Chapter 4: Facility Requirements

Introduction

This chapter of the Airport Master Plan analyzes the existing and anticipated future facility needs at the Black Hills Airport – Clyde Ice Field (SPF). It is divided into sections that assess the needs of primary airport elements including airfield, 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.

Black Hills Airport – Clyde Ice Field continues to grow as a result of its role in serving the northern Black Hills. Since the last Master Plan, the airport has constructed various improvements including extending the primary runway, relocating hangars and fuel farm, constructing a full parallel taxiway and adding an additional apron area.

Discussions with airport management, coupled with forecasts depicting growth in all areas of aviation led to areas of emphasis in this chapter. These include identifying the alignment of a crosswind runway, assessing the impact of a crosswind runway on current facilities and layout and determining the demand for general aviation hangars. 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 forecasts developed in the last chapter are now correlated with each PAL 1, 2, 3 and 4 which were 2019, 2024, 2029, and 2034 respectively.

Table 4-1 identifies the PAL metrics for the Black Hills Airport – Clyde Ice Field.

Table 4-1 – Planning Activity Levels (PALs)

Planning Activity Levels					
Metric	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Based Aircraft					
Single Engine	65	67	69	70	70
Twin Engine	4	6	7	9	11
Turbojet	0	1	2	3	4
Helicopter	0	0	0	0	0
Other	3	3	3	3	4
Total	72	76	81	85	89
Operations					
Itinerant	4,320	4,597	4,886	5,188	5,502
Local	9,500	10,194	10,915	11,671	12,456
Total	13,820	14,791	15,801	16,859	17,958
Peak Month	1,889	2,022	2,160	2,289	2,455
Design Day[1]	76	81	86	93	98
Design Hour[2]	15	16	17	19	20

Source: KLJ Analysis

Airfield

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

[1] The Design Day is a day when the number of operations is in greater concentration than typical days. 0.4% of the peak month was used to calculate the design day.

[2] The Design Hour was determined by estimating 20% of the design day operations would be the peak amount occurring during a single hour.

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.

Other Design Considerations

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

- 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 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.
- 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 flight plans at SPF from 2008 to 2014 were analyzed considering potential changes to the design aircraft from the aviation forecasts developed in **Chapter 3** from local and national aviation trends. The following Table depicts the critical general aviation aircraft flight plans.

Table 4-2 – Critical General Aviation Aircraft Flight Plan Operations

Critical General Aviation Aircraft Flight Plan Operations							
Aircraft Type		AAC	ADG	TDG	2012	2013	2014
Beech King Air	90	B	II	1A	113	87	60
Beech King Air	200/300	B	II	2	95	109	120
Beech King Air	350	B	II	2	2	2	8
Beech Jet	400	B	I	1A	16	27	8
Beech Hawker	800	C	II	1B	23	16	6
Cessna 340	340	B	I	1A	22	28	50
Cessna Chancellor	414	B	I	1A	23	16	3
Cessna Golden Eagle	421	B	I	1A	11	10	19
Cessna Conquest II	441	B	II	2	106	106	113
Cessna Citation I	500/501	C	I	2	2	3	20
Cessna Citation Mustang	510	B	I	2	12	12	4
Cessna CJ1, CJ2, CJ3, CJ4	525	C	II	1A	8	14	44
Cessna Citation II	550	B	II	1A	38	30	26
Cessna Citation V	560	C	II	2	54	88	73
Cessna Citation III, VI, VII	650	D	II	1A	4	6	20
Dassault Falcon	2000	B	II	2	8	10	4
Gulfstream IV	450	D	II	2	2	4	8
Pilatus PC-12	12	A	II	2	130	106	114
Piper Cheyenne	31/42	B	I	2	39	57	52
Piper Malibu	46	A	I	1A	63	64	138

Source: FAA Flight Plans, KLJ Analysis
NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.

Table 4-3 summarizes the existing air cargo activity at SPF which occurs during the annual Sturgis Motorcycle Rally. UPS typically only flies to Rapid City Regional Airport but due to the increased demand during the motorcycle rally, there are several flights over a two week period that fly directly to SPF to get packages to and from customers.

Table 4-3 - Critical Air Cargo Flight Plan Operations

Critical Air Cargo Flight Plan Operations						
Aircraft Type	AAC	ADG	TDG	2012	2013	2014
Air Cargo						
Cessna 402/404	B	I	2	-	2	4
Swearingen Metro III	B	II	2	20	24	23

Source: FAA Flight Plans, KLJ Analysis
NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.

The most demanding aircraft for the overall airport is a Category C/D, Group II aircraft. These are a mixture of aircraft mostly turbojet aircraft. These aircraft operate on Runway 13/31 as it is the only paved runway currently at Black Hills Airport – Clyde Ice Field.

Table 4-4 - Aircraft Approach Categories Flight Plan Operations

Aircraft Approach Categories Flight Plan Operations							
	Filed Flight Plans			Total Operations Forecast			
AAC	2012	2013	2014	PAL1	PAL2	PAL3	PAL4
A	452	466	612	9,908	10,480	11,087	11,694
B	566	535	545	4,261	4,645	5,064	5,482
C	130	147	146	535	583	629	675
D	16	14	34	87	93	100	107

Source: FAA Flight Plans, KLJ Analysis

The most demanding family of aircraft to use the airport are summarized in **Table 4-5.** This determination is adequate for the future classification of the airport as a C-II, TDG-2 facility.

Table 4-5 - Design Aircraft Flight Plan Operations

Design Aircraft Flight Plan Operations							
	Filed Flight Plans			Total Operations Forecast			
Design Component	2012	2013	2014	PAL1	PAL2	PAL3	PAL4
AAC-C & D	146	161	170	622	676	729	782
ADG-II	632	636	626	2,862	3,117	3,403	3,689
TDG-2	485	535	560				

Source: FAA Flight Plans, KLJ Analysis

Meteorological Considerations

Meteorological conditions that affect the facility requirements of an airport include wind coverage and weather condition encountered. Metrological data at Spearfish were reviewed using that past 6 years of data from the Black Hills Airport – Clyde Ice Field AWOS III facility from September 30, 2008 through February 1, 2017, available from the National Climactic Data Center. This provides a comprehensive look into the average weather trends at an airport.

Wind Coverage

The FAA recommends that an airport provide wind coverage of 95% or greater. The existing primary runway, Runway 13-31, alone cannot meet this standard as shown in Table 4-7. Aircraft ideally takeoff and land into headwinds aligned with the runway orientation, but sometimes weather patterns require more than one runway. Small, light aircraft are most affected by crosswinds. Each aircraft's AAC-ADG combination corresponds to a maximum crosswind wind speed component.

Table 4-6 – 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

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

Wind coverage for the airport is separated into all-weather visual meteorological conditions – (VMC) and instrument meteorological conditions- (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.

Wind Conditions Requiring Crosswind Runway

Black Hills Airport – Clyde Ice Field currently has one paved runway (13/31) and two turf crosswind runways (4/22 & 8/26). While the alignment for a paved crosswind runway was examined in past ALP Updates it was decided that alignments would be re-evaluated based on the new aerial survey data; this information is depicted in **Appendix N - Crosswind Runway Determination.** The analysis showed that a paved crosswind, Runway 5/23, would be the best alignment based on wind coverage, terrain and airfield safety constraints. Since the justification for Runway 5/23 is covered in detail in **Appendix N** it will not be covered in **Chapter 5 - Alternatives**. For the remainder of this **Chapter 4 - Facility Requirements**, the future runway arrangements will be for Runway 13/31 and 5/23 paved and a crosswind turf Runway 8/26. Turf Runway 4/22 will be closed even though as an existing runway it will periodically be referenced. The tables below provide the wind coverage with the existing and future runway configuration.

The design aircraft (able to use the runway with a 13.0 knot crosswind component) is accommodated on Runway 13/31 during all-weather conditions with airfield wind coverage exceeding 95 percent. For small aircraft that have a 10.5 knot crosswind threshold, these airplanes can be accommodated 97.97 percent of the time with a two-runway configuration.

Table 4-7 - All-Weather Wind Analysis

All-Weather Wind Analysis				
Runway	**AAC-ADG**	**Crosswind Component (Wind Speed)**		
		10.5 knots	**13.0 knots**	**16.0 knots**
Runway 13/31	C-II	91.91%	95.62%	97.96%
Runway 5/23	B-I	83.80%	90.42%	-
Runway 8/26	A-I (turf)	93.39%	-	-
Combined*	**-**	**98.05%**	**99.45%**	**97.96%**

**Combined for 13/31 and 5/23 since these are the only planned paved runways. This also assumes up to maximum design aircraft crosswind component for each runway.*
Source: National Climactic Data Center from Black Hills Airport – Clyde Ice Field AWOS (2008-2017)

The design aircraft is accommodated on Runway 13/31 during IFR with airfield wind coverage exceeding 95 percent. For small aircraft that have a 10.5 knot crosswind threshold, these airplanes can be accommodated 97.74 percent of the time with a two-runway configuration.

Table 4-8 - IFR Wind Analysis

IFR Wind Analysis				
Runway	**AAC-ADG**	**Crosswind Component (Wind Speed)**		
		10.5 knots	**13.0 knots**	**16.0 knots**
Runway 13/31	C-II	96.18%	98.43%	99.65%
Runway 5/23	B-I	75.18%	82.73%	-
Combined*	**-**	**98.26%**	**99.52%**	**99.65%**

**Combined assumes up to maximum design aircraft crosswind component for each runway*
Source: National Climactic Data Center from Black Hills Airport – Clyde Ice Field AWOS (2008-2017)

When analyzed by runway end, Runway 31 is the preferred end by wind direction for IMC operations, followed by 23, 5 then 13. The lowest published instrument approach minimums are available on Runway 31 followed by Runway 13. It is recommended to take steps to have instrument approach procedures for Runway 23 and to amend the visibility minimum for Runway 31 from ¾ mile to 1 mile visibility due to existing building constraints.

Table 4-9 - IFR Wind Analysis by Runway End

IFR Wind Analysis by Runway End				
Runway End	**AAC-ADG**	**Crosswind Component (Wind Speed)**		
		10.5 knots	**13.0 knots**	**16.0 knots**
Runway 13	C-II	25.31%	26.28%	26.79%
Runway 31	C-II	75.98%	77.96%	78.77%
Runway 5	B-I	32.88%	34.56%	35.83%
Runway 23	B-I	43.74%	52.52%	61.53%

Source: Iowa Mesonet data from Black Hills Airport – Clyde Ice Field AWOS (2008-2014)

Weather Conditions

When reduced visibility weather conditions occur, aircraft must operate under IFR and utilize instrument approach procedures to an airfield. These IFR 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 instrument approach minimums in the following table.

Table 4-10 – Meteorological Analysis

Meteorological Analysis			
Weather Condition	**Cloud Ceiling Minimum**	**Visibility Minimum**	**Observation Percentage**
Visual Flight Rules (VFR)	3,000 feet	5 miles	81.55%
Marginal Visual Flight Rules (MVFR)	1,000 feet	3 miles	10.31%
Instrument Flight Rules (IFR)	600 feet	1 mile	5.39%
Instrument Flight Rules (IFR) Category I	200 feet	½ mile	1.83%
Instrument Flight Rules IFR Category II	100 feet	¼ mile	0.87%
IFR Category III & Below	0 feet	$^{1}/_{8}$ mile	0.05%
TOTAL			100.00%

Source: Iowa Mesonet data from Black Hills Airport – Clyde Ice Field AWOS (2008-2014)

Average high temperature data for the hottest month was reviewed from climate summaries available from the National Weather Service for Spearfish. The average high temperature in the hottest month from 2008-2014 was 85.1 degrees Fahrenheit.

Runways

Black Hills Airport – Clyde Ice Field has one paved runway, and two existing turf runways. Runway 13/31 is the longest runway at 6,401 feet long and 75 feet wide. This runway currently accommodates non-precision approaches with the lowest instrument approach minimums on the airfield of ¾ mile (4000 RVR). However, Runway 13/31 was designed for 1 mile visibility minimums when the FAA Flight Procedures instituted a ¾ mile approach. The difference between the ¾ and 1 mile visibility is the width of the primary surface which is 1000’ wide for a ¾ mile approach and 500’ for a 1 mile approach. 11 of the current 12 buildings at the airport would need to be fully relocated to move them outside the primary surface for a ¾ mile approach and therefore the airport is choosing to raise the minimums to a 1 mile approach. Based on weather analysis this will affect 1.56% of total operations at the airport when the visibility minimums are raised from ¾ mile to 1 mile.

Runway 8/26 and 4/22 are secondary turf runways. Runway 8/26 is 4,002 feet long by 100 feet wide and Runway 4/22 is 1,995 feet by 120 feet and each have only visual approaches. As noted previously Runway 5/23 is planned to be added as a paved crosswind runway.

Table 4-11 - Runways at Black Hills Airport - Clyde Ice Field

Runway Design Codes			
Runway	**Existing**	**Future**	**Ultimate**
4/22	120' x 1,995' turf	closed	closed
5/23	N/A	60' x 4,000'	60' x 4,000'
8/26[3]	100' x 4,002' turf	100' x 4,002' turf	100' x 4,002' turf
13/31	75' x 6,401'	75' x 6,401'	100' x 6,401'

Source: KLJ Analysis

Runway Design Code

The existing design aircraft identifies the RDC for Runway 13/31 as B-II-4000 (¾ mile). The RDC for turf Runways 8/26 and 4/22 is A-I-Visual accommodating small aircraft exclusively. These are recommended to change to an ultimate as C-II-5000 for Runway 13/31 and A-I-Visual for any turf runways. The planned crosswind Runway 5/23 will be B-I-5000 for the future and ultimate.

Table 4-12 - Runway Design Codes

Runway Design Codes			
Runway	**Existing**	**Future**	**Ultimate**
4/22	A-I-Visual (turf)	closed	closed
5/23	N/A	B-I-5000	B-I-5000
8/26	A-I-Visual (turf)	A-I-Visual (turf)	A-I-Visual (turf)
13/31	B-II-4000	B-II-5000	C-II-5000

Source: KLJ Analysis

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.

[3] Runway 8/26 is currently designated and will continue to be designated as a runway available with prior permission required.

- 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 include 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 from 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 is a public road, Interstate – 90, within the approach RPZs to Runways 4, 8 and 31. Except for Interstate - 90, the airport controls the RPZ for Runways 13, 22 and 26.

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.

The dimensions described above are detailed by specific runway in the following tables. **Table 4-13 Runway 13/31**, **Table 4-14 Runway 8/26**, **Table 4-15 Runway 4/22** and **Table 4-16 Runway 5/23**. As noted previously Runway 4/22 is planned for closure and Runway 5/23 is the new planned crosswind runway.

Table 4-13 – Runway 13/31 FAA Design Standard Matrix

Runway 13/31 FAA Design Standard Matrix			
Design Standard	**Existing**	**Runway Design Code (RDC)**	
		C-II-5000 (Future)	**C-II-5000 (Ultimate)**
Approach Reference Code	B-II-4000	C-II-5000	C-II-5000
Departure Reference Code	B-II	C-II	C-II
Runway Width	75 feet	100 feet	100 feet
Shoulder Width*	0 feet	10 feet	10 feet
Blast Pad Width*	0 feet	120 feet	120 feet
Blast Pad Length*	0 feet	150 feet	150 feet
Line of Sight Requirements	No Objects	No Objects	No Objects
RSA Width	300 feet	500 feet	500 feet
RSA Length Past Departure End	300 feet	1,000 feet	1,000 feet
RSA Length Prior to Threshold	300 feet	600 feet	600 feet
ROFA Width	500 feet	800 feet	800 feet
ROFA Length Past Departure End	300 feet	1,000 feet	1,000 feet
ROFA Length Prior to Threshold	300 feet	600 feet	600 feet
ROFZ Length Past Runway	200 feet	200 feet	200 feet
ROFZ Width	400 feet	400 feet	400 feet
Inner Approach OFZ	N/A	N/A	N/A
Inner Transitional OFZ	N/A	N/A	N/A
Precision ROFZ Length	N/A	N/A	N/A
Precision ROFZ Width	N/A	N/A	N/A
Primary Surface^	1,000 feet	500 feet	500 feet
Approach RPZ Start from Runway	200 feet	200 feet	200 feet
Approach RPZ Length	1,000’ RW 13 1,700’ RW 31	1,700’	1,700’
Approach RPZ Inner Width	500’ RW 13 1,000’ RW 31	500’	500’
Approach RPZ Outer Width	700’ RW 13 1,510’ RW 31	1,010’	1,010’
Departure RPZ Start from Runway	200 feet	200 feet	200 feet
Departure RPZ Length	1,000 feet	1,700 feet	1,700 feet
Departure RPZ Inner Width	500 feet	500 feet	500 feet
Departure RPZ Outer Width	700 feet	1,010 feet	1,010 feet
Runway Centerline to Parallel Taxiway Centerline	300 feet	300 feet	300 feet
Runway Centerline to Edge of Aircraft Parking	360 feet	400 feet	400 feet
Runway Centerline to Hold Line	200 feet	250 feet	250 feet

Note: RED indicates a deficiency to existing design standards
**Denotes recommendation not a requirement in AC 150/5300-13A*
^Denotes FAR Part 77 surface; this is not a standard but important surface which affects approach capabilities
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

Table 4-14 - Runway 8/26 FAA Design Standard Matrix

Runway 8/26 FAA Design Standard Matrix		
Design Standard	**Existing**	**Future & Ultimate[4]**
Approach Reference Code	A-I-Visual	A-I-Visual
Departure Reference Code	A-I	A-I
Runway Width	100 feet	100 feet
Shoulder Width	N/A	N/A
Blast Pad Width	N/A	N/A
Blast Pad Length	N/A	N/A
Line of Sight Requirements	No Objects	No Objects
RSA Width	120 feet	120 feet
RSA Length Past Departure End	240 feet	240 feet
RSA Length Prior to Threshold	240 feet	240 feet
ROFA Width	250 feet	250 feet
ROFA Length Past Departure End	240 feet	240 feet
ROFA Length Prior to Threshold	240 feet	240 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	200 feet	200 feet
Approach RPZ Length	1,000 feet	1,000 feet
Approach RPZ Inner Width	250 feet	250 feet
Approach RPZ Outer Width	450 feet	450 feet
Departure RPZ Start from Runway	200 feet	200 feet
Departure RPZ Length	1,000 feet	1,000 feet
Departure RPZ Inner Width	250 feet	250 feet
Departure RPZ Outer Width	450 feet	450 feet
Runway Centerline to Parallel Taxiway Centerline	150 feet	150 feet
Runway Centerline to Edge of Aircraft Parking	125 feet	125 feet
Runway Centerline to Hold Line	125 feet	125 feet

Note: RED indicates a deficiency to existing design standards
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

[4] With the addition of Runway 5/23 and closure of Runway 4/22, Runway 8/26 is planned to become a prior permission required area.

Table 4-15 - Runway 4/22 FAA Design Standard Matrix

Runway 4/22 FAA Design Standard Matrix		
Design Standard	**Existing**	**Future & Ultimate**
Approach Reference Code	A-I-Visual	Closed
Departure Reference Code	A-I	
Runway Width	100 feet	
Shoulder Width	N/A	
Blast Pad Width	N/A	
Blast Pad Length	N/A	
Line of Sight Requirements	No Objects	
RSA Width	120 feet	
RSA Length Past Departure End	240 feet	
RSA Length Prior to Threshold	240 feet	
ROFA Width	250 feet	
ROFA Length Past Departure End	240 feet	
ROFA Length Prior to Threshold	240 feet	
ROFZ Length Past Runway	200 feet	
ROFZ Width	250 feet	
Inner Approach OFZ	N/A	
Inner Transitional OFZ	N/A	
Precision ROFZ Length	N/A	
Precision ROFZ Width	N/A	
Approach RPZ Start from Runway	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	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	150 feet	
Runway Centerline to Edge of Aircraft Parking	125 feet	
Runway Centerline to Hold Line	125 feet	

Note: RED indicates a deficiency to existing design standards
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

Table 4-16 – Runway 5/23 FAA Design Standard Matrix

Future Runway 5/23 FAA Design Standard Matrix			
Design Standard	Existing	Runway Design Code (RDC)	
		B-I-5000 - Small (Future)	B-I-5000 - Small (Ultimate)
Approach Reference Code	N/A	B-I Small	B-I Small
Departure Reference Code	N/A	B-I	B-I
Runway Width	N/A	60 feet	60 feet
Shoulder Width	N/A	0 feet*	0 feet*
Blast Pad Width	N/A	0 feet*	0 feet*
Blast Pad Length	N/A	0 feet*	0 feet*
Line of Sight Requirements	N/A	No Objects	No Objects
RSA Width	N/A	120 feet	120 feet
RSA Length Past Departure End	N/A	240 feet	240 feet
RSA Length Prior to Threshold	N/A	240 feet	240 feet
ROFA Width	N/A	250 feet	250 feet
ROFA Length Past Departure End	N/A	240 feet	240 feet
ROFA Length Prior to Threshold	N/A	240 feet	240 feet
ROFZ Length Past Runway	N/A	200 feet	200 feet
ROFZ Width	N/A	250 feet	250 feet
Inner Approach OFZ	N/A	N/A	N/A
Inner Transitional OFZ	N/A	N/A	N/A
Precision ROFZ Length	N/A	N/A	N/A
Precision ROFZ Width	N/A	N/A	N/A
Approach RPZ Start from Runway	N/A	200 feet	200 feet
Approach RPZ Length	N/A	1,000 feet	1,000 feet
Approach RPZ Inner Width	N/A	250 feet	250 feet
Approach RPZ Outer Width	N/A	450 feet	450 feet
Departure RPZ Start from Runway	N/A	200 feet	200 feet
Departure RPZ[5] Length	N/A	1,000 feet	1,000 feet
Departure RPZ Inner Width	N/A	250 feet	250 feet
Departure RPZ Outer Width	N/A	450 feet	450 feet
Runway Centerline to Parallel Taxiway Centerline	N/A	150 feet	150 feet
Runway Centerline to Edge of Aircraft Parking	N/A	125 feet	125 feet
Runway Centerline to Hold Line	N/A	125 feet	125 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

[5] For Departure Runway 23 this includes 0.22 lane miles of Interstate 90 east and west bound within the RPZ and a total of 2.3 acres outside of airport property which is Interstate right of way.

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 FAA Advisory Circular AC 150/5325-4B, *Runway Length Requirements for Airport Design.* 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 into reduced fuel, passenger and/or cargo loads. It is very important to adequately plan for a future runway configuration as these projects tend to affect the community beyond the property line. Projects of this magnitude require many resources and long lead times for planning, environmental review and funding allocation. For Black Hills Airport – Clyde Ice Field, these aircraft include business jets and other general aviation aircraft accommodating aircraft less than 60,000 pounds. The FAA recommended runway length calculations for SPF are summarized in the following table:

Table 4-17 – FAA Runway Length Requirements

FAA Runway Length Requirements	
Airport and Runway Data	
Airport Elevation	3,933 feet
Mean Daily Maximum Temperature of Hottest Month	85.1°F
Maximum Difference in Runway Centerline Elevation	23 feet
Runway Condition	Wet & Slippery Runways
Aircraft Classification	**Recommended Length**
Large airplanes less than 60,000 lbs. but greater than 12,500 lbs.	***(SPF Rwy 13/31)***
100 percent of fleet at 90 percent useful load	9,380 feet
100 percent of fleet at 60 percent useful load	7,730 feet
75 percent of fleet at 90 percent useful load	8,830 feet
75 percent of fleet at 60 percent useful load	6,180 feet
Runway Length Justified & Recommended for Rwy 13/31	6,401 feet
Small airplanes 12,500 lbs. or less	
10 or more passenger seats	4,870 feet
Less than 10 passenger seats at 100 percent of fleet	5,375 feet
Less than 10 passenger seats at 95 percent of fleet	5,050 feet
Specific Small Aircraft Analysis for SPF Rwy 5/23	
Cessna 182 (single piston) A-I 3,100lb MTOW	2,180 feet
Beech Bonanza A36 (single piston) A-I 3,850lb MTOW	3,550 feet
Beech Baron B58 (twin-piston) B-I 6,200lb MTOW	3,800 feet
Pilatus PC-12 (30° flaps) (single turboprop) A-II 9,920lb MTOW	3,900 feet
Pilatus PC-12 (15° flaps) (single turboprop) A-II 9,920lb MTOW	4,390 feet
Runway Length Justified & Recommended for Rwy 5/23	4,000 feet

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

The existing length of 6,401 feet is sufficient for Runway 13/31 to handle the vast majority of departures from Black Hills Airport – Clyde Ice Field. The runway is sufficient for operations in 75 percent of aircraft less than 60,000 pounds at 60 percent of percent useful load. Local wind conditions allow this runway to accommodate business aircraft. Common business aircraft that operate at Black Hills Airport – Clyde Ice Field include the Cessna 441, Bravo, Excel and 340; the Beech King Air 90, 200 and 300 series; the Pilatus PC12; and Piper Malibu, Saratoga and Cheyenne aircraft.

The design aircraft for Runway 5/23 (future) is an A/B-I aircraft due to the magnitude of the crosswinds and coverage for this aircraft using the primary runway at just 91.91%. While the ideal runway length is 5,050 feet based on the FAA charts, additional analysis was done using specific small aircraft.

These aircraft included several A/B-I aircraft and one A-II[6] aircraft expected to use this runway in severe crosswind conditions. After analyzing both the FAA charts and the specific small aircraft the runway is recommended to be established as 4,000 feet based on terrain constraints and expected strong wind conditions when the crosswind would be needed. The details regarding the justification of Runway 5/23 are compiled in **Appendix N – Crosswind Runway Determination**. **Appendix N** also includes the documented surveys and letters of support for Runway 5/23.

[6] The Pilatus PC-12, an A-II aircraft, is included because even though it is larger than the critical design, it is expected to use the crosswind runway in severe crosswind conditions. The runway will still be recommended as 60 feet wide even though a Group II categorization would justify a 75 foot width.

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 pavement strength for Runway 13/31 should be sufficient to accommodate regular use by the design aircraft. The design aircraft for pavement strength calculations is the Beech King Air 300 with a gross landing weight of 15,000 lbs. dual wheel. Runway 5/23 should be established to accommodate small aircraft of 12,500 pounds or less maximum takeoff weight.

Table 4-18 – Pavement Strength Requirements

Pavement Strength Requirements		
Runway	**Existing**	**Future**
Runway 13/31	30,000 lbs. - SW	30,000 lbs. - SW
	45,000 lbs. - DW	45,000 lbs. – DW
Future Runway 5/23		12,500 lbs. - SW
Runway 8/26	N/A	N/A

SW = Single Wheel, DW = Dual Wheel landing gear configuration
Source: SPF Airport Master Record (FAA Form 5010-1), 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.

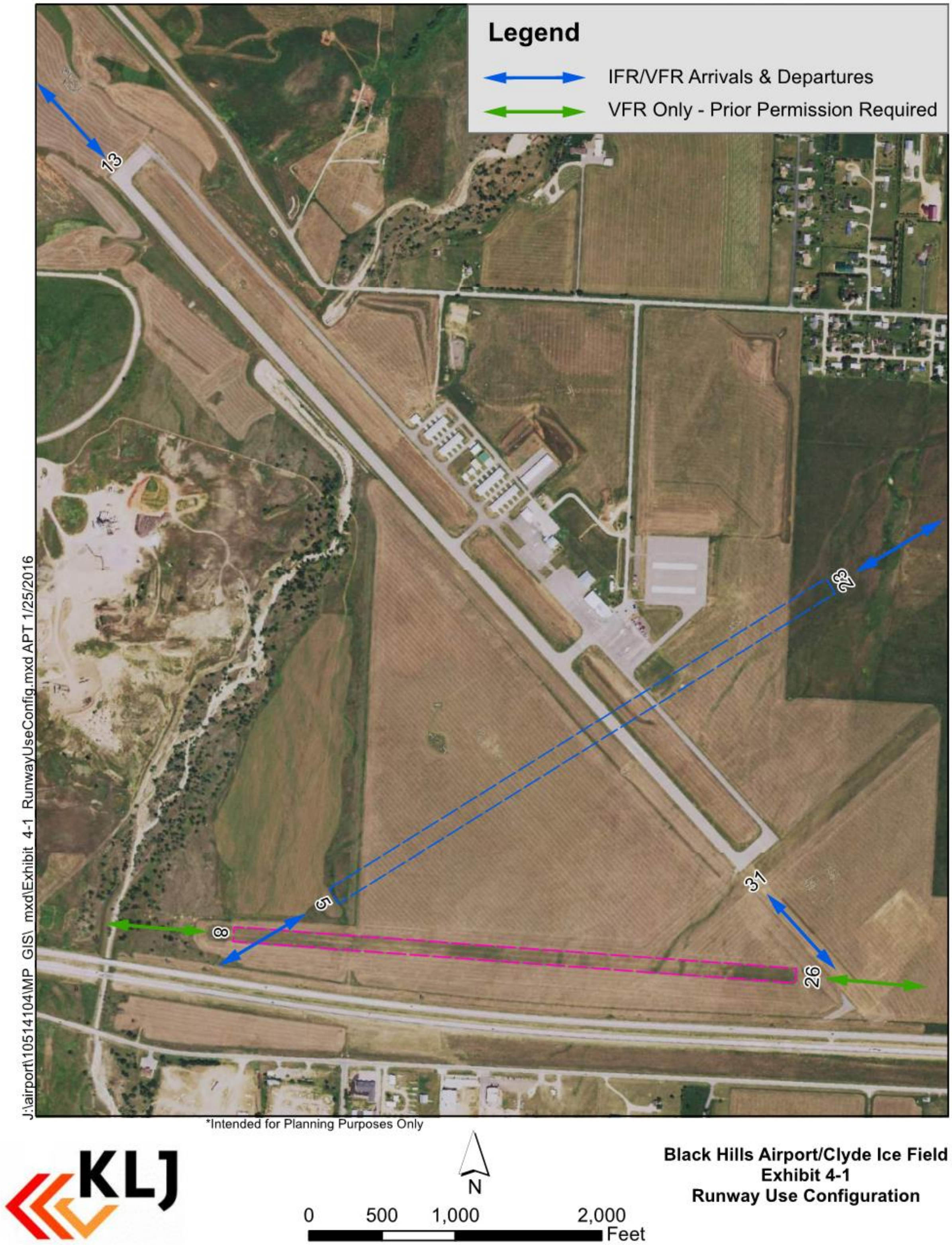
At SPF, Runway 13/31 is the only paved runway and a crosswind runway 5/23 would intersect at the middle of the runway. See **Exhibit 4-1 Runway Use Configuration**. Both of these runways would be able to handle VFR and IFR operations, arrivals and departures. The estimated runway end utilization is identified in the table below based on the prevailing winds.

Table 4-19 – Runway Utilization

Runway Utilization			
Runway End	**Wind Coverage at 10.5 Knots**	**End Utilization**	**Runway Utilization**
13	38.9%	15.0%	65.0%
31	63.6%	50.0%	
5	36.1%	5.0%	35.0%
23	58.0%	30.0%	

Source: KLJ Analysis

Exhibit 4-1 – Runway Use Configuration



Runway Recommendations

There are many improvements summarized for the airport's runways. These improvements are expected to be scheduled throughout the planning period. The scheduling of these improvements will be examined through the Alternatives Analysis chapter of this Master Plan and will be determined in the Implementation chapter of this Master Plan. Runway improvement recommendations are as follows:

- **Construct a crosswind Runway 5/23 paved at 60' x 4,000'. Declared distances will be required to achieve 4,000' takeoff distance due to terrain constraints Runway 5 will be displaced 1,140'.**
- **Close turf Runway 4/22.**
- **Increase the width of Runway 13/31 to 100' wide.**
- **Expand all required safety areas to accommodate the increased standards in Aircraft Approach Category B to C**
    - **Relocate False Bottom Creek outside of AAC-C Runway Safety Area.**
    - **Remove or shorten 5 existing hangars currently in the AAC-C Runway Object Free Area**
- **Add 10' paved shoulders and 120' wide by 150' long blast pads to Runway 13/31.**
- **Maintain turf Runway 8/26 only as Prior Permission Required[7] (PPR) so that pilots will be required to confirm runway availability during winter weather or wet surface conditions.**

Instrument Procedures

Instrument approach procedures to a runway end are used by landing aircraft to navigate to the airport during low visibility weather 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 2015, Black Hills Airport – Clyde Ice Field has an RNAV (GPS) approach (APV) for Runway 31 with a 300-foot cloud ceiling minimum and ¾ mile visibility. Runway 13 has an RNAV (GPS) approach (APV) with a 300-foot cloud ceiling minimum and a 1 $^{1}/_{8}$ mile visibility. The airport also has a non-precision NDB circling approach to the airport with 1000-foot ceiling minimum and a 1 ¼ mile visibility.

As noted previously Runway 31 was designed for a 1 mile visibility and to meet the standards for the current ¾ mile visibility minimums, 11 of 12 existing buildings will need to be

[7] Please note that even though AC 150/5200-35A restricts the use of PPR for entire airports, PPR is still recognized for certain circumstances such as turf conditions.

relocated out of the 1000’ wide primary surface. Runway 31 visibility minimums are therefore being raised from ¾ mile to 1 mile.

Except for increasing the Runway 31 visibility minimums from ¾ mile to 1 mile, the existing approach procedures are considered adequate for the current facility.

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 obstructions 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 Black Hills Airport – Clyde Ice Field is Class E controlled airspace. Ellsworth Air Force Base, 40 miles east of the airport is in Class D airspace and operates 24 hours a day Monday through Friday providing approach/departure control for Black Hills Airport – Clyde Ice Field. On weekends the approach/departure control is provided by Denver ARTCC.

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. 34:1).

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 and outward from the runway on a slope defined as the horizontal distance traveled for every one vertical foot (i.e. 34:1). The transitional surface is a 7:1 slope and extends to the side of the primary and approach surfaces. The following **Table 4-20** indicate the future approach airspace surfaces for Black Hills Airport – Clyde Ice Field:

Table 4-20 - 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**
13	Non-Precision	C	500’	3,500’	10,000’	34:1
31	Non-Precision	C	500’	3,500’	10,000’	34:1
5	Visual	A (V)	250’	1,250’	5,000’	20:1
23	Non-Precision Utility	A (NP)	500’	2,000’	5,000’	20:1
8	Visual	A (V)	250’	1,250’	5,000’	20:1
26	Visual	A (V)	250’	1,250’	5,000’	20:1

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

New development should be kept below the Part 77 primary 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 Spearfish 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.

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. Since Runway 4/22 is planned for closure when Runway 5/23 is constructed, there are no anticipated incompatible airport design areas.

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

Table 4-21 – Approach/Departure Surface Requirements

Approach/Departure Surface Requirements			
Runway End(s)	Table 3-2 Row	Description	Slope
Existing			
31	6	Instrument approaches having visibility minimums ≥ ¾ statute mile	20:1
13	4	Approaches supporting instrument night operations in Category A and B aircraft only	20:1
4, 8, 22, & 26	2	Approach end of runways expected to serve small airplanes with approach speeds of 50 knots or more (Visual runways only, day/night)	20:1
13, 31	9	Departure runway ends for all instrument operations	40:1
Future			
13,31	5	Approaches supporting instrument night operations in greater than Category B aircraft	20:1
23	4	Approaches supporting instrument night operations in Category A and B aircraft only	20:1
5, 8, 26	2	Approach end of runways expected to serve small airplanes with approach speeds of 50 knots or more (Visual runways only, day/night)	20:1
5, 13, 23 & 31	9	Departure runway ends for all instrument operations	40:1

Source: FAA Advisory Circular 150/5300-13A Table 3-2, KLJ Analysis

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 than Part 77 standards. Penetrations to TERPS surfaces results in higher weather minimums or operations restrictions.

Visual Aids

Visual aids at an airport require clear line of sight 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 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 being conducted with this planning effort. Imagery was acquired in 2014. 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.

Airspace Recommendations

Recommendations related to airspace protection and approach procedures are as follows:

- **Reduce the Runway Protection Zone for Runway 31 to reflect a change from ¾ mile to 1 mile visibility minimums for the runway's instrument approach.**
- **Increase the Runway Protection Zone for Runway 13/31 when the Aircraft Approach Category increases from B to C.**

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.

Black Hills Airport – Clyde Ice Field should plan for the use of satellite-based area navigation. Satellite based RNAV approaches have been created for runway 13 and 31 approaches. These approaches do not rely on ground-based NAVAIDs such as the NDB at Black Hills Airport – Clyde Ice Field.

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.

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.

Black Hills Airport – Clyde Ice Field maintains the four box PAPIs for Runway 13/31 at the airport and should be maintained through the planning period. A two box PAPI system should be planned for Runway 5/23.

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.

REILs are recommended for Runway 13/31.

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 SPF 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 MIRL for Runway 13/31 is required for instrument approaches. The proposed Runway 5/23 should be lighted as MIRL when it is paved. The existing turf runways 4/22 and 8/26 are not lighted.

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 Black Hills Airport – Clyde Ice Field.

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. Spearfish has all the required signage including mandatory, location and direction/destination signs. The signs are in compliance with FAA Advisory Circular 150/5340-18F, *Standards for Airport Sign Systems*.

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, aiming point)

Runway 13/31 should continue to have non-precision markings maintained. The proposed Runway 5/23 should be marked when it is paved as non-precision if it has an instrument approach established. Turf Runways 4/22 and 8/26 are not marked but are identified with white boundary cones and should be maintained for the time that the runways exist. Should any of the turf runways be permanently taken out of service the boundary cones should be immediately removed.

Taxiway/Taxilane

Taxiway and taxilane markings are important for directional guidance for taxiing aircraft and ground vehicles. Common taxiway and apron markings include taxiway/taxilane 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.

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 of yellow bars and dashes on a black background. The required setback is 200 feet from Runway 13/31 centerline. The hold position for proposed Runway 5/23 will be 200 feet when it is paved.

While turf runways and turf taxiways do not have markings, a hold position does still exist at the edge of the applicable runway safety area. **Unlighted hold position signs are recommended for Runway 8/26 and for Runway 13/31 on the southwest side where aircraft taxi back from Runway 8/26 to the apron area**.

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 airport-owned AWOS located west of Runway 31 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. Should development be considered on the west side of the airport, the AWOS may need to be relocated. Pilots can listen to the AWOS current conditions broadcast on 118.325 or by calling 605.642.8536.

Wind Cone

Wind cones visually indicate the current wind direction and velocity on an airfield. The primary wind cone and segmented circle is located west of Runway 31, adjacent to the AWOS and is in a central visible location and lighted for night operations. A lighted supplemental wind cone is installed near the end of Runway 13 to provide local surface wind direction information to pilots. **A lighted supplemental wind cone should be planned for the proposed Runway 5/23 for the Runway 23 end when the runway is paved and lighted.**

Communications

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.

The airport maintains a Common Traffic Advisory Frequency (CTAF) for pilots to self-announce intentions on and in vicinity of the airport. The CTAF for Black Hills Airport – Clyde Ice Field is 122.7. On the airfield a Ground Communications Outlet (GCO) accessible at 121.725 provides access to Ellsworth Approach Control with 4 clicks and to Denver ARTCC with 6 clicks. In the vicinity of the airport Ellsworth Approach Control can be reached at 119.5 and Denver ARTCC can be reached at 127.95. A Remote Communications Outlet (RCO) is located on Terry Peak near Lead, SD, south of Spearfish and includes the ability to communicate with Flight Service at 122.55.

Each of these communications systems should be maintained through the planning period.

Navigational Aid/Marking/Lighting/Meteorological Recommendations[8]

Following is a summary of the recommendations for navigational aids, marking, lighting, meteorological and communications items:

- **Install REILs on Runway 13/31**
- **Install two box PAPIs on Runway 5/23**
- **Install unlighted hold position signs for Runway 8/26 and for Runway 13/31 for aircraft taxiing back from Runway 8/26 to the apron area.**
- **Request that the FAA or National Weather Service take over the ownership and maintenance of the AWOS equipment at the airport.**
- **Lighted supplemental windcones should be installed near Runway 23 when the runway is paved and lighted.**

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 design requirements identified in FAA AC 150/5300-13A, *Airport Design*.

System Design

FAA has placed a renewed emphasis on taxiway design in the updated airport design standards (AC 150/5300-13A). In order to develop efficient systems that meet demands, reduce pilot confusion and enhance safety the following considerations were identified:

- 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.

[8] As noted previously regarding runway improvements. These improvements are expected to be scheduled throughout the planning period. The scheduling of improvements will be examined through the Alternatives Analysis chapter of this Master Plan and will be determined in the Implementation chapter of this Master Plan.

- 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.

Black Hills Airport - Clyde Ice Field has no identified "hot spots" or other identified design problems with taxiways.

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.

Table 4-22 - FAA Taxiway Design Standards Matrix (ADG)

FAA Taxiway Design Standards Matrix (ADG)		
Design Standard	Airplane Design Group (ADG)	
	ADG I (Existing)	ADG II (Existing & Future)
Taxiway Safety Area	49 feet	79 feet
Taxiway Object Free Area	89 feet	131 feet
Taxilane Object Free Area	79 feet	115 feet
Taxiway Centerline to Parallel Taxiway/Taxilane Centerline	70 feet	105 feet
Taxiway Centerline to Fixed or Movable Object	44.5 feet	65.5 feet
Taxilane Centerline to Parallel Taxiway/Taxilane Centerline	64 feet	97 feet
Taxilane Centerline to Fixed or Movable Object	39.5 feet	57.5 feet
Taxiway Wingtip Clearance	20 feet	26 feet
Taxilane Wingtip Clearance	15 feet	18 feet

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

Table 4-23 - FAA Taxiway Design Standards Matrix (TDG)

FAA Taxiway Design Standards Matrix (TDG)			
Design Standard	Taxiway Design Group (TDG)		
	TDG 1A (Existing)	TDG 1B (Existing)	TDG 2 (Existing & Future)
Taxiway Width	25 feet	25 feet	35 feet
Taxiway Edge Safety Margin	5 feet	5 feet	7.5 feet
Taxiway Shoulder Width	10 feet	10 feet	10 feet
Taxiway Fillet Dimensions	See specific guidance in FAA AC 150/5300-13A		

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

The existing airfield system serving Runway 13/31 has taxiways that are at least 35 feet in width sufficient to accommodate existing and future design aircraft. The connectors at the ends of Runway 13/31 are each 100 feet wide and Taxiway A2 connecting the main apron to the runway is 80 feet wide.

The only deficiency to the existing design standards is the lack of a taxiway shoulder. A paved taxiway shoulder width of 10 feet is recommended but not required.

Taxiway Recommendations

Following are the recommendations related to taxiways:

- **Construct a full parallel taxiway to Runway 5/23 meeting TDG 1B standards with separation sufficient for ADG II aircraft.**

General Aviation

General Aviation includes all civil aviation activities except for commercial service. Most of the activity at Black Hills Airport – Clyde Ice Field is considered GA and includes activities such as 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 as compared to airline service.

Black Hills Airport - Clyde Ice Field as the primary GA facility for the northern Black Hills including Spearfish, Lead and Deadwood. There are 72 based aircraft and over 13,800 annual flight operations classified as GA. Based aircraft is projected to grow 24 percent with operations growing by 30 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) and Specialized Aviation Service Operators (SASOs) provide aircraft maintenance, fueling and other pilot and passenger services.

Table 4-24 identifies the PAL metrics for the General Aviation.

Table 4-24 – General Aviation Planning Activity Levels (PALs)

General Aviation Planning Activity Levels					
Metric	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Based Aircraft					
Single Engine	65	67	69	70	70
Multi Engine[9]	4	6	7	9	11
Turbojet	0	1	2	3	4
Helicopter	0	0	0	0	0
Other	3	3	3	3	4
Total Based Aircraft	72	76	81	85	89
General Aviation Operations					
Itinerant	4,320	4,597	4,886	5,188	5,502
Local	9,500	10,194	10,915	11,671	12,456
Total GA Operations	13,820	14,791	15,801	16,859	17,958
General Aviation Peak Transient Operations					
Peak Month Transient Operations	1,889	2,022	2,160	2,289	2,455
Design Day Transient Arrivals	76	81	86	93	98
Transient Aircraft Parked on Apron	15	16	17	19	20

Source: KLJ Analysis

[9] For Black Hills Airport – Clyde Ice Field the multi-Engine aircraft category includes multi-engine piston aircraft and all turboprop aircraft including single and multi-engine.

Aircraft Storage

Aircraft storage requirements are driven by the aircraft size, local climate and owner preferences. Aircraft are becoming increasingly complex and expensive. The overall trend is for continued use of turboprop and corporate business jet aircraft to operate at the Black Hills Airport - Clyde Ice Field. The harsh winters in the upper Great Plains 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 the based aircraft at Spearfish 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. As indicated in **Chapter 3 – Forecast**, the based aircraft numbers in the forecast did not include approximately 10 aircraft which rent space at Black Hills Airport – Clyde Ice Field but are only located at the airport for portions of the year. For hangar planning purposes, these aircraft are being included since they are part of this demand driven component of airport infrastructure. For projection purposes, a 9 percent increase was made to the total based aircraft to include aircraft based at Black Hills Airport – Clyde Ice Field for only portions of the year. Including these adjusted figures, the Black Hills Airport – Clyde Ice Field based aircraft forecasts estimate another 25 based aircraft through the planning period (PAL 4) consisting of 13 single-engine, 8 multi-engine and 4 turbojet aircraft.

Aircraft are currently stored in approximately 99,300 square feet of aircraft storage space. There are three main hangar types identified:

- T-Hangar: Nested small aircraft storage units
- Small Conventional Hangar: Private aircraft storage or Commercial aeronautical use of 6,000 square feet or less
- Large Conventional Hangar: Private aircraft storage or Commercial aeronautical use of more than 6,000 square feet

The following assumptions were made about aircraft storage space requirements:

- T-Hangar: 1,200 square feet per aircraft; 93% single-engine, 7% multi-engine aircraft
- Small Conventional Hangar: 3,000 square feet per aircraft; 10% single-engine, 50% multi-engine, 25% turbojet aircraft
- Large Conventional Hangar: 3,600 square feet per aircraft; 12% single-engine, 25% multi-engine, 63% turbojet aircraft
- An additional 20 percent of building space is added for hangars to be used for other aeronautical purposes including maintenance and 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.

Table 4-25 - Aircraft Storage Requirements

Aircraft Storage Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Hangar Space						
T-Hangar	57,100	69,200	71,500	73,400	75,500	76,700
Other Conventional	12,800	18,700	25,700	28,800	33,800	38,700
FBO/SASO Conventional	29,400	31,700	38,500	42,800	48,400	53,400
Total	99,300	119,600	135,700	145,000	157,700	168,800
Capacity/(Deficiency)		(20,300)	(36,400)	(45,700)	(58,400)	(69,500)

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Aircraft Storage Recommendations

As a result of the construction of Runway 5/23 a Runway Visibility Zone will require the removal of the 3 existing FBO hangars and office area. This space is approximately 21,200 square feet and based on demand this space will need to be replaced in the near term.

The change from AAC B to AAC C for Runway 13-31 will increase the OFA for this runway and require the shortening of 4 T-Hangars resulting in the loss of 8 storage spaces and the relocation of 1 conventional hangar. This space is approximately 9,100 square feet of T-Hangar and 2,400 square feet of conventional hangar and will need to be replaced.

Beyond the hangars impacted by the Runway Visibility Zone, the requirements for hangar space will be demand driven and it is recommended that space be allocated so that expansion can occur in each area of need without negatively affecting any other area. This facility requirement analysis shows there is a need for about 67 percent more hangar space at Black Hills Airport - Clyde Ice Field through PAL 4. The demand has been validated by there currently being 16 people with deposits for the T-Hangar waiting list and regular request for building conventional hangar space.

Aircraft Parking Apron

At airports general aviation aircraft parking is used by both itinerant and based aircraft. At Spearfish nearly all based aircraft are stored in hangars, and most of the aircraft parking area is for itinerant aircraft for a short period of time ranging from a few minutes to a few days. The design day aircraft operations that use GA facilities were evaluated to determine the total apron size requirements at Black Hills Airport – Clyde Ice Field during the peak month based on 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 80 percent of itinerant operations, conducted by non-local users.
- Peak month (13.58 percent of annual operations) and design day (6 percent of monthly operations) are based on the aviation forecasts.
- Peak month for Black Hills Airport – Clyde Ice Field is July primarily because of summer activity and leading up to the annual Sturgis Motorcycle Rally in early August. This is due to the abilities of Black Hills Airport – Clyde Ice Field to meet the GA needs for the northern Black Hills.
- An operation is an arrival or a departure.
- Apron space will be needed by 90 percent of arriving transient aircraft, with the remaining 10 percent requiring hangars.

Table 4-26 – Transient Apron Aircraft Requirements

Transient Apron Aircraft Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Operations						
GA Itinerant	4,320	4,320	4,597	4,886	5,188	5,502
Apron Aircraft						
Transient Operations	3,456	3,456	3,678	3,909	4,150	4,402
Peak Month Ops.	469	469	499	531	564	598
Design Day Ops.	28	28	30	32	34	36
Design Day Arrivals	14	14	15	16	17	18
Aircraft Needing Apron	13	13	13	14	15	16

Source: KLJ Analysis

Itinerant airport operations included 30 percent single-engine piston and helicopters, 50 multi-engine and turboprop, and 20 percent turbojet (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-Engine Piston (ADG-I) – 1,200 square yards per aircraft
- Multi-Engine and Turboprop (ADG-II) – 2,000 square yards per aircraft

- Business Jet (ADG-II) – 2,200 square yards per aircraft

Additionally, total space requirements also assume 10 to 20 percent of the based aircraft are located on the apron for transient purposes.

Table 4-27 – Total Apron Space Requirements

Total Apron Space Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Aircraft						
Single Engine Piston	-	11	12	11	12	12
Multi Engine & Turboprop	-	8	9	10	11	12
Turbojet	-	3	3	3	3	3
Total	24	21	23	24	26	28
Capacity/(Deficiency)	-	3	1	0	(2)	(4)
Apron Space (SY)						
Single/Multi Engine Piston	-	13,500	14,100	13,700	14,100	14,500
Turboprop	-	15,300	17,400	20,400	22,600	25,000
Turbojet	-	5,600	5,900	6,300	6,700	7,100
Total Space	37,600	37,200	40,400	43,600	46,900	50,300
Capacity/(Deficiency)	-	400	(2,800)	(6,000)	(9,300)	(12,700)

Note: RED indicates a deficiency to existing facilities; Since the apron space can be used for any size of aircraft, only the sum totals are indicated in Red when there is an identified deficiency.
Source: KLJ Analysis

This evaluation combines total apron space. At Black Hills Airport – Clyde Ice Field there are three general aviation apron areas. The area is designed to meet ADG-II requirements with a pavement strength of 33,000 lbs (SW).

FBO Apron

The primary purpose of the main apron is to provide parking for aircraft at the FBO terminal and provide circulation space for aircraft and ground support equipment. All of the existing FBO apron will be in the airports runway visibility zone (RVZ) (created as a result of the intersection of Runway 13/31 and Runway 5/23). A replacement apron will need to be constructed adjacent to a future FBO facility and sized sufficient for the forecast demand at the airport.

North SASO Apron

The SASO apron is sized and arranged to accommodate the needs of aeronautical service providers including the storage of aircraft being serviced and the movement of ground support equipment. The existing SASO apron will be impacted by the airports new RVZ and the south hangar in this area used by Black Hills Aero will lose 48% of its current usable apron space. Replacement apron with a workable layout will need to be constructed adjacent to the SASO facilities.

East New Apron

The new apron east of the existing FBO is clear of the airports new RVZ. Hangars adjacent to this 22,100 square yard apron will need to be configured to accommodate a layout that makes the most effective use of space while maximizing long term development options at Black Hills Airport - Clyde Ice Field.

Air Cargo

Air cargo does not have a dedicated area at Black Hills Airport - Clyde Ice Field. During the Sturgis Motorcycle Rally there is additional cargo demand and UPS has a flight directly from Sioux Falls to Spearfish to meet this demand. The reason is to limit ground vehicle travel going to Sturgis during the congested time of the rally. This unique demand must be accommodated within the mix of other users.

Apron Recommendations

The Apron needs are as follows:

- **Remove 12,200 square yards of usable apron which will be inside the Runway Visibility Zone resulting from the planned Runway 5-23.**
- **Construct a minimum of 12,200 square yards of usable apron configured to function with hangars and the planned airfield layout.**
- **Construct additional apron as demand dictates.**

Ground Access & Circulation

The roadways around the airport are intended to provide adequate access to and from the airport and the community. Roadway plans can also influence airport development. There are two routes to get to Black Hills Airport – Clyde Ice Field from Spearfish's Central Business District. The route from the south via Colorado and Rainbow Roads is the only fully paved route. The route from North 27th Street is unpaved in portions and circuitous until it joins with Airport Road. The City of Spearfish has plans in place to straighten portions of North 27th street and pave the route.

Realignment and paving of the 27th Street route should be completed as soon as practicable.

Support Facilities

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

Fueling Facilities

The airport has one Fixed Base Operator that sells fuel. The operator uses the dedicated fuel farm with Jet-A and 100 low lead (LL) aviation fuel types owned by the airport. The fuel tanks have a 12,500 gallon capacity of Jet-A fuel and 12,500 gallons capacity of 100LL fuel. The fuel tanks are underground and are located north of the existing FBO area.

The 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 20 percent through PAL 4, with Jet-A operations increasing 30 percent. There are plans within the aviation industry for a replacement fuel for 100LL. If it is possible to completely replace this fuel so that existing aircraft can use the new fuel then it may be possible to convert the 100LL tanks to use for the new fuel. If it is not possible for existing aircraft to use the new fuel, then it will be necessary to maintain three types of fuel at the airport for general aviation aircraft.

The airport does not have either diesel or unleaded fuel for airport maintenance equipment. The airport should consider establishing a fuel farm since most of this maintenance equipment is not designed to operate on roadways and is otherwise required to leave the premises to refuel or have fuel tinkered in.

Airport Maintenance & Snow Removal

The airport maintenance equipment is stored in a portion of a T-Hangar. This space is both intended for aircraft use and not sized sufficient to accommodate all the airport's equipment due to equipment height.

Construction of a dedicated Airport Maintenance Facility should be completed in PAL 1 to provide space suitable for housing this equipment and make the T-hangar space available for general aviation.

Security & Access

FAA generally recommends airports limit access to the greatest extent practicable. This aids in safety by not allowing vehicles onto the airfield and for security by limiting unauthorized persons from having access to aircraft. At Black Hills Airport – Clyde Ice Field, access is limited to a few gates in the vicinity of the hangars. All other access points for the airport are secured by locked gates and there is fencing all around the airport.

Airport Utilities

Utilities including power, communications and natural gas are provided to the airport. Sanitary sewer is provided through septic systems and water is provided by wells. Future facility development may require the relocation, replacement and/or upgrading of portions of the airport utility infrastructure.

The utility services for electrical power, communications and natural gas were determined to be sufficient to meet the existing and projected needs of the airport. If development were to occur in any new areas new utilities of adequate size will need to be added.

Other

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.

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.

Summary

This chapter identifies safety, capacity and development needs for Black Hills Airport – Clyde Ice Field based on forecasted activity levels. These recommendations provide the basis for formulating development alternatives to adequate address recommended improvements. As noted previously in the chapter. These improvements are expected to be scheduled throughout the planning period. The scheduling of improvements will be examined through the Alternatives Analysis chapter of this Master Plan and will be determined in the Implementation chapter of this Master Plan.

The most notable elements of the Facility Requirements is the need to construct a new crosswind runway. Runway 5/23 is recommended to provide necessary wind coverage and subsequently Runway 4/22 will be closed. The construction of the crosswind runway then will drive the removal of 12,200 square yards of apron and removal of the 3 FBO hangars which are all within the Runway Visibility Zone.

The following summarizes the facility recommendations:

Airfield Facilities

- **Construct a crosswind Runway 5/23 paved at 60’ x 4,000’.**
- **Close turf Runway 4/22.**
- **Increase the width of Runway 13/31 to 100’ wide.**
- **Expand all required safety areas to accommodate the increased standards in Aircraft Approach Category B to C**
  - **Relocate False Bottom Creek outside of AAC-C Runway Safety Area.**
  - **Remove or shorten 5 existing hangars currently in the AAC-C Runway Object Free Area**

- Add 10’ paved shoulders and 120’ wide by 150’ long blast pads to Runway 13/31.
- Reduce the Runway Protection Zone for Runway 31 to reflect a change from ¾ mile to 1 mile visibility minimums for the runway’s instrument approach.
- Increase the Runway Protection Zone for Runway 13/31 when the Aircraft Approach Category increases from B to C.
- Install REILs on Runway 13/31
- Install two box PAPIs on Runway 5/23
- Install unlighted hold position signs for Runway 8/26 and for Runway 13/31 for aircraft taxiing back from Runway 8/26 to the apron area.
- Request that the FAA or National Weather Service take over the ownership and maintenance of the AWOS equipment at the airport.
- Lighted supplemental windcones should be installed near Runway 23 when the runway is paved and lighted.
- Construct a full parallel taxiway to Runway 5/23 meeting TDG 1B standards with separation sufficient for ADG II aircraft.

General Aviation

- As a result of the construction of Runway 5/23 a Runway Visibility Zone will require the removal of the 3 existing FBO hangars and office area. This space is approximately 21,200 square feet and based on demand this space will need to be replaced in the near term.
- The change from AAC B to AAC C for Runway 13-31 will increase the OFA for this runway and require the shortening of 4 T-Hangars resulting in the loss of 8 storage spaces and the relocation of 1 conventional hangar. This space is approximately 9,100 square feet of T-Hangar and 2,400 square feet of conventional hangar and will need to be replaced.
- Beyond the hangars impacted by the Runway Visibility Zone, the requirements for hangar space will be demand driven and it is recommended that space be allocated so that expansion can occur in each area of need without negatively affecting any other area. This facility requirement analysis shows there is a need for about 67 percent more hangar space at Spearfish through PAL 4.
- Remove 12,200 square yards of usable apron which will be inside the Runway Visibility Zone resulting from the planned Runway 5/23.
- Construct a minimum of 12,200 square yards of usable apron configured to function with hangars and the planned airfield layout.
- Construct additional apron as demand dictates.

Ground Access

- Paving the route using 27th Street should be completed as soon as practicable.

Support Facilities & Other

- Construction of a dedicated Airport Maintenance Facility should be completed in PAL 1 to provide space suitable for housing this equipment and make the T-hangar space available for general aviation.