ADG II, III) for parking and maneuvering.

*Exhibit 4-54 – Transient Apron Space Requirements*

| Transient Apron Space Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Existing*** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Aircraft** | | | | | | |
| Single/Multi Engine Piston | - | 14 | 15 | 16 | 18 | 19 |
| Turboprop | - | 21 | 23 | 26 | 29 | 33 |
| Turbojet | **-** | **7** | **8** | **9** | **10** | **12** |
| **TOTAL** | ***52*** | **41** | **46** | **51** | **57** | **65** |
| **Deficiency** | **-** | **-11** | **-6** | **-1** | **5** | **13** |
| **Apron Space (SY)** | | | | | | |
| Single/Multi Engine Piston | - | 11,211 | 12,055 | 12,985 | 14,213 | 15,575 |
| Turboprop | - | 41,645 | 46,555 | 52,004 | 58,754 | 66,623 |
| Turbojet | - | 15,453 | 17,841 | 20,358 | 23,541 | 27,413 |
| **Total Space** | *90,900* | 68,129 | 76,452 | 85,347 | 96,508 | 109,610 |
| **Capacity/Deficiency** | **-** | **-22,711** | **-14,448** | **-5,553** | **5,608** | **18,710** |

*Source: KLJ Analysis*

This evaluation combines total apron space. At FSD there is a west and east apron area. The west area is designed to meet ADG-III requirements with a pavement strength of 90,000 lbs., while the east apron can only meet ADG-II requirements and is limited to 60,000 lbs. The east apron should also be designed to accommodate use of ADG-III aircraft with pavement strengthening to 90,000 lbs. Expansion concepts will be developed in the following chapter. Due to increasing use in these larger GA aircraft at FSD and industry-wide, expansion and strengthening of the east GA apron should be initiated as funding allows.

## Landside Facilities

### *Terminal Curbside*

The terminal building at FSD is served by one curbside area adjacent to the arrival and departure areas. There are a total of five lanes providing access to the terminal area to pick-up and drop-off passengers:

- Lane 1 – Direct inner curbside access next to the terminal building providing 580 LF of capacity for personal occupancy vehicles (POV) and the airport shuttle.
- Lane 2 – Lane used for vehicle circulation. During peak hours Lane 2 can be used as a secondary curbside area for passenger pick-up and drop-offs where double-parking is observed. These are operations are typical even for LOS C standards.
- Lane 3 – Dedicated vehicle through lane for those entering and existing the inner curbside area.
- Lane 4 – Outer curbside access for commercial vehicles including busses, shuttles and limousines with a portion near the arrivals area used for a three-stall taxi queue area. Airport security and local police park in this lane as well.
- Lane 5 - Dedicated vehicle through lane for the outer curbside area vehicles.

Total inner and outer curbside length each is 580 LF less pedestrian walkways. The total available terminal vehicular curbside area is 1,160 LF between Lane 1 and Lane 4.

Terminal curbside needs are evaluated using industry planning criteria to determine linear frontage for the curb to meet LOS standards. A planning factor of about 0.25 vehicles per peak hour total passengers based on factors developed from observed vehicle movements in December 2013. A dwell time of 5 minutes was used for personal vehicles FSD assuming unloading, loading or waiting times. Vehicles types are assumed percentages based in part on the traffic log. Industry standard vehicle lengths were used to determine curbside length requirements based on demand. The individual peak 15 minute period represents 35 percent of the design hour vehicles which is a conservative estimate.

*Exhibit 4-55 - Curbside Requirements*

| Curbside Requirements | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | ***Exist.**** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| **Lane 1 Inner Curbside** | | | | | | |
| Personal Occupancy Vehicles | *103* | 123 | 142 | 156 | 175 | 196 |
| Airport Shuttle | *4* | 5 | 5 | 6 | 7 | 7 |
| Commercial Vehicles | *6* | 7 | 8 | 9 | 10 | 11 |
| **Curbside Length** | ***580*** | **348** | **404** | **447** | **502** | **557** |
| **Lane 4 Outer Curbside** | | | | | | |
| Commercial/Other Vehicles | *15* | 18 | 20 | 22 | 25 | 28 |
| **Curbside Length** | ***580*** | **172** | **180** | **187** | **194** | **202** |

*Source: Goldsmith Heck Engineers, KLJ Analysis*
**Hourly traffic sample completed on December 13-20, 2013*

As enplanements increase at the airport so will the number of vehicles occupying the terminal curbside. The curbside length at FSD is projected to be adequate for LOS C standards but the inner lane will approach single-lane capacity by PAL 4. As activity increases there will be additional peak periods where double-parking occurs on the inner curbside. These operations are deemed acceptable for LOS C standards but may not meet customer expectations at FSD. This enhanced LOS would require planning for an expanded inner curbside area starting between PAL 2 and PAL 3 when demand exceeds 80 percent of capacity.

### Automobile Parking

The automobile parking needs at a commercial service airport directly relates to the number of annual enplaned passengers. Automobile parking types include public, employee and rental car parking.

Existing automobile parking supply is summarized in the table below. The airport reconfigured the main parking lots in 2011 and constructed an expanded south parking lot in 2012. These two projects increased parking capacity by about 1,000. An additional 100 spaces will be added to the south economy lot in 2014. The number of effective parking spaces was determined. This figure assumes 95 percent of the actual supply of spaces is available to the public due, maintenance or snow removal or for circulating parkers to find an available stall. The effective space count will be used for planning purposes.

*Exhibit 4-56 – Automobile Parking Supply*

| Automobile Parking Supply | | |
|---|---|---|
| **Parking Category** | **Actual Spaces** | **Effective Spaces (95%)** |
| **Public Parking** | | |
| Waiting Lot | 93 | 88 |
| Short-Term Lot | 300 | 285 |
| Main Long-Term Lot | 1,405 | 1,335 |
| South Economy Lot | 765 | 727 |
| **Total Public Parking** | **2,563** | **2,435** |
| **Employee Parking** | | |
| North Employee Lot | 23 | 22 |
| South Employee Lot | 192 | 182 |
| **Total Employee Parking** | **215** | **204** |
| **Rental Car Parking** | | |
| Ready-Return Lot | 167 | 159 |
| South Rental Car Storage Lot | 563 | 535 |
| **Total Rental Car Parking** | **730** | **694** |
| **Total Parking Spaces** | **3,508** | **3,333** |

*Source: KLJ Analysis*

A parking demand study was completed in 2011 prior to the expansion project. Current enplanements are exceeding the “high” enplanement and parking forecast for 2015. The actual growth in passenger enplanements necessitates a review of the parking projections in this Master Plan.

### Public Parking

Public parking includes waiting, short-term and long-term parking lots at FSD. This analysis combines all parking needs into a cumulative review. The need for public parking spaces is driven by passenger enplanements in the peak day of the peak month. Using updated data, there are periods experienced in March 2014 where actual peak overnight demand is within 10 percent of total effective public parking capacity. The current desired level of service at FSD is that there are available spaces within airport property during absolute peak airport activity periods.

The peak month at FSD is experienced in March. This is due in large part to a large geographic catchment area driving to FSD utilizing leisure flights to warm weather destinations during the spring break period. Total overnight public parking occupancy figures were obtained at FSD. The highest overnight rate using the most current data is 2,100 overnight parked cars in March 2014. Accounting for an additional 20 percent of space needed for daytime parkers in the different public lot types, the peak parking demand is 2,520 public spaces. Using the base enplanement figure this represents 5.32 spaces per 1,000 annual enplanements. This is higher than the common planning ratio of 3.5. The total peak parking demand is very close to existing capacity which is consistent with airport observations during peak periods. The figure actually exceeds the available long-term lot capacity meaning cars are parked in the short-term lot overnight. Local parking officials observe the short-term lot is up to 80 percent full during peak overnights.

The peak month (March) average overnight parkers is 18.5 percent higher than the peak day. Although the total number of spaces may be deficient for the absolute peak day, there is currently ample supply during the average and non-peak months. The average number of overnight parkers based on average monthly figures is 1,209 nightly in 2013, or 42 percent fewer than the peak day. Again, this assessment assumes FSD will plan to provide spaces for parking needs for absolute peak periods.

Public parking demand is projected using the 5.32 spaces per 1,000 annual enplanements ratio projected through the planning period. The forecasted demand exceeds available capacity in the base period, with over 1,500 spaces additional needed to meet forecasted PAL 4 demands at FSD. An additional 100 spaces to be constructed in 2014 would be adequate to meet total current demand.

***Exhibit 4-57 - Public Parking Requirements***

| Public Parking Requirements | | | | | |
|---|---|---|---|---|---|
| **Category** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Enplanements | 474,118 | 547,938 | 604,872 | 676,594 | 756,820 |
| Ratio per 1,000 Enplanements | 5.32 | 5.32 | 5.32 | 5.32 | 5.32 |
| Public Parking Demand | 2,520 | 2,912 | 3,215 | 3,596 | 4,023 |
| Effective Public Parking Supply | *2,435* | *2,435* | *2,435* | *2,435* | *2,435* |
| **Capacity/Deficiency** | **85** | **477** | **780** | **1,161** | **1,588** |

*Source: KLJ Analysis*

The need for more long-term and economy overnight parking is clear based on observed values in peak periods. Parking should be located no more than 1,000 feet from the terminal without a shuttle service to maintain an adequate LOS. The revenue structure should be adjusted to discourage overnight use of the short-term lot once sufficient total parking spaces are provided.

Additional public parking needs include providing a waiting lot. FSD provides a cell phone and waiting lot with 93 total spaces. These spaces are also reserved for queuing taxis for arriving passengers. A cell phone/waiting lot of about 30 spaces should be sufficient through PAL 4 when comparing size of cell phone lots at airports with enplanements that approach 1 million. Total taxi queue demand of 15 is also assumed, yielding a total demand of 45 spaces. The existing space has sufficient capacity to accommodate needs through PAL 4.

### Employee Parking

Employee parking is available in the south lot totaling 183 spaces next to the rental car ready/return lot. The lot is located in a prime location adjacent to the terminal. The 23-stall north lot may not be available in the future if proposed hotel is constructed. Demand was evaluated by counting occupied parking spots using available aerial imagery taken in 2012. In

August 2012 there were 111 spaces occupied. Current 2013 and future needs are expected to also follow a ratio of passenger enplanements as airport, flight crew and concession employment needs increase. A peaking demand factor of 20 percent was also added. The existing capacity will meet the needs through PAL 3. If capacity is reduced to an effective 174 spaces then additional spaces are needed by PAL 2.

### *Exhibit 4-58 - Employee Parking Requirements*

| Employee Parking Requirements | | | | | |
|---|---|---|---|---|---|
| **Category** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Employee Parking Demand | 139 | 161 | 178 | 199 | 223 |
| Effective Public Parking Supply | *204* | *204* | *204* | *204* | *204* |
| **Capacity/Deficiency** | **-65** | **-43** | **-26** | **-5** | **18** |

*Source: KLJ Analysis*

### Rental Car Parking & Facilities

Rental car parking needs include ready/return lots for customers near the terminal, and long-term storage lots where the rental car fleet can be stored. Facilities with the parking areas include a quick-turn facility for rental car companies to clean and maintain vehicles. Each of the three car rental concessionaires at FSD will have different facility needs. Car rental facility requirements are evaluated cumulatively.

#### *Ready/Return Parking*

Ready/return parking needs correlates with the peak number of customer transactions rather than the total number of customers. Increased demand requires rental car staff to transport cars to/from the storage lot more frequently placing additional costs and demands on their operation. This parking lot should be located immediately adjacent to the rental car counters as is the case with the present location at FSD. There are currently 167 spaces occupying a total space of 0.9 acres.

The 2011 parking study reported demand from the rental car agencies for a 200-250 stall covered ready/return lot to accommodate demands through year 2030. The number of estimated peak hour rental car transactions was reviewed to quantify demand. Two of the three agencies responded to inquiries. One agency indicated number of ready/return spaces presently is adequate but in the future (5 to 10 years) additional spaces may be necessary if demand continues to increase. Another agencies does not estimate peak number of transactions to change into the future. The peak period is late October for pheasant hunting season. Based on this feedback, peak hour transactions are assumed to grow at half the rate of enplanements.

*Exhibit 4-59 – Rental Car Ready/Return Parking Requirements*

| Rental Car Ready/Return Parking Requirements | | | | | |
|---|---|---|---|---|---|
| **Category** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Peak Hour Transactions/ Demand* | 190 | 205 | 215 | 228 | 242 |
| Effective Ready/Return Supply | *159* | *159* | *159* | *159* | *159* |
| **Capacity/Deficiency** | **31** | **46** | **57** | **70** | **83** |

*Source: KLJ Analysis*
**Estimated based on available data*

The calculation shows a deficiency in the number of spaces during the peak period. The actual ready/return lot needs should be evaluated more thoroughly with the rental car companies. An expansion should be planned. Also of note, the size of FSD's ready/return lot is small when compared to other airports with similar annual rental car revenue.

### *Rental Car Storage*

The size of the rental car storage lot is directly tied to the total rental car fleet. Total fleet is directly attributed to the total number of arriving passengers requiring rental cars. The 2011 parking study noted a 540 stall lot would be sufficient for 5 to 10 years (2015-2020). Rental car companies were queried to determine their peak parking needs. Car deliveries, or "ramp-up" occurs during the summer and late October through late November. Between all rental car agencies there is an estimated need to store 765 cars that are delivered to FSD to prepare for peak rental car activity. These "ramp-up" periods occur when public parking demand is not at peak allowing portions of the south public economy to be used for rental car storage overflow parking. The typical on-going storage need is assumed to be about 60 percent of peak.

*Exhibit 4-60 - Rental Car Storage Parking Requirements*

| Rental Car Storage Parking Requirements | | | | | |
|---|---|---|---|---|---|
| **Category** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Peak Rental Car Storage Demand | 765 | 884 | 976 | 1,092 | 1,221 |
| Typical Rental Car Storage Demand | 459 | 530 | 586 | 655 | 733 |
| Effective Rental Car Storage Supply | *535* | *535* | *535* | *535* | *535* |
| **Capacity/Deficiency** | **-76** | **-4** | **51** | **120** | **198** |

*Source: KLJ Analysis*
**Estimated based on available data*

Starting just after PAL 1 there will be a need to provide additional on-going rental car storage parking. At about this same time, the south public economy lot will also reach capacity when rental car and public parking needs are combined during "ramp-up" months. There is a need to provide about 200 additional spaces at PAL 4 and to 700 new spaces to provide adequate spaces for full "ramp-up" operations without affecting public parking needs.

### *Quick Turn Facility (QTF)*

A facility to accommodate rental car operations is a maintenance or "quick-turn" facility. These facilities are located within the vicinity of rental car operations and parking. A typical rental car QTF consists of a car wash, maintenance bays, storage and fueling area. The existing rental car QTF is located within the rental car storage parking area. Total space is approximately 5,750 SF of total space one car wash, five maintenance bays and a fueling area with underground storage tanks. All three FSD concessionaires constructed a QTF with private funds and share in its use. Local rental car stakeholders have expressed an increasing need for an expanded facility to support growing operations.

New rental QTF installations are other comparable airports were evaluated. Each airport's QTF needs were evaluated based on rental car revenue as reported to the FAA in 2012. These airports included:

- Bozeman Yellowstone International Airport (BZN)
  - Quick Turn Facility Size: 16,927 SF *(4 wash, 9 maintenance bays, storage)*
  - *Rental Car Revenue: $2,245,640*
  - *Revenue per QTF SF: $167*
- Rapid City Regional Airport (RAP)
  - Quick Turn Facility Size: 8,970 SF *(2 wash, 4 maintenance bays, storage)*
  - *Rental Car Revenue: $997,338*
  - *Revenue per QTF SF: $111*
- *Sioux Falls Regional Airport*
  - *Quick Turn Facility Size: 5,750 SF (1 wash, 4 maintenance bays)*
  - *Rental Car Revenue: $1,183,148*
  - *Revenue per QTF SF: $205*

The size of the FSD facility was the smallest overall in terms of revenue per available QTF SF. Based on this evaluation, a QTF size planning factor of $150 per SF was used accounting for facility sizing based on current and projected facility needs. Rental car revenue at FSD is projected to increase at the same rate as enplanements. Using these factors a projected QTF size was determined.

### *Exhibit 4-61 – Rental Car QTF Requirements*

| Rental Car QTF Requirements | | | | | |
|---|---|---|---|---|---|
| **Category** | **Base** | **PAL 1** | **PAL 2** | **PAL 3** | **PAL 4** |
| Rental Car Revenue | $1,242,189 | $1,435,598 | $1,584,765 | $1,772,676 | $1,982,868 |
| Revenue per QTF SF Factor | 150 | 150 | 150 | 150 | 150 |
| QTF Building Size | 8,260 | 9,570 | 10,570 | 11,820 | 13,220 |
| Existing QTF Building | *5,750* | *5,750* | *5,750* | *5,750* | *5,750* |
| **Capacity/Deficiency** | **2,530** | **3,820** | **4,810** | **6,070** | **7,470** |

*Source: KLJ Analysis*

The recommended QTF at FSD totaling about 8,300 SF with 2 car wash bays and 4 maintenance bays would meet the existing need. A facility of over 13,000 SF would be needed to accommodate the needs through PAL 4. A 13,000 SF facility would include 3 car wash bays and 6 maintenance bays. This facility would include a separate designated fueling area with at least four fuel dispensers each with two nozzles. Its overall site area is based on building configuration and vehicle circulation needs. If a new facility is planned, FSD needs to work directly with the car rental concessionaires to agree upon a funding plan considering the value of the existing structure.

#### Recommendations

Automobile parking facility recommendations for FSD include:

- Provide approximately 500 additional public parking spaces through PAL 1 to accommodate absolute peak parking periods. A total of about 1,600 additional spaces over existing capacity is needed by PAL 4.
- Expand the employee parking lot after PAL 2 to meet forecasted demands if capacity is limited as a result of existing spaces lost to hotel development.
- Provide an additional 46 rental car ready/return parking spaces to meet PAL 1 meets, and a total of 83 additional spaces to demand through PAL 4.
- Additional rental car storage parking to meet typical and peak “ramp-up” operations between PAL 1 and PAL 2. A total of about 200 new spaces will be required by PAL 4.
- Upgrade the existing 5,300 SF rental car quick-turn facility (QTF) to meet current and future needs. A QTF of 8,300 SF is needed now with a need for a 13,000 SF facility by PAL 4.

### *Ground Access & Circulation*

#### Passenger Terminal Complex

Access to the passenger terminal complex is provided by North Jaycee Layne with access from Minnesota Avenue. There is one entrance and three exit points. As passenger volumes increase so will the traffic count and flow through the terminal complex.

The existing airport access road was reconfigured in 2011 with additional signage. Improvements to the north airport entrance/exit with signaled intersection at Minnesota Avenue were completed. The third access point along Minnesota Avenue was removed. Curbside access was enhanced to provide additional capacity, adequate flow and circulation. Internal parking circulation roads were also enhanced with second-chance entrances and enhancement of the circuitous return to airport roadway. The existing ground access and circulation infrastructure is adequate through the planning period.

With the construction of a new south economy parking lot, airport management has identified a need to construct better way finding signage prior to the entrance for the short and long-term lots. Enhanced landscaping to further discourage parking lot violators is also recommended. Other long-term needs include the development of a fueling and convenience store closer to the airport. A potential site identified by the airport is north of the cell phone/waiting lot adjacent to Minnesota Avenue.

### Roadway System Considerations

Surrounding roadways provide adequate access for customers to and from the airport. Roadway plans can also influence airport development. The primary access roadway for FSD is North Minnesota Avenue. This roadway provides direct connection to the Sioux Falls central business district. The airport is located within Interstate 90, 29 and 229 each less than three miles from FSD.

### Interstate Access

There is no direct access point from the local interstate system to the airport. Each access point requires travel on at least one other roadway prior to North Minnesota Avenue. Challenges in developing an interchange with Interstate 90 would be a northward extension of North Minnesota Avenue, an existing railroad line, Silver Creek and other existing ponds/wetlands. No interchange is planned.

The extension of North Minnesota Avenue with an overpass over Interstate 90 has been studied and is feasible. This would provide congestion relief for the local roadway system. This improvement would not noticeably benefit the airport.

### West Airport Access

Airport management has expressed a desire to provide connectivity to the areas on the west side of the airfield with new roadway infrastructure to the west of the airport. Maverick Air Center, SDARNG and Satnan Avionics have singular access through West National Guard Drive, connecting to Minnesota Avenue. A new westward access would reduce or eliminate the need those requiring access to the west side of the airport to travel over one mile to the east side of the airfield to access the roadway system. It would also reduce travel times for those from Interstate 29 or 90 with planned upgrades to West Benson Road and North Westport Avenue per the Sioux Falls MPO Long-Range Transportation Plan (2021-2025). It would also open up the opportunity to use an existing section of West National Guard drive as an internal airport perimeter roadway.

A proposed roadway alignment connecting West National Guard Drive with West 60$^{th}$ Street and/or North Westport Avenue should be explored. Options to provide westward roadway system connectivity will be explored in the next Chapter.

### West 60$^{th}$ Street Improvements

Additional roadway system capacity is needed along West 60$^{th}$ Street / South Dakota Highway 38. The corridor from North Westport Avenue through Minnesota Avenue must consider airport facility requirements to meet airport safety standards. A 60$^{th}$ Street Feasibility Study was completed in 2012 to evaluate options to upgrade this roadway to six-lanes for roadway system capacity improvements. The first section of roadway improvements between Interstate 29 and North Westport Avenue is scheduled to be completed within the next five years. Improvements along the Westport through Minnesota Avenue corridor is planned to be completed thereafter once an Environmental Assessment is completed.

The proposed improvements would lower the roadway profile to an elevation 20 feet lower than an assumed FAR Part 77 50:1 approach surface and 62.5:1 one-engine inoperative (OEI) departure surface to Runway 15/33. Although prevailing terrain would still penetrate both of these surfaces, a lower roadway is seen as a safety benefit to the airport. The construction would provide access points for a potential future west airport access.

The intersection with North Minnesota Avenue and the railroad tracks would either be an at-grade intersection or be elevated with grade separation. This intersection is located about 3,500 feet from the end of Runway 3/21 within the approach surface. The construction of a grade-separated intersection would potentially have light poles as high as 1,493' MSL. Objects at this elevation and location would likely be lower than the FAR Part 77 50:1 approach surface but penetrate a 62.5:1 OEI departure surface.

As of October 2013 no decision has been made by the City of Sioux Falls on either option. The recommendation is for the airport to monitor and advocate for Option 2 for at-grade intersections to keep a 62.5:1 OEI surface clear. This would also provide additional options for future West 60th Street access.

#### Minnesota Avenue Corridor Improvements

The City of Sioux Falls is proposing to enhance the North Minnesota Avenue corridor between the airport and downtown. Improvements would include new streetscape elements including new medians, trails, signage, lighting and vegetation. A corridor study was completed in 2013.

The proposal calls for landscaping and signage within the existing Runway Protection Zone (RPZ) for Runway 33. Reduced height tree plantings would be completed to stay below approach and departure airspace surfaces. A proposed multi-use trail would traverse the RPZ. Under current guidance this would require an alternatives analysis to be submitted to FAA for approval. A proposed airport windbreak would also have to stay clear of airspace surfaces.

It is recommended to work together with the City to verify improvements are compatible with existing and proposed future airport operations.

#### Other Airport Areas

The majority of roads with public are not designated public roads. This standard applies to West National Guard Drive, West Weather Lane, North John Orr Drive, Maverick Place, Lien Place, West Hanger Street and North Aviation Avenue. The primary advantage to this designation is the ability for fuel trucks and other vehicles to drive on these roadways without restriction. This is recommended to remain so long as the airport has the financial resources to maintain these roadways.

The primary goal is to plan for a west airport access roadway. Existing access and circulation roads are adequate to meet future needs. Any new roadways should consider potential aeronautical or non-aeronautical industrial development to the northwest of SDARNG. There are no other recommendations for additional airport access or public circulation roadways.

#### Public Transportation

There is no public transportation access to FSD to serve passengers or airport employees. Minnesota Avenue adjacent to the airport is not served by fixed route service on the Sioux Area Metro (SAM). The closest SAM bus stop is at the corner of North Minnesota Avenue and North Drive on Route 8, over 1 mile from the passenger terminal. Services runs every 50 minutes to 1 hour on weekdays from 5:30 a.m. to 6:45 p.m. The area by the airport is a frequently requested area for new service according to the 2011-2015 Transit Development Plan. A route evaluation process would have to be completed by the Public Transit Advisory Board. It is recommended the Airport work together with the Public Transit Advisory Board to determine to need for service to the airport.

## Support Facilities

Support facilities are necessary to support a safe and efficiently run airport supporting airport operations and the travelling public.

### *Fueling Facilities*

Each Fixed Base Operator has their own dedicated fuel farms with Jet-A and 100 low lead (LL) aviation fuel types. Both FBOs combined have privately owned fuel tanks with 254,000 gallon capacity of Jet-A fuel and 57,000 gallons capacity of 100LL fuel.

Landmark Aviation operates a fuel farm with total storage of 214,000 gallons of Jet-A fuel in two 47,000 gallons tanks and six 20,000 gallons tanks. Total 100LL storage capacity is 50,000 gallons of 100LL in one 20,000 gallons tank and two 15,000 gallons tanks. Landmark is currently the contract supplier of Jet-A fuel to the airlines. The fuel farm has expandability to the west and north to provide additional fuel storage capacity into the future.

Maverick owns and operates a fuel facility with two 20,000 gallon Jet-A fuel tanks and one 12,000 gallon tank with 100LL fuel. The fuel farm has expandability to effectively double fuel storage capacity with additional tanks located to the west. This site is located on the east side of the airport with the FBO located on the west side. Maintaining on-airport access between the two areas is important for operational efficiency.

Each fuel farm should provide capacity for two-week usage and be sized for a full tanker truck. Overall 100LL airport operations are forecast to increase 51 percent through PAL 4, with Jet-A operations increasing 43 percent. This indicates a potential for a similar increase in fuel usage. A simple projection shows a need for up to an additional 110,000 gallons of Jet-A storage and 26,000 gallons of 100LL storage. Considerations should also be made to encourage the use of alternative fuels through accommodating additional storage. Additional fuel tanks and facilities will be constructed as demand arises. There is expandable space to meet the needs through PAL 4 at FSD. No 24-hour self-serve fuel pumps are located on the airport as each FBO provides fueling services during regular business hours.

The airport should consider automobile and/or diesel fuel facility upgrades as needed for ground vehicles at the airport maintenance complex. The site is considered adequate.

### Aircraft Rescue and Fire Fighting (ARFF)

As a certificated FAR Part 139 facility, FSD must comply with ARFF equipment, staffing, training and operational requirements. The South Dakota Air National Guard (SDANG) owns and operates the ARFF facility east of Taxiway B at the south end of the airport. This facility and its operation meets all FAA requirements.

ARFF requirements are driven by the length of the largest air carrier aircraft that serves the airport with an average of five or more daily departures. FSD is currently classified as an ARFF Index B facility. Future anticipated operations would regularly be conducted in a Boeing 717 (124' 0" length) aircraft. The ARFF index is not anticipated to change into the future. If Index C is required additional foam agent capacity is needed according to SDANG.

*Exhibit 4-62 - ARFF Index Requirements*

| ARFF Index Requirements | | |
|---|---|---|
| **ARFF Index** | **Aircraft Length** | **Representative Aircraft** |
| A | < 90 feet | CRJ-200 |
| B | 90 feet - < 126 feet | CRJ-900, A-320, ERJ-145 |
| C | 126 feet - < 159 feet | B-737-800, B-757, MD-80 |
| D | 159 feet - < 200 feet | B-767, A-300 |
| E | > 200 feet | B-747 |

*Source: Title 14 CFR Part 139*

The ARFF station must be located so that at least one firefighting vehicles can reach the midpoint of the farthest runway within three minutes. The current ARFF site meets this requirement. With no major airfield configuration changes anticipated, this location will be sufficient to meet the needs into the future. The ARFF building will soon be expanded to add one additional equipment storage bay for a total of six.

### Airport Maintenance & Snow Removal

The airport maintenance complex is located in the west development area. Total facilities consists of 38,200 square feet of offices, maintenance, storage and shop space once an additional storage building is relocated to the site. This complex was developed in 2007. Additional storage space may be needed through PAL 4. Some expansion is possible to the northeast with additional expandable space to the northwest with reconfiguration or remote structures. This complex is considered sufficient to meet the needs into PAL 4.

Winter operations require the removal of snow and ice from the airfield to maintain airport operations. Snow removal equipment is stored in the airport maintenance building. Snow needs be cleared from the pavement surfaces, around airfield lights and signs. Piled snow should not create a visible obstruction to pilots. It should be piled in a location that does not impede airport operations and can sufficiently melt and adequate drainage. There are no known snow removal or storage issues at FSD. Future facilities should provide adequate clear space for snow removal storage.

### *Customs and Border Protection (CBP)*

As of May 2014, CBP has asked the airport to upgrade the current 2,700 square foot CBP facility within the airport passenger terminal building. The upgrade, if approved by the airport, would allow the facility to meet acceptable General Aviation Facility (GAF) requirements. These facilities are designed to accommodate on-demand general aviation and commercial charter flights seating up to 20 people. Facilities include administration, processing and inspection areas. The existing facility between the east cargo and general aviation aprons would be used as a field office. CBP currently will not operate a facility larger than a GAF.

Processing larger private or commercial aircraft requires the construction of a conventional passenger processing facility with Federal Inspection Services (FIS). This is a long-term goal of the airport which should be accommodate in any terminal design alternative. An FIS facility provides primary immigration processing, secondary exam areas and baggage screening. Basic FIS facilities are designed to process up to 200 passengers per hour. This facility is required to accommodate on-demand charter flights with more than 20 people. FIS requirements are based on demand for international service at the airport. A facility of this size could accommodate charter service from international locations in Boeing 737-800 or similar aircraft. Some airports of similar size to FSD are planning for FIS facilities.

*Exhibit 4-63 – Customs and Border Protection (CBP) Space Requirements*

| Customs and Border Protection (CBP) Space Requirements | |
|---|---|
| **Area Type** | **Square Feet Required** |
| **General Aviation Facility (GAF)** | |
| Passenger Waiting and Processing | 2,160 |
| CBP General Office | 225 |
| Computer/Communications Room | 60 |
| Storage Room | 60 |
| Search/Hold Room | 80 |
| Interview Room | 80 |
| Agricultural Quarantine Inspection (AQI) Laboratory | 110 |
| Public Restrooms | 112 |
| **TOTAL** | **2,892** |
| **Small Airport Facility (200 passengers/hour)** | |
| Primary Processing | 3,370 |
| Secondary Processing | 3,460 |
| CBP Administration | 1,310 |
| General Aviation Facilities | 2,900 |
| **TOTAL** | **11,040** |

*Source: Airport Technical Design Standards for Passenger Processing Facilities (USCBP, 2006)*

A small airport facility of at least 9,000 square feet should be planned to be accommodated as an add-on development. Space requirements do not include secure corridors from the gate or baggage claim. Upgrading to an FIS facility requires legislative support at the federal level, adequate CBP staffing and funding for a facility. No PAL trigger is identified in this Master Plan.

A separate long-term GAF facility of approximately 3,000 square feet should be provided for in the long-term to serve the east general aviation and cargo area if and when the existing facility is upgraded to FIS. This would separate passenger airline and general aviation/cargo processing. An upgrade of the existing CBP building should be considered to accommodate this need.

### *Security & Access*

Security is an important consideration when operating a safe airport. Transportation Security Administration (TSA) publishes recommended airport design guidelines. The first line of security protection infrastructure is a perimeter fence. Its installation will help prevent unauthorized persons from entering the airfield and also to control wildlife. A minimum 6-foot high fence with added barbed wire is recommended by TSA with upgraded FAA standards recommended to control wildlife. At FSD the perimeter fence is currently being upgraded to be 10-feet high with a barbed wire security top. This is recommended to be maintained to all TSA and FAA standards. All access points are controlled.

Other security considerations include a 100 foot recommended setback for new automobile parking areas from an FIS facility. A 300 foot building bomb blast setback required from the terminal building to automobile parking unless a separate study demonstrates a reduced distance.

FAA generally recommends airports have a full internal access road system that allows authorized vehicles to access various portions of the airfield, minimizing the need to navigate on taxiways, cross runways or leave the boundaries of airport property. A typical perimeter road is 20 to 24 feet wide and located outside of the airfield safety areas. FSD has a partial perimeter road with a dedicated alignment around Runway 3 and 15. An upgraded roadway alignment around Runway 21 and 33 ends is recommended. Considerations need to be made for SDANG military operations which may render a full perimeter road impossible.

## *Airport Utilities*

On-airport utilities including water, sanitary sewer, storm sewer, gas, power and communications are discussed in this section. Future facility development may require the relocation, replacement and/or upgrading of portions of the airport utility infrastructure.

### Water

FSD is constructed on top of the Big Sioux Aquifer providing drinking water to the area. There are several water pumping wells and main lines constructed within airport property. The City of Sioux Falls Water Department recommends a setback of 1,000 feet from new proposed underground storage tanks to existing water wells. Removing and relocating water wells is a significant cost. The water well south of the passenger terminal (#15) is planned for replacement. No new buildings or structures shall be placed in close proximity to water main lines. This has affected development in the east hangar area where a 24-inch well main runs north-south. Relocation of a well main line is possible, but costly.

Water service for domestic use and fire protection for FSD is provided by the City of Sioux Falls. There is currently an existing water main that loops around the entire airfield. The main is 10” diameter along the Terminal area and then 8” diameter throughout most of the remainder of the airfield, which is the minimum main size for fire protection as per City Design Standards. There are a few areas with sub-standard main size including a 6” main along the east cargo building and a 4” main from the east cargo building over to the Army National Guard. However, the Army Guard area also is fed from an 8” looped main coming from the south that was installed in 2002. Replacement of water mains less than 8” in diameter should be included in the long term capital improvement program.

The majority of the water main throughout the developed areas along the east side of the airport was installed back in the late 1960s and 70s when the current passenger terminal and GA areas were first established. The eastside mains follow a utility corridor that generally runs along the west side of the terminal, under Aviation Avenue and along the east edge of the East Cargo Apron. These mains are mostly under street or apron pavement and should be evaluated for replacement in conjunction with future pavement replacement projects.

Water mains around the west side of the airfield vary in age as the area has developed with the mains along the south end installed in the 1990s up to the most recent mains installed along Maverick Drive and Lien Drive when the northwest development streets were constructed in 2007.

All buildings throughout the airfield have public water service with the exception of the east GA T-hangars.

### Sanitary Sewer

Sanitary Sewer is also provided by the City of Sioux Falls. There is currently sewer service throughout all developed areas of the airfield with the exception of the east GA T-hangar areas. Due to the flat terrain, there are several lift stations throughout the airfield with the main lift station located near the southwest corner of the terminal building. A 6" diameter force main runs south from the lift station and exits the airport property at the corner of Minnesota Avenue and Maple Street. The eastside gravity sewer mains were installed in 1966 and follow the same utility corridor as the water main along the west side of the terminal, under Aviation Avenue and along the east edge of the East Cargo Apron.

Another lift station is located just north of the West Cargo Apron and it serves the northwest development area with the force main located north of the Runway 21 approach and connecting into the eastside sewer north of the east cargo apron. A third lift station is located just northeast of the City Fire Training Center on the west side of the airfield and it serves the westside City Fire/Police and SDANG facilities. The forcemain for this lift station runs south and east around the Runway 3 approach discharging to public sewer on "M" Avenue north of Cherokee Street and was installed in the mid-1990s. There are several other smaller lift stations in the East GA area serving individual or small clusters of hangars or other properties.

Similar to the water mains, the majority of the sanitary sewer on the east side of the airfield is under street or apron pavement and is 40-50 years old. These mains have sufficient capacity for future airport growth, but should be evaluated for replacement or rehabilitation in conjunction with various future pavement replacement projects.

### Storm Sewer

The topography throughout the Sioux Falls Airport is flat with a major drainageways located adjacent to or across the street from the airport property on three sides. The Big Sioux River flows southerly and bounds the Sioux Falls Airport along the west side of the airfield. At the northwest corner of the airport, a diversion structure diverts flow from the Big Sioux River to the Big Sioux River Diversion Channel that flows east along the north property line of the Airport and then south on the east side of Minnesota Avenue just east of the Airport.

The drainage basins throughout the developed areas on the east side of Airport and the majority of the airfield are served by a storm sewer pipe networks with four major storm trunklines that discharge to the Big Sioux River Diversion Channel on the east side of Minnesota Avenue. These trunklines range in size from 48" to 72" in diameter.

Drainage at the southwest end of the airfield and the west half of the SDANG Base is conveyed by a 24" and 48" storm sewer pipes that discharge west into the oxbow along the northern edge of Elmwood Golf Course. The oxbow primarily drains by infiltration into the aquifer, but also has an overflow outlet to the Big Sioux River to the west.

The City Fire, City Police and SDANG facilities on the west side of the airfield surface drain west and then outlet to the Big Sioux River through a 48" storm pipe through the levee. There are also two 30" outlets through the Big Sioux levee that drain the open spaces on the west side of the airfield north of the Westside SDANG facilities.

All of the storm sewer discharge pipes through the Big Sioux River and Diversion Channel levees are equipped with a flap gate and sluice gate combination structure to protect the airport and surrounding properties from backflow when the river is at flood stage.

There are several flat open grass areas throughout the airfield that do not have any drainage systems and rely solely on infiltration into the ground.

Storm runoff in the highly developed terminal area is routed by inlets and storm pipe system through four different detention/BMP ponds before discharging to the storm trunklines that leave the airport property. The purpose of the ponds is to provide storage volume to reduce peak flows for significant storm events and to provide brief runoff retention time for smaller events to allow sediment to settle out. The ponds are all designed to fully drain within 48 hours. Similar type water quantity/water quality pond facilities are also located at the Landmark FBO and at the West GA Apron/Maverick FBO.

City Design Standards require that storm conveyance systems carry flow for the minor (5-year) storm event and that significant property damage or loss of life does not occur during the major (100-year) storm event. The majority of the storm sewer system in the developed areas of the airfield will be a maximum capacity during a 5-year storm event. As a result, future improvements that add significant impervious areas to the airport will be required to provide storm detention facilities so that peak flows are maintained to current levels. Additionally, as per City Drainage Design Standards, any development that adds more than one acre of new impervious area will be required to route the drainage from such development through a water quality (BMP) facility. Therefore, in addition to drainage conveyance, all future airport improvements should factor in budget and space needs for water quantity and water quality infrastructure.

### Gas, Power & Communications

Services for gas, power and communications are provided to airport facilities by a combination of private and public companies. A vast network of infrastructure is already in place serving the various airport users. Infrastructure to the meter point on each property is typically provided by the utility company and is recouped through monthly user fees. Therefore, the airport capital improvement plan only needs to account for service line costs on the building side of the meter for these utilities for each project and does not need to factor in the more expensive costs of installing the utility infrastructure to the site.

## Other

### *Military Facilities*

The military facilities at FSD support the South Dakota Air National Guard (SDANG) and South Dakota Army National Guard (SDARNG). SDANG occupies a total of 160 acres on the south and west portion of the airport. SDARNG leases approximately 25 acres of land from the Airport for a readiness center and parking/storage facilities. The scope of this Master Plan related to the military is limited to planning the appropriate location on the Airport for military area requirements, as determined by the military.

It is anticipated the SDANG F-16 flying missions will occur through the short-term, however it is impossible to predict changes the Federal government may make to the mission at FSD. SDANG is expected to complete a facilities Master Plan in 2014. SDANG will continue to provide Aircraft Rescue and Fire Fighting (ARFF) facility and operations. Taxiway C is now for exclusive SDANG use and maintenance. For the purposes of this Master Plan Update, it was assumed that the current lease area, 160 acres, will satisfy the SDANG military requirement through the planning period.

SDARNG completed a facilities master plan in 2011. There are no plans to expand the existing readiness center building, however is a plan to acquire the existing "alert" hangars and develop the site into non-aeronautical storage with the apron used as automobile parking. Roadway and drainage improvements to West National Guard Drive will be completed in the short-term.

A new regional training institute is needed according to the SDARNG plan. The proposed site is west of the Big Sioux River within airport property with direct access to 60$^{th}$ Street. The site will require 25 acres of land for construction of a 95,000 square foot building. The development site should be a consideration when developing alternatives a new west airport access compatible with existing and future airport operations. A site with access to an expanded west access road should be considered with site modifications made accordingly.

Ongoing coordination between the Airport, SDANG and SDARNG will ensure that facilities remain sufficient for current and future military operations. Space for potential future expansion of these military facilities should be factored into the long-term, on-airport land use planning.

### *Other Aeronautical/Non-Aeronautical Development*

Other aeronautical development includes aviation-related businesses. Examples include aircraft maintenance, repair and overhaul (MRO) facilities or other businesses that require direct access to the airfield. Considerations for developing property for these uses include adequate airfield access, parcel size, landside roadway access/parking and utilities. This type of development should be protected if sufficient available land exists. The airport has identified property to the west of SDARNG as a potential development site with airfield access.

Airports should primarily be reserved for existing and planned aeronautical uses, however, non-aeronautical uses can enhance the customer experience and provide additional revenue-generation opportunities to the airport. If airport owned land does not have any aeronautical need for the safety, capacity or other airport development needs then it can be considered for a non-aeronautical use. Non-aeronautical development requires a concurrent land use or land release with approval from the FAA.

Examples of non-aeronautical land uses at FSD include SDARNG, National Weather Service and agricultural production. The airport is currently planning for an adjacent hotel to be constructed next to the terminal in 2014. A few examples of non-aeronautical land uses include retail development, manufacturing/storage facilities, mineral extraction and even cell phone towers (compatible with airspace). Non-aeronautical development can be financially lucrative for the airport but must be approved by FAA.

Additional opportunities for non-aeronautical uses are located outside of access to the airfield including land near the initial passenger terminal access road, land within the east general aviation complex and airport-owned land north of the Big Sioux River northwest of the airport. Considerations for developing property for non-aeronautical uses parcel size, landside roadway access/parking and utilities.

There are no recommendations for non-aeronautical use in this Master Plan, however the airport should continue to explore and market opportunities in areas not needed for aeronautical use. The preferred development alternative in the next chapter and in the subsequent Airport Layout Plan will identify the land needed for aeronautical use.

## Summary

This chapter identifies safety, capacity and development needs for the Sioux Falls Regional Airport based on forecasted activity levels. These recommendations provide the basis for formulating development alternatives to adequate address recommended improvements. The following summarizes the facility recommendations:

### *Airside Facilities*

- Maintain Runway 3/21 and 15/33 to accommodate regular use of a Boeing 767-300F aircraft with ARC D-IV standards. No runway extension is recommended.
- Maintain Runway 9/27 for small aircraft up to a Beechcraft King Air B-250 and ARC B-II standards.
- Upgrade Runway 3/21 blast pads and construct runway shoulders to meet FAA design standards.
- Upgrade Runway 15/33 blast pads, construct runway shoulders and mitigate Runway Object Free Area to best meet FAA design standards.
- Increase holdline separation to 265 feet for runway and taxiway intersections adjacent to Runway 3/21 and 15/33.

- Plan to accommodate a Category II ILS approach on Runway 3 or 21 and review accommodating a ¾ mile visibility approach to Runway 15/33.
- Acquire adequate land use control within each of the existing and expanded Runway Protection Zones (RPZ).
- Review and accommodate potential alternate ATCT sites.
- Provide TDG-5 taxiway design standards for areas used by the critical design aircraft.
- Mitigate airspace obstructions to existing and future runway configuration airspace.
- Mitigate the “hot spots” identified at the “five-corners” intersection, reconfigure the taxiways near Runway 9/27 as they cross other runways, and correct direct access taxiways.
- Construct future high-speed exit taxiways as needed to increase airfield capacity.
- Construct exit taxiway improvements for Runway 15 landing operations.
- Construct bypass taxiway and/or holding bays for Runway 33 and 3 ends. Expand holding bays for Runway 15 and 21 ends.
- Construct paved shoulders for taxiways commonly used by TDG-5/ADG-IV aircraft.

### *Passenger Terminal*

- Expand the terminal building to meet PAL demand requirements.
  - Expand the security checkpoint and meeter/greeter lobby (planned by 2016)
  - Expand the baggage claim circulation and claim device frontage to meet peak aircraft and overall demand by PAL 1.
  - Expand the rental car queuing area to improve circulation.
  - Accommodate a general aviation Customs and Border Protection (CBP) facility with future expansion for an FIS facility.
  - Increase the total number of gates to 9 including expanded holdrooms and concourse circulation space by PAL 4.
  - Construct additional restroom fixtures starting in PAL 3.
  - Provide additional dedicated self-service check-in kiosks.
- Expand terminal apron in conjunction with the number of gates in the terminal.
- Provide three Remain Over Night (RON) parking spaces for aircraft as large as ADG-IV.
- Provide four aircraft deicing pads for sufficient peak throughput.

### *Air Cargo*

- Provide an additional 31,000 SF of air cargo processing building space to accommodate existing UPS and expanded operations.
- Construct an additional 30,600 SY of air cargo apron to accommodate all existing air cargo traffic and expected future air cargo aircraft.

### *General Aviation*

- Provide an additional 80,000 SF of aircraft storage building space with flexible development space between the east and west development areas.

- Additional overall general aviation (GA) apron space will be needed starting in PAL 3 with 18,700 SY of additional space anticipated by PAL 4. Local needs may be needed sooner for the east apron.
- Expand the east GA apron to accommodate ADG-III and 90,000 lb. aircraft to meet growing demands.

### *Landside Facilities*

- Additional total public automobile parking space is needed now at FSD. Construct an additional 500 spaces by PAL 1 with over another 1,000 needed by PAL 4.
- Construct an expanded employee parking area by PAL 2.
- Expand the rental car ready/return parking area in the short-term and expand the rental car storage parking area starting after PAL 1.
- Construct a 13,300 SF rental car Quick Turn Facility (QTF) to meet the needs through PAL 4.
- Plan and construct a west airport access road to serve west GA and SDARNG areas. Monitor other surrounding roadway projects for compatibility with the airport.

### *Support Facilities & Other*

- Maintain the ARFF facility to comply with Index B requirements through the planning period.
- Provide at least an additional 9,000 SF of CBP space in the passenger terminal for a small airport facility to accommodate international charters. A long-term GA/cargo CBP facility should be sited.
- Maintain an airfield perimeter fence to FAA and TSA standards.
- Upgrade the internal access road to minimize crossing airfield areas.
- Consider upgrades/relocation of airport utilities to accommodate growth and minimize limitations to development.
- Identify areas for potential other aeronautical or non-aeronautical development.