

Appendix C – Land Use Assessment

C.1. Introduction

To supplement the assessment of airport performance in meeting the compatible land use zoning Performance Measure (PM) (see **Chapter 5. System Performance, Section 5.2.2.1**) a high-level evaluation of existing land uses near system airports was completed. This appendix provides information on the presence of incompatible land uses, beyond what was provided by airport managers on the 2020 SDSASP Inventory Form.

C.1.1. Existing Land Use Evaluation

A high-level review and assessment of specific types of land use was conducted to provide greater context and understanding of the major land uses near SDSASP airports. The assessment focused on identifying major land uses that are typically considered to be incompatible by the Federal Aviation Association (FAA) in close proximity to airports and aircraft operations. Land uses are typically considered incompatible if they penetrate navigable airspace (height), are noise-sensitive, attract large concentrations of people, provide water/food/roosting habitats for wildlife, or create visual obstructions for pilots (smoke, steam, glare, etc.).

As discussed in **Chapter 2. Inventory of System Conditions**, the FAA defines a set of imaginary surfaces (called Part 77 surfaces) around airports to protect the airspace from obstructions (tall structures). It is within this area that aircraft are departing, landing, and operating in the traffic pattern. The size of the Part 77 surfaces applicable to an airport is based on that airport's runway design and visibility minimums, and therefore vary from airport to airport. The assessment of land uses in this appendix was conducted using the maps generated for each airport during the inventory effort that define each facilities' Part 77 surfaces (see **Figure C-1**), including:

- **Primary Surface:** This surface (shown in black) is longitudinally centered on the runway. The length of the Primary Surface is determined by existence of a prepared hard surface on the runway.
- **Approach Surface:** The surface (indicated by blue lines) is longitudinally centered on the centerline of the runway. It then extends outward and upward three-dimensionally from each end of the Primary Surface. The length and width of the Approach Surface is dependent upon the approach capabilities of that specific runway (visual approach, non-precision instrument approach, precision instrument approach).
- **Transitional Surface:** This surface (indicated by the blue lines) extends outward and upward from the sides of Primary Surfaces and Approaches Surfaces at a slope of 7:1 until it reaches the height of the Horizontal Surface.
- **Horizontal Surface:** This surface (inside the green lines) is positioned 150 feet above the established airport elevation. The perimeter of the horizontal surface is constructed by swinging arcs of specified radii from the center of each end of the Primary Surface of each runway. Tangents then connect the adjacent arcs to form the Horizontal Surface.
- **Conical Surface:** This surface (also inside the green lines) extends outward and upward from the Horizontal Surface for a horizontal distance of 40,000 feet at a slope of 20:1.

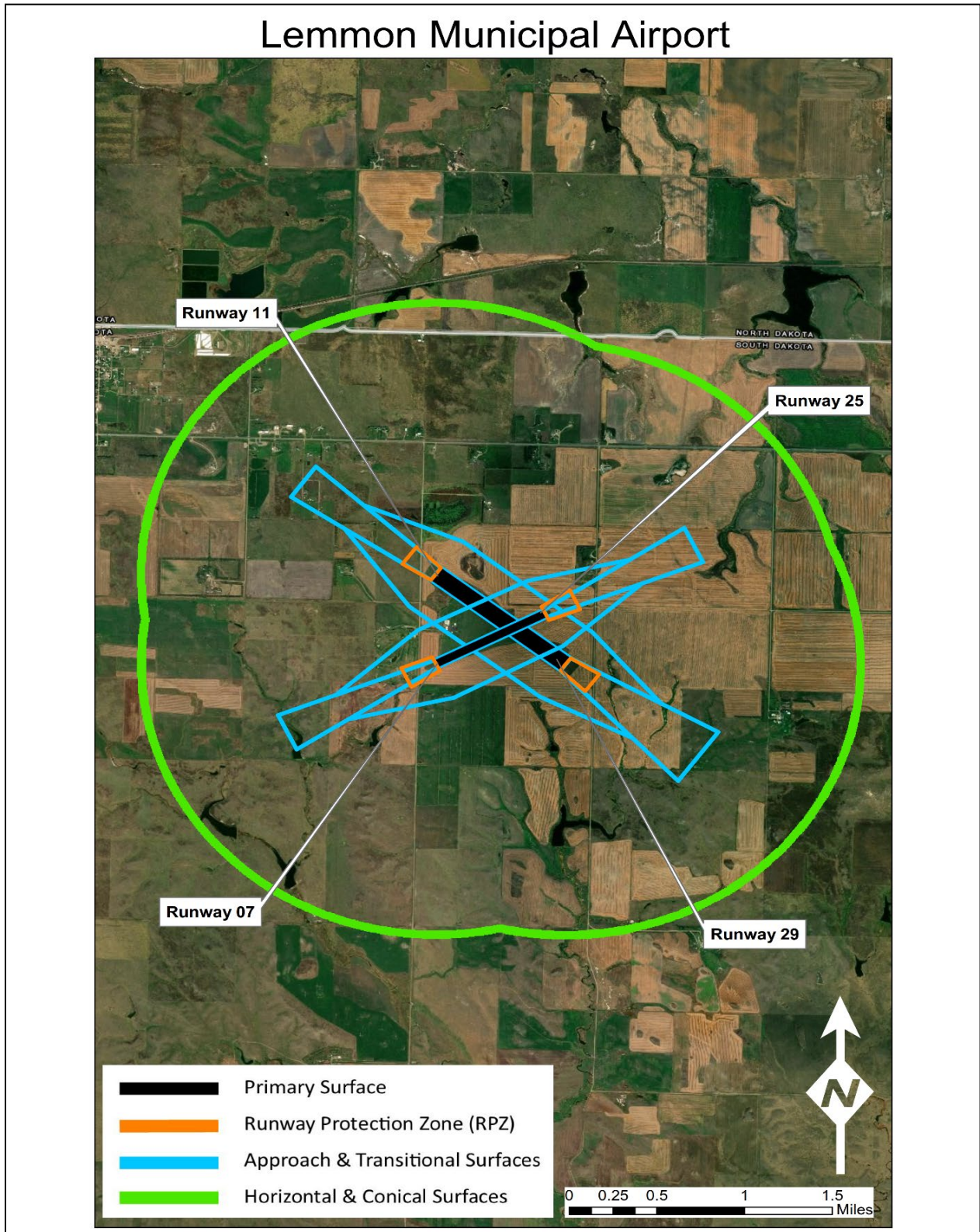
In addition to Part 77 surfaces, Runway Protection Zones (RPZs) were also imposed on the aerial maps for the land use assessment (shown in orange lines). RPZs are trapezoidal areas designated at each end of the runway that the FAA established to protect people and property on the ground near the ends of the runway. The size of an RPZ is determined based on the most demanding aircraft operating at each airport, approach types, and visibility minimums. The FAA encourages airports to have RPZs that are completely clear of any objects and, if possible, are controlled/owned by the airport.

The maps generated for each airport were used in conjunction with Google Earth to identify any major incompatible land uses within the Part 77 surfaces and RPZs. The following sections review the presence of development often considered incompatible, including:

- Residential development
- Major developments
- Water bodies
- Landfills
- Incompatible development within the RPZ

It should be noted that this is not a detailed assessment of all types of individual land uses that could be considered incompatible, rather a high-level evaluation of the presence of some major types of land uses or features that may pose compatibility challenges and can be identified through aerial imagery.

Figure C-1: Example Part 77 Map



Sources: GIS; Kimley-Horn, 2020

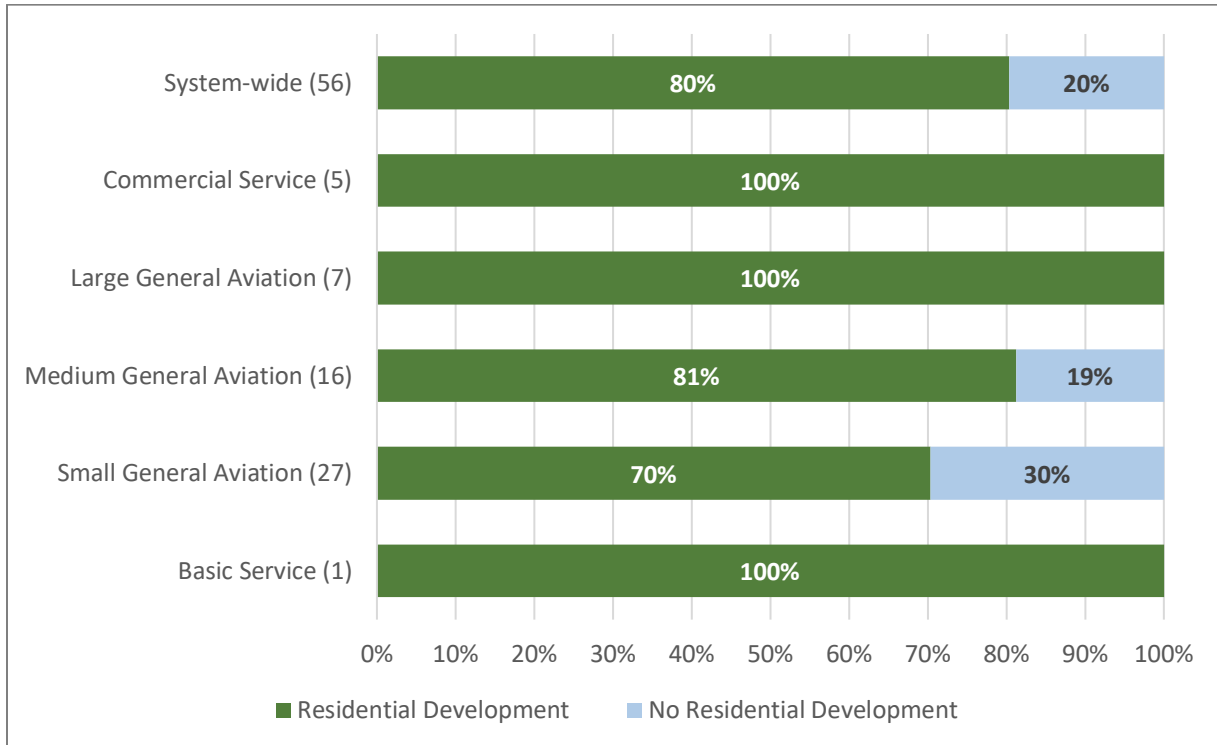
C.1.1.1. Residential Developments

A common incompatible land use found near airports is residential development. This type of development is often considered incompatible due to the noise sensitivity of residential uses. The incompatibility of residential development near airports is well documented and appears in ACRP Report 27: *Enhancing Airport Land Use Compatibility* and is recognized by the FAA as an impact to airport communities through Federal Aviation Regulation (FAR) Part 150, *Airport Noise Compatibility Planning*. FAR Part 150 and the Aviation Safety and Noise Abatement Act of 1979 offer guidance to limiting growth and the spread of noise pollution through the implementation of various programs and development standards in which to measure noise. While additional noise compatibility studies were not completed for the SDSASP, it is still a major component to consider in land use compatibility studies for airports. The industry-recognized noise impact threshold is 65 day-night average sound level (DNL); actual noise impact is subjective and based on perception. Aircraft noise may be highly disruptive to some nearby residents at lower or higher levels.

Moreover, dense residential development (either multi-level, multi-family, or dense single-family neighborhoods) creates a large concentration of people in a single location. When located under a runway approach or within an aircraft traffic pattern, it can threaten the safety of residents in the event of an aircraft incident.

For these reasons, residential development is typically considered incompatible at face value near airports. **Figure C-2** shows the percentage of airports by classification with residential development within their Part 77 surfaces. A review of the Part 77 maps and aerial imagery found that 80 percent of system airports had some type of residential development existing within the boundaries of the Part 77 surfaces. All of the Commercial Service, Large General Aviation (GA), and Basic Service airports have residential development within their Part 77 surfaces. Nineteen of 27 Small GA airports, and 13 of 16 Medium GA airports have residential development showing within their Part 77 surfaces. It is important to note that due to the size of Part 77 surfaces, it may be virtually impossible to prevent residential development in the whole area, unless airport compatible land use zoning has been in place for some time. Additionally, some of these residential uses were developed many years ago when airport noise may not have been as great of an issue.

Figure C-2: Percentage of Airports with Residential Development in their Part 77 Surfaces



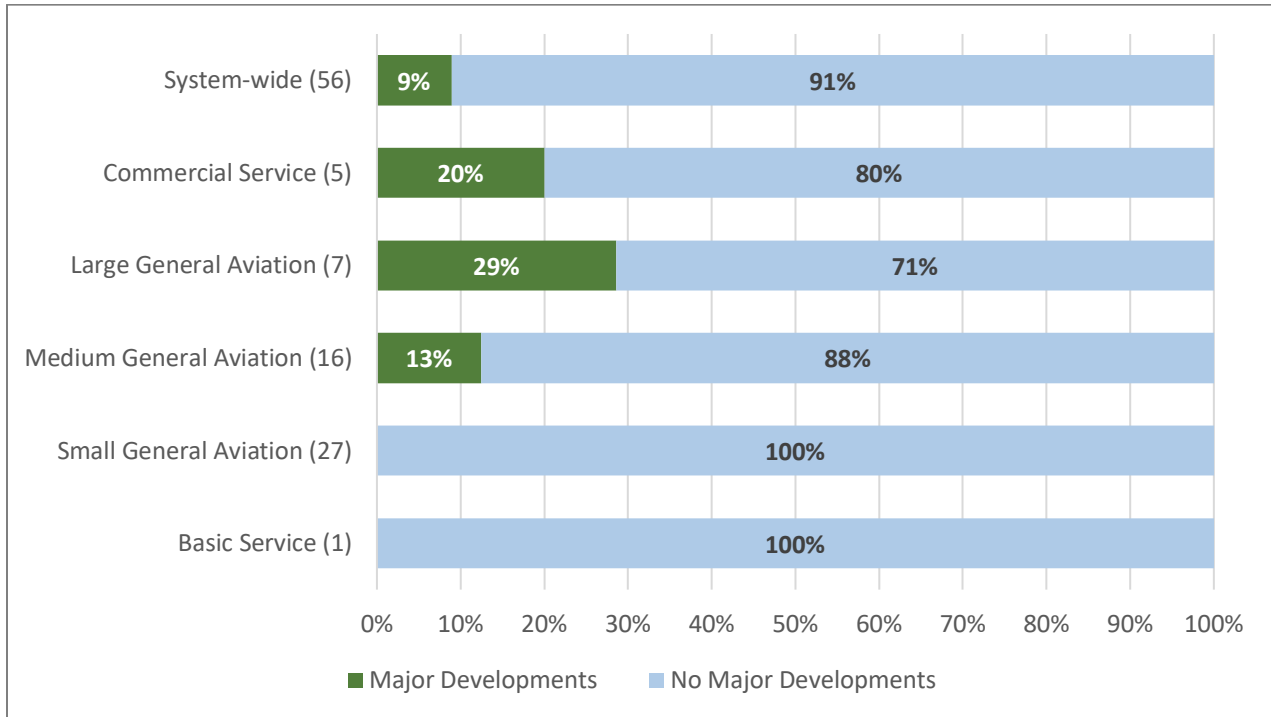
Sources: Google Earth; Kimley-Horn, 2020

C.1.1.2. Major Developments

Aerial imagery was used to identify major, high-intensity uses near SDSASP airports, such as malls, stadiums, amusement parks, educational and medical campuses, military installations, and more. The characteristics that make these types of land uses incompatible vary. For example, developments that attract high concentrations of people such as malls, sport stadiums, correctional facilities, educational and medical campuses, and others pose a population density concern near airports. Educational facilities are susceptible to noise, while the high intensity lighting associated with stadiums, correctional facilities, industrial uses, and military sites can cause visual obstructions for pilots during takeoff/descent operations. Major industrial or energy production sites can produce smoke or steam can cause visual obstructions to pilots. Many of these uses also include tall structures which can obstruct the navigable airspace surrounding airports.

Figure C-3 shows the percentage of airports by classification with major developments in their Part 77 surfaces. These developments were found near only a few system airports (five total) equaling nine percent system-wide. There are two Medium GA and two Large GA airports with major developments nearby, and one Commercial Service airport with major developments within the Part 77 surfaces area. These specific developments include universities, large medical campuses, sports stadiums, and event centers.

Figure C-3: Percentage of Airports by Classification with Major Developments in their Part 77 Surfaces



Sources: Google Earth; Kimley-Horn, 2020

C.1.1.3. Water

Water bodies in an airport’s Part 77 surfaces, other than at a seaplane base, can pose multiple risks to aviation activity based on size, location, and wildlife. For example, water features can produce glare off the surface which can obstruct a pilot’s visibility. Water features causing glare that are directly ahead or slightly to the side of the pilot’s vision on final approach causes the greatest impairment to their ability to see their instruments. According to the FAA’s study on hazardous glare, bodies of water should be limited to as least 25 degrees from the direction of the pilot’s viewpoints.¹

Second, the FAA’s AC 150/5200-33B, *Hazards Wildlife Attractants on or Near Airports* provides guidelines and considerations regarding bodies of water known to attract wildlife collisions on and around runways and in the airspace as birds and other wildlife travel to and from the water – sometimes between two or more bodies of water. Wildlife strikes result in expensive aircraft damage and pose serious threats to pilots, passengers, and at times, the nearby public.

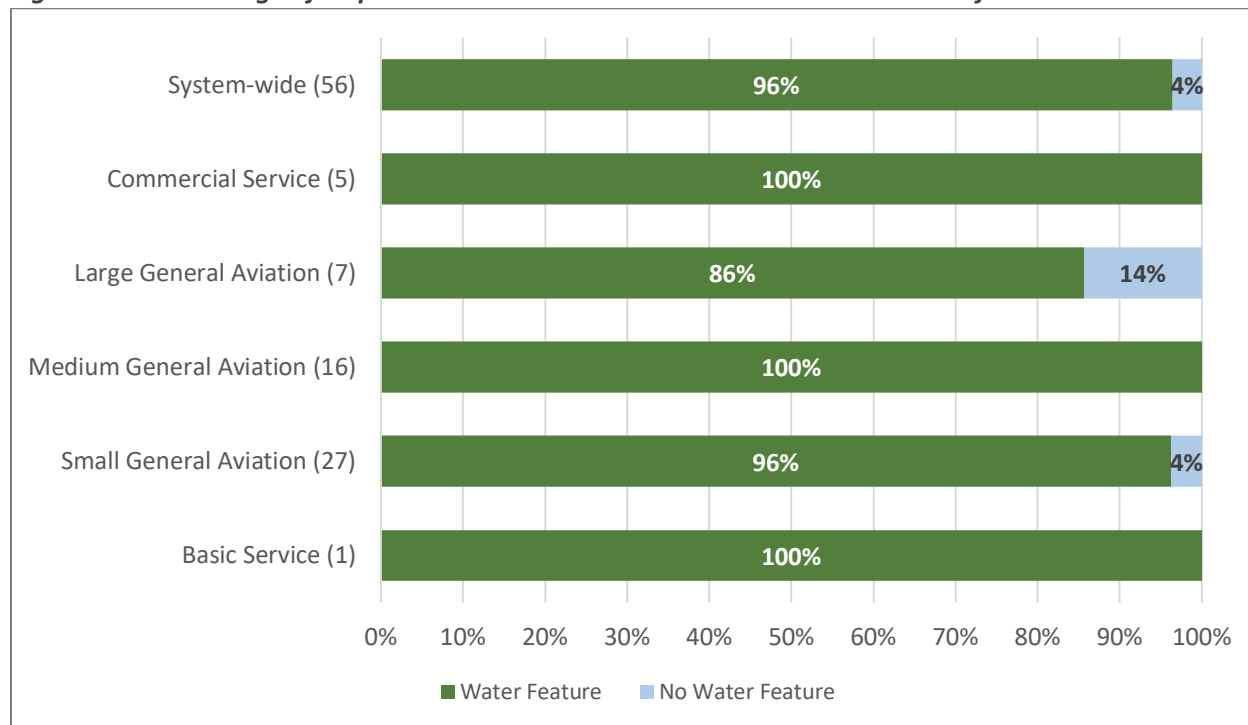
For this evaluation, water bodies were defined as lakes, reservoirs, rivers, and creeks that were clearly identifiable from a bird’s eye view of the aerial images with the Part 77 surfaces overlaid. In addition to the water body types listed previously, smaller water features such as water detention and retention ponds were considered, as they too can pose a threat to safe aircraft operations.

Figure C-4 shows the percentage of airports by classification with an identified water feature within the Part 77 surface maps. Overall, there is some form of water feature at 96 percent of system airports, including all Commercial Service airports, all of the Medium GA airports and the one Basic Service

¹ FAA, *Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach*, 2015.

Airports. Eighty six percent of the Large GA airports, and 96 percent of the Small GA airports had a water feature within their Part 77 surfaces.

Figure C-4: Percentage of Airports with a Water Feature within their Part 77 Surfaces



Sources: Google Earth; Kimley-Horn, 2020

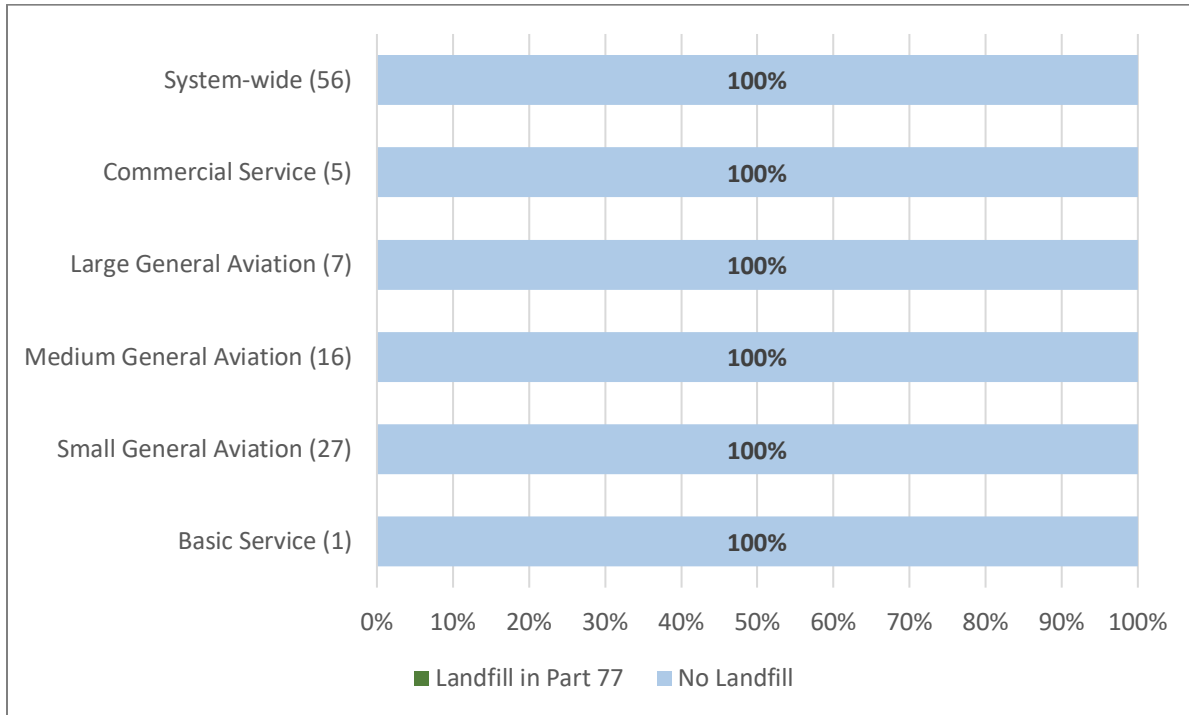
C.1.1.4. Landfills

Similar to water bodies, landfills can create significant risks to the safety of aircraft operations due to the proliferation of wildlife, particularly birds, that are found at these sites. To limit the impact of these wildlife attractants, the FAA discourages the development of landfills within 5,000 feet of all runways, 10,000 feet of runways serving turbine-powered aircraft, and five miles away from any runway if the landfill initiates bird movement across aircraft pathways and circulation.² South Dakota Department of Environment and Natural Resources (SD DENR) provides an up to date list of the state’s regulated municipal solid waste landfills. These sites were assessed for proximity to SDSASP airports.

Figure C-5 shows no system airports having a landfill inside their Part 77 surfaces. However, when the extent of the analysis expands to five miles from the airports air operations area (AOA) per the direction of the FAA’s AC 150/5200-33B, *Hazardous Wildlife Attractants on or near Airports*, the number of airports that have landfills within this proximity increases. **Figure C-6** shows the percentage of airports by classification with a landfill within five miles of the airport. Five percent of system airports (three Medium GA airports) have a municipal solid waste landfill within five miles of their airport.

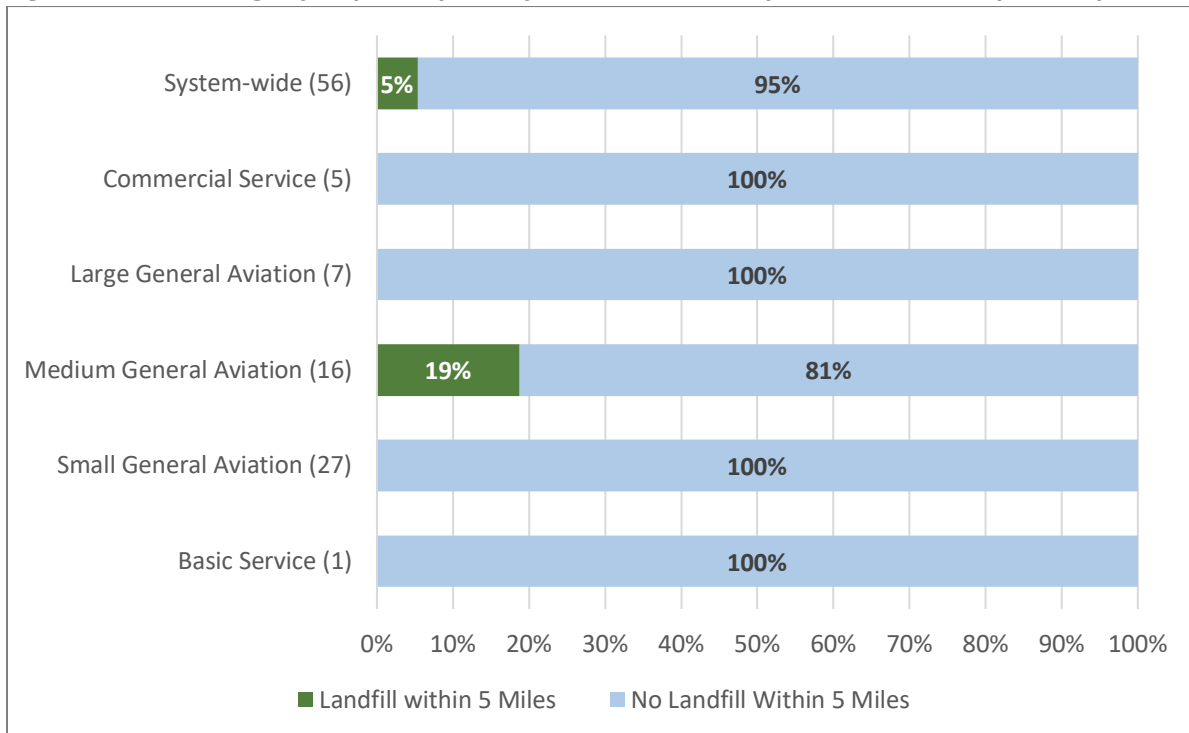
² FAA AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports*, August 2007.

Figure C-5: Percentage of Airports with a Landfill within their Part 77 Surfaces



Sources: Google Earth; Kimley-Horn, 2020; SD DENR Municipal Solid Waste Map

Figure C-6: Percentage of Airports by Classification with a Landfill within 5 Miles of the Airport



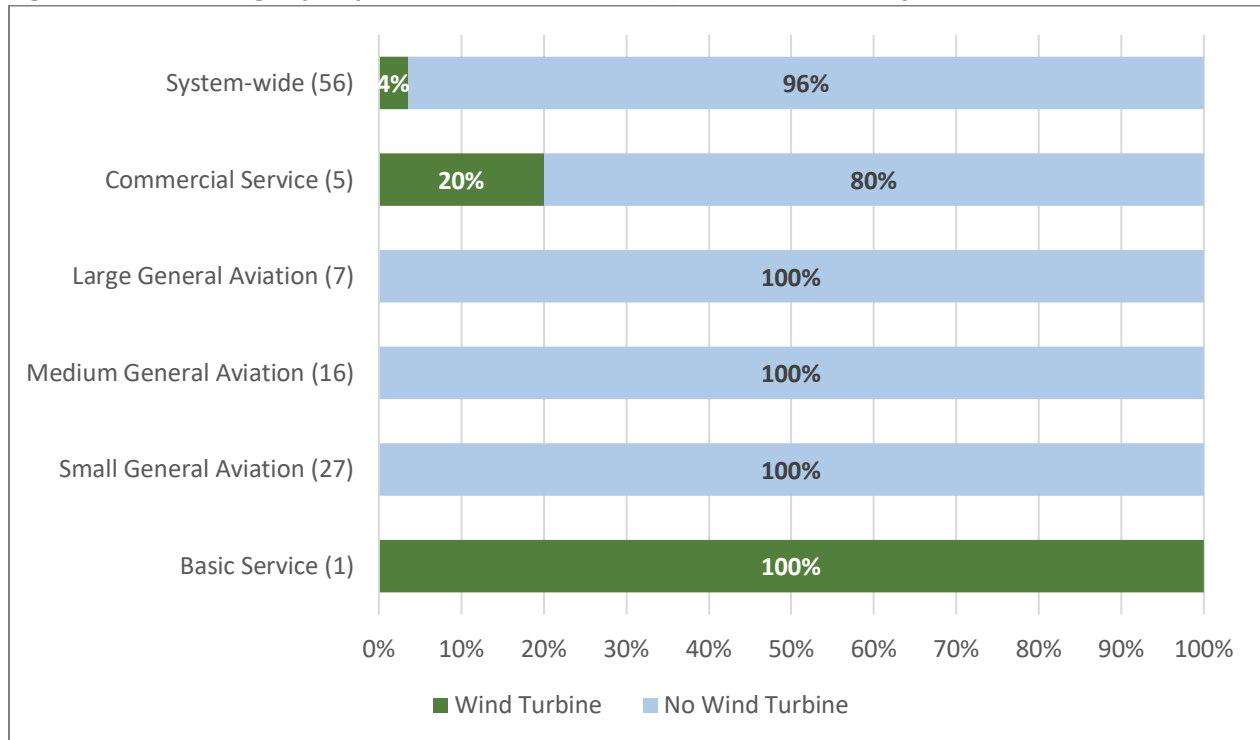
Sources: Google Earth; Kimley-Horn, 2020; SD DENR Municipal Solid Waste Map

C.1.1.5. Wind Turbines

Wind turbines, sometimes referred to as wind energy converters, generate electric energy using the wind’s kinetic energy. As advancements in alternative energy production continue to be made, wind turbines are being raised across the country in areas with desired wind conditions. While there are benefits to alternative energy production, wind turbine installations can cause compatibility concerns close to airports due to their height. Wind turbines can pose obstructions for pilots during takeoff and landing procedures as well as low level flight in the traffic pattern around the airport. To identify where wind turbines are currently located in the state, the United States Geological Survey (USGS) interactive web-based map “U.S. Wind Turbine Database” was used to compare airport locations and wind turbine locations to identify areas of close proximity.

Figure C-7 shows the percentage of airports by classification with an identified wind turbine(s) within their Part 77 surfaces. While only two airports system wide (five percent) were identified as having one or more wind turbines within their Part 77 surface, there were five other airports that had wind turbines within 10 miles of their location (two of those airports had wind turbines approximately one mile from the outer edge of their Part 77 surfaces).

Figure C-7: Percentage of Airports with Wind Turbine(s) within Part 77 Surfaces



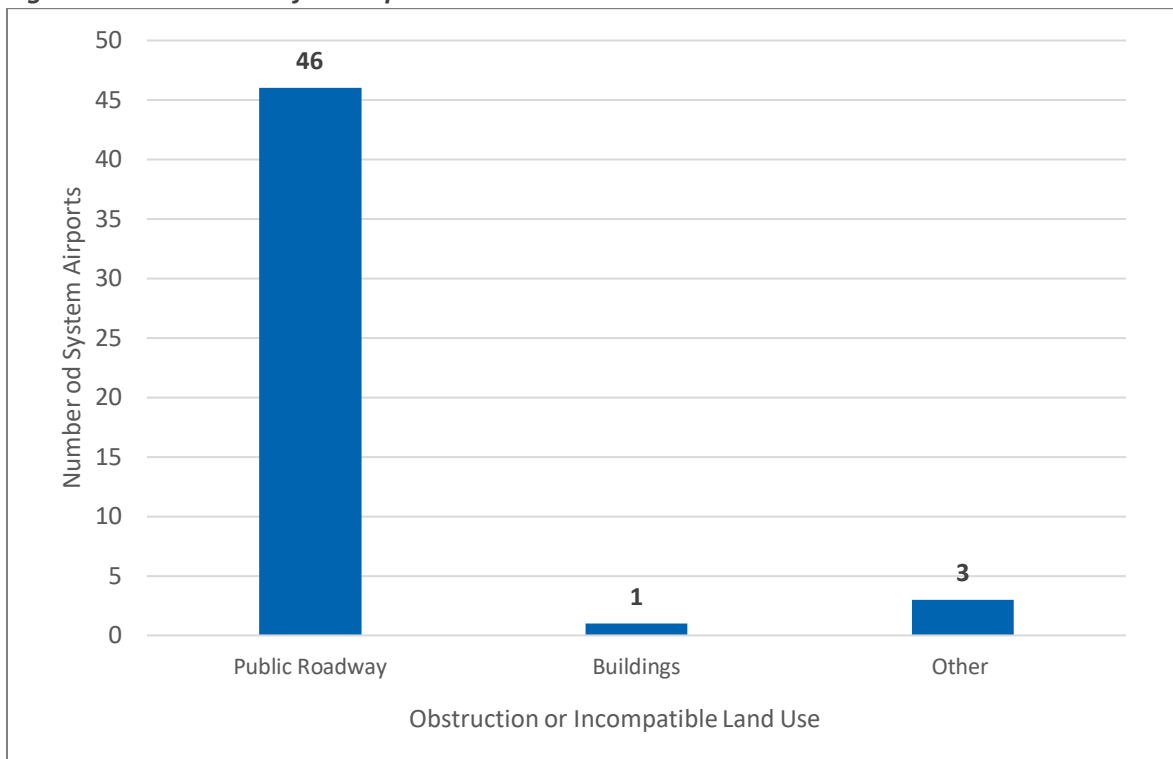
Sources: Kimley-Horn, 2020; USGS U.S. Wind Turbine Database

C.1.2. Runway Protection Zones (RPZ)

As previously noted in this appendix, RPZs are trapezoidal areas designated at both ends of a runway to promote safety and minimize damage in the event of an aircraft overrun or undershoot. Ideally, these areas would be clear of all non-airport development and would be controlled by the airport. However, complete control of these areas is not always feasible and therefore development is possible in these areas that is considered incompatible. For the RPZ assessment, the presence of three elements was

evaluated: public roadways, buildings, and any type of non-airport related development (other). **Figure C-8** shows the count of each of these uses in RPZs at all airports. Forty-six airports in the system have a public roadway intersecting with a portion of at least one of the RPZs. One airport has a building identified in an RPZ, and three airports have other non-airport related development (two have golf courses and one has a body of water).

Figure C-8: Evaluation of Incompatible Uses or Structures in RPZ



Sources: Google Earth; Kimley-Horn, 2020

It is important to note that existing public roadways, structures, or land uses may have been found to comply with earlier FAA regulations during their initial development. New research and airport planning practices have led to changes in FAA regulations regarding new development or modifications of existing land uses within RPZs. The FAA recommends coordination with the National Airport Planning and Environmental Division (APP-400) to check if new development or modifications to existing development in RPZs conforms with regulations and best practices when the following changes are made:³

- An airfield project will be constructed (e.g., runway extension, runway shift).
- A change is made in the critical design aircraft that increases the RPZ dimensions.
- A new or revised instrument approach procedure is established that increases the RPZ dimensions.
- A local development proposal in the RPZ is submitted (either new or reconfigured).

New or proposed public roadways, structures, and non-airport development are ideally located outside of RPZs and if this is not possible, a full range of alternatives should be analyzed and coordinated with FAA to minimize the associated risks.

³ FAA, *Memorandum Interim Guidance on Land Uses Within a Runway Protection Zone*, September 2012.

C.1.3. Summary of Land Use Assessment

This land use assessment identifies various types and characteristics of land uses that are often considered incompatible with airport operations. Identification of the location and extent of incompatible land uses near SDSASP airports fosters awareness of the issue and supports recommendations to mitigate existing incompatibilities and limit the development of new ones.