Appendix A. Land Use Evaluation

To accurately gauge the aviation system's alignment to its Safety and Efficiency goal, performance measures (PMs) and system indicators (SIs) were established in **Chapter 6: System Performance**. This appendix provides supplemental information related to the PM "Percent of Airports That Have Adopted Appropriate Land Use Controls." A high-level land use evaluation was conducted for each airport in the Colorado Aviation System Plan (CASP) to assess the existing land use conditions that goes beyond the airport-reported responses to the 2018 Inventory & Data Form.

A.1. Existing Land Use Evaluation

A cursory review and assessment of specific types of land use was conducted to provide greater context and understanding of the major land uses near CASP airports. This evaluation focused on the identification of land uses that are typically considered incompatible by the FAA in close proximity to airports and aircraft operations. Incompatible land uses include buildings and structures whose height exceeds Part 77 standards as well as other types of development that may attract wildlife or large concentrations of people, are noise-sensitive, or cause visual obstructions. The land uses within the Part 77 surfaces and within the Runway Protection Zone (RPZ) were the focus of the evaluation.

Part 77 surfaces are defined by the FAA and are used by many jurisdictions to protect airports from encroachment, particularly from a height perspective. The size of Part 77 surfaces is dependent on each airport's runway types and visibility minima and therefore are not the same for all system airports. These surfaces are imaginary and include the following as portrayed in **Figure A.1**:

- **Primary Surface:** This surface (indicated 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 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 yellow lines) extends outward and upward from the sides of Primary Surfaces and Approach Surfaces at a slope of 7:1 until it reaches the height of the Horizontal Surface
- **Horizontal Surface:** This surface (indicated by the innermost ring of red lines and highlighted in green) is positioned 150 feet above the established airport elevation. The perimeter of the Horizontal Plan 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 (indicated by the outermost ring of red lines) extends outward and upward from the Horizontal Surface for a horizontal distance of 4,000 feet at a slope of 20:1

RPZs are trapezoidal areas located at each end of the runway that the FAA established to protect people on the ground and in the air near airports. The size of the RPZs differ throughout the system of airports and is determined based on the most demanding aircraft operating at each airport, approach types, visibility minima. The FAA encourages airports to have RPZs that are completely clear of any objects and, if possible, are controlled by the airport.

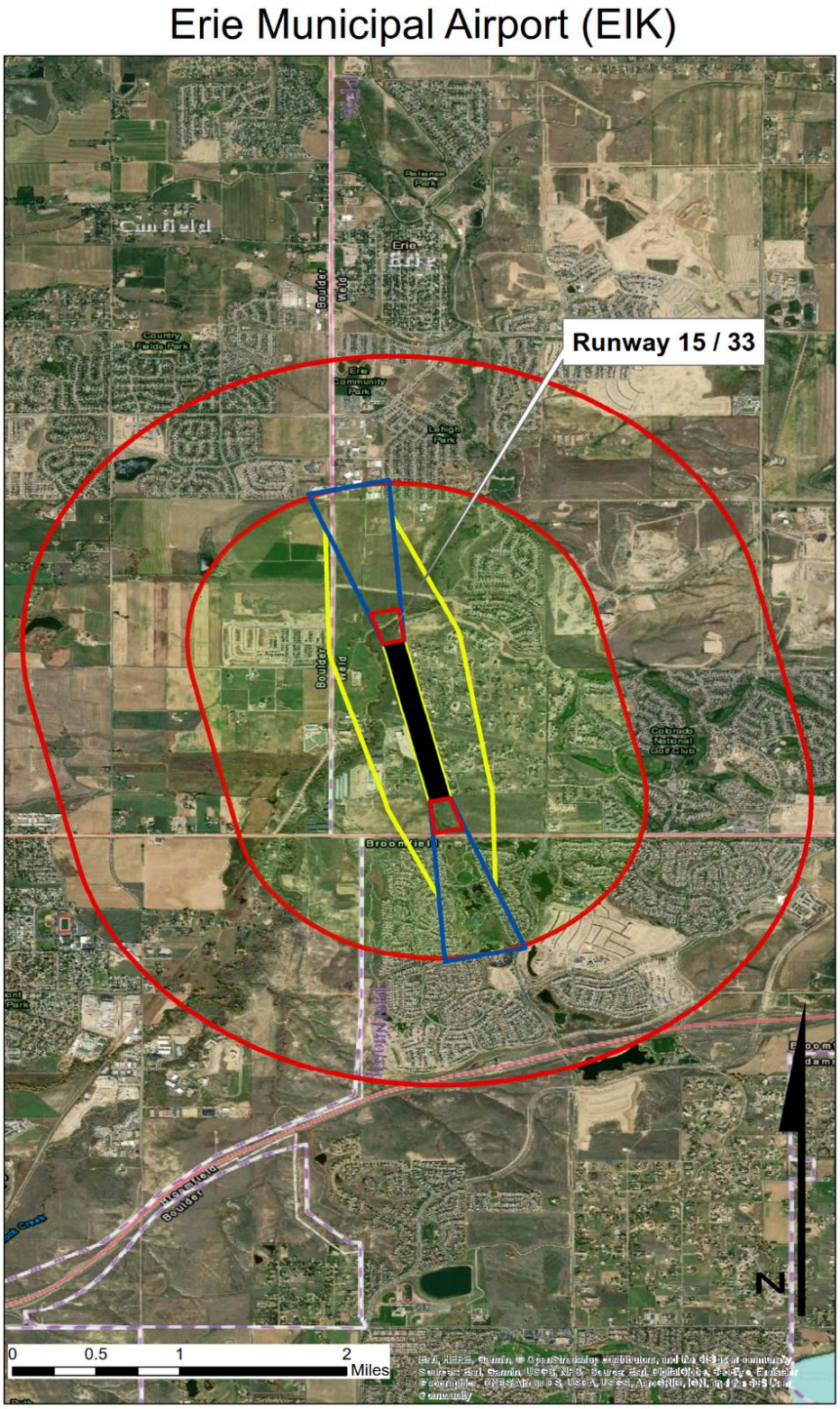
As part of the CASP, Part 77 surfaces and RPZs were identified for each airport and the associated boundaries for these were mapped on aerial imagery to provide a two-dimensional view. These maps provide the capability to hone in on uses within runway approaches and traffic patterns – the most critical areas for enhancing compatibility.[1] Each airport was provided an aerial map with these surfaces during the on-site visit as part of the discussion about current and potential future land use issues at or around their facility. Feedback from airport managers and sponsors during the on-site visit and aerial imagery via Google Earth provide the basis for this assessment.

The following sections review the presence of development often considered incompatible, including residential development, major developments, water bodies, and landfills within the two-dimensional Part 77 footprint and RPZs of each CASP airport maps.

Figure A.1 shows a sample of the land use compatibility maps that were developed for the analysis using Geographic Information Systems (GIS). The outer boundaries of the Part 77 surfaces are shown in red on the sample map for Erie Municipal Airport (EIK). The inner red trapezoidal shapes represent the RPZs.

[1] While Part 77 surfaces are three-dimensional in shape, the two-dimensional footprint of the surfaces are often used to define areas of close proximity to airports and identify the locations around the airport most susceptible to the impact of incompatible land uses.

Figure A.1. Land Use Compatibility Map Example



Source: Kimley-Horn, 2019

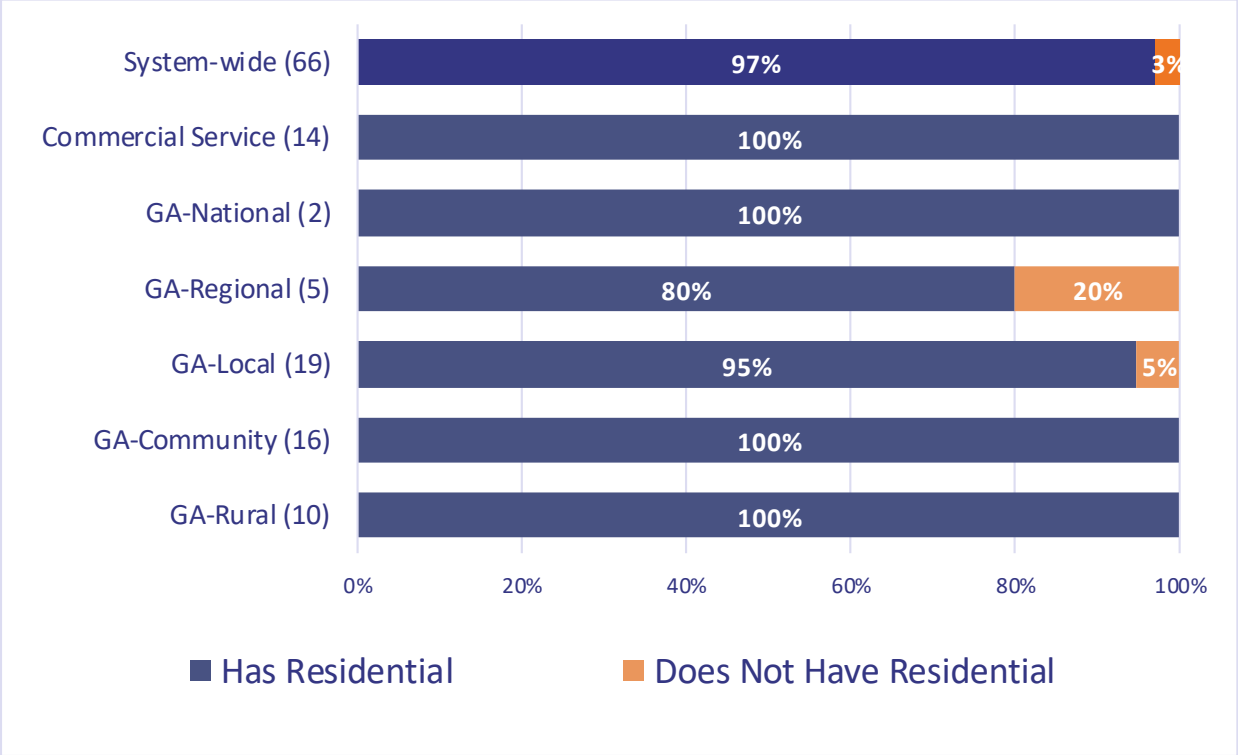
A.1.1. Residential Developments

One of the most commonly recognized incompatible land uses near airports is residential development, due to the levels of noise that are inherent to aircraft operations. This incompatibility is well documented, such as in ACRP Report 27: *Enhancing Airport Land Use Compatibility* and is recognized by the FAA as an impact to airport communities through FAR Part 150, *Airport Noise Compatibility Planning*. FAR Part 150 and the Aviation Safety and Noise Abatement Act of 1979 offer guidance limiting the growth and spread of noise incompatibility through the implementation of various programs and development of standards in which to measure noise. While additional noise incompatibility studies were not completed for the CASP, 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.

In addition to the noise factor, 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 near airports.

Based on the review of GIS maps created for each airport in the CASP, 97 percent of system-wide airports had some sort of residential development that existed within the boundaries of the Part 77 surfaces. All Commercial Service and GA-National airports and 80 percent of GA-Regional airports have residential developments within their Part 77 surfaces. Ninety-five percent of GA-Local, and all GA-Community and GA-Rural airports were identified as having residential uses within the boundaries of their Part 77 surfaces. **Figure A.1.** presents the number of airports by classification that were identified as having residential developments within their Part 77 surfaces.

Figure A.2. Airports by Classification with Residential Developments within Part 77



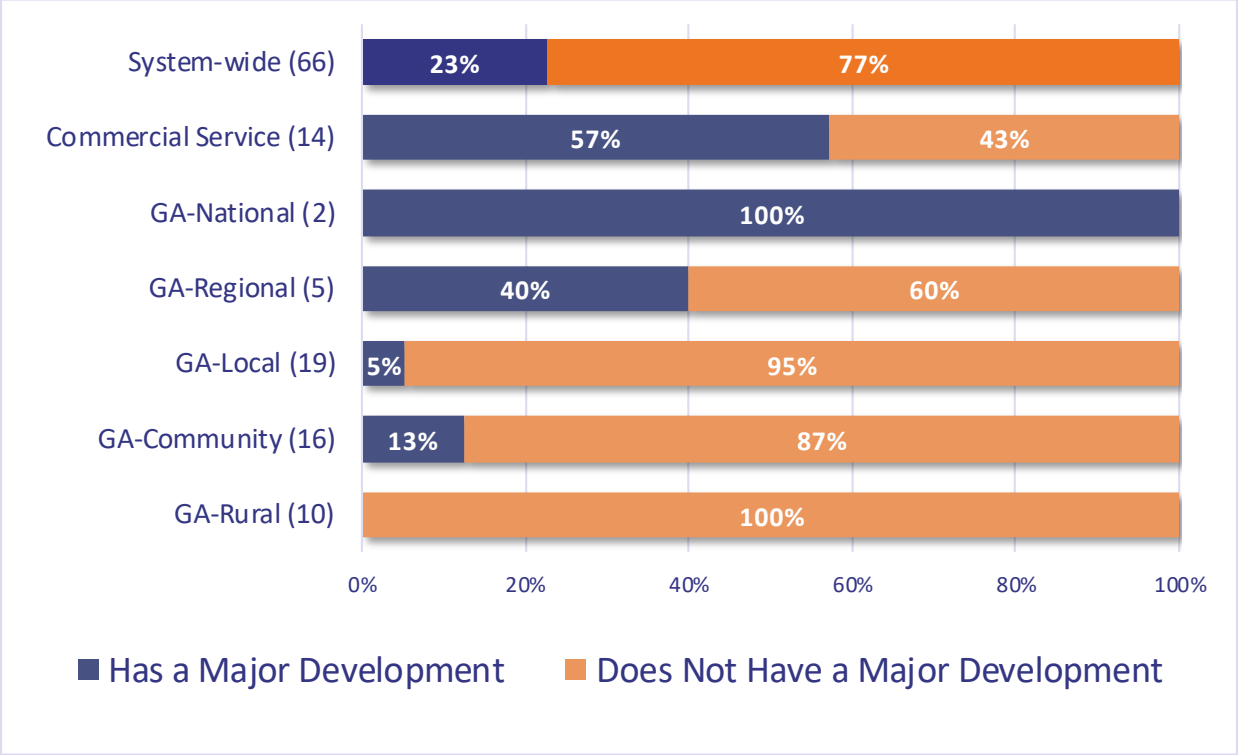
Sources: Google Earth; Kimley-Horn, 2019

A.1.2. Major Developments

The incompatible characteristics of major developments differ based on use. Educational and medical campuses, stadiums, malls, correctional facilities, and military installations attract high concentrations of people, posing a population density concern in proximity to airports. Educational facilities are susceptible to noise. Sports stadiums, major entertainment venues, correctional facilities, industrial uses, and military installations all require high intensity lighting that can cause light interference and distractions for pilots during takeoff or descent. Energy extraction, power plants and other industrial uses can generate smoke and steam that also may pose visual obstructions to pilots. Many of these uses can also include tall structures which may penetrate into the navigable airspace surrounding airports.

For all system-wide airports, 23 percent were identified as having some form of major development within their Part 77 surfaces. More than half of all Commercial Service airports and 100 percent of GA-National airports had a major development within this boundary. None of the GA-Rural airports had an existing major development within their Part 77 surfaces. **Figure A.3** summarizes the results of the analysis and depicts the airports by classification that have a major development within their Part 77 surfaces.

Figure A.3. Airports by Classification with a Major Development within Part 77



Sources: Google Earth; Kimley-Horn, 2019

A.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. First, water features can generate glare off the surface which can disorient and/or impact pilots' ability to locate and land their aircraft on the runway.[2] The presence of a water feature contributing to glare located directly ahead and 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 at least 25 degrees from the direction of the pilots' viewpoints.

Second, the FAA's AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports* provides guidelines and considerations regarding bodies of water known to attract wildlife by providing a source of water and roosting habitats, especially for birds. This can lead to 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.

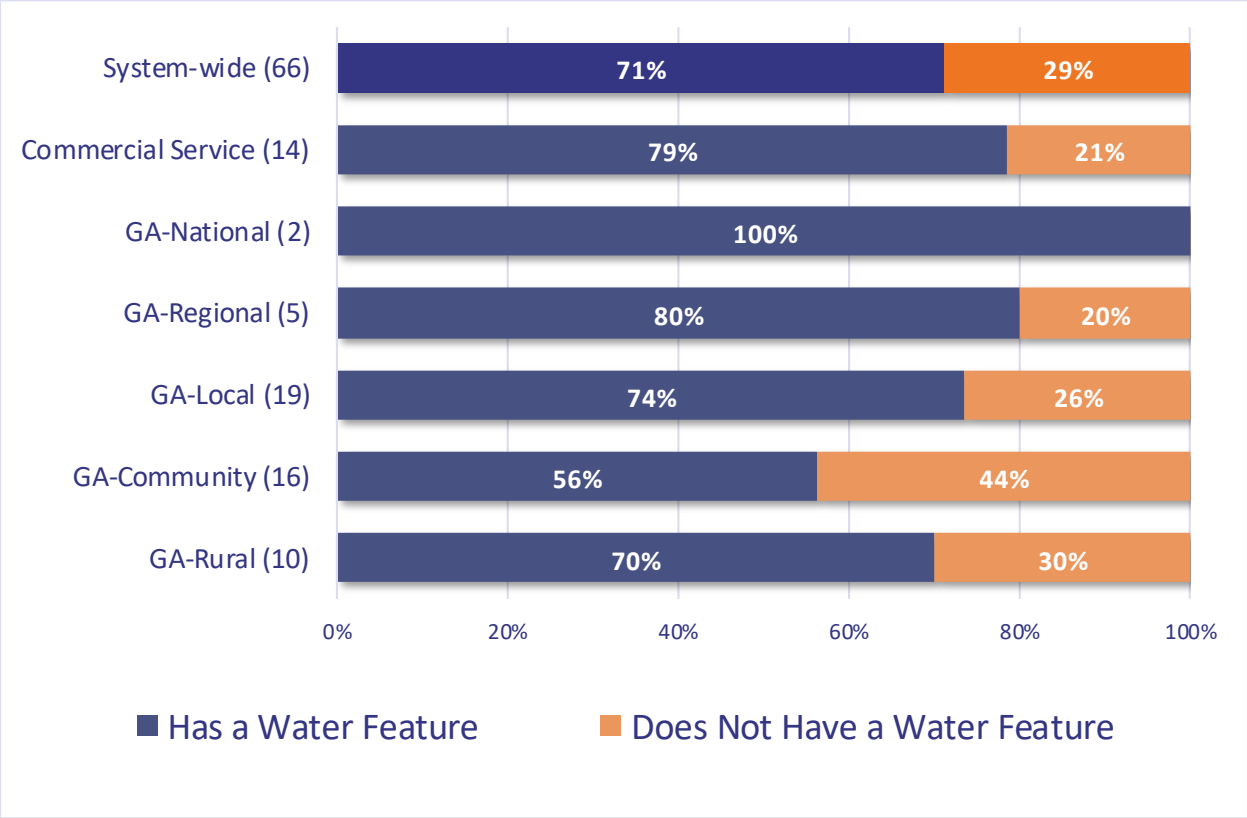
For this evaluation, water bodies are defined as: lakes, reservoirs, rivers, and creeks that were clearly identifiable from a bird's eye view of the aerial images with the Part 77 surfaces overlaid. This does not imply that these are the only water features that can impact aircraft operations. Other smaller

[2] FAA "Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach." July 2015.

features, such as water detention/retention ponds and, open irrigation canals can also pose a threat to safe aircraft operations and should be carefully considered near airports.

System-wide, 71 percent of all airports had some form of body of water within their Part 77 surfaces. Seventy-nine percent of Commercial Service airports had a water feature within these boundaries. All GA-National and 80 percent of GA-Regional airports were identified as having a water feature within their imaginary surfaces. Seventy-four percent of GA-Local, more than half of GA-Community (56 percent), and 70 percent of GA-Rural airports had an existing water feature within their Part 77 surface. Of the 76 water features inventoried within Part 77 surfaces for airports, 13 were identified as manmade reservoirs and 63 as naturally occurring water bodies. Percentages of airports with water features identified within Part 77 surfaces are presented by classification in **Figure A.4**.

Figure A.4. Airports by Classification with an Existing Water Feature in Part 77 Surfaces



Sources: Google Earth; Kimley-Horn, 2019

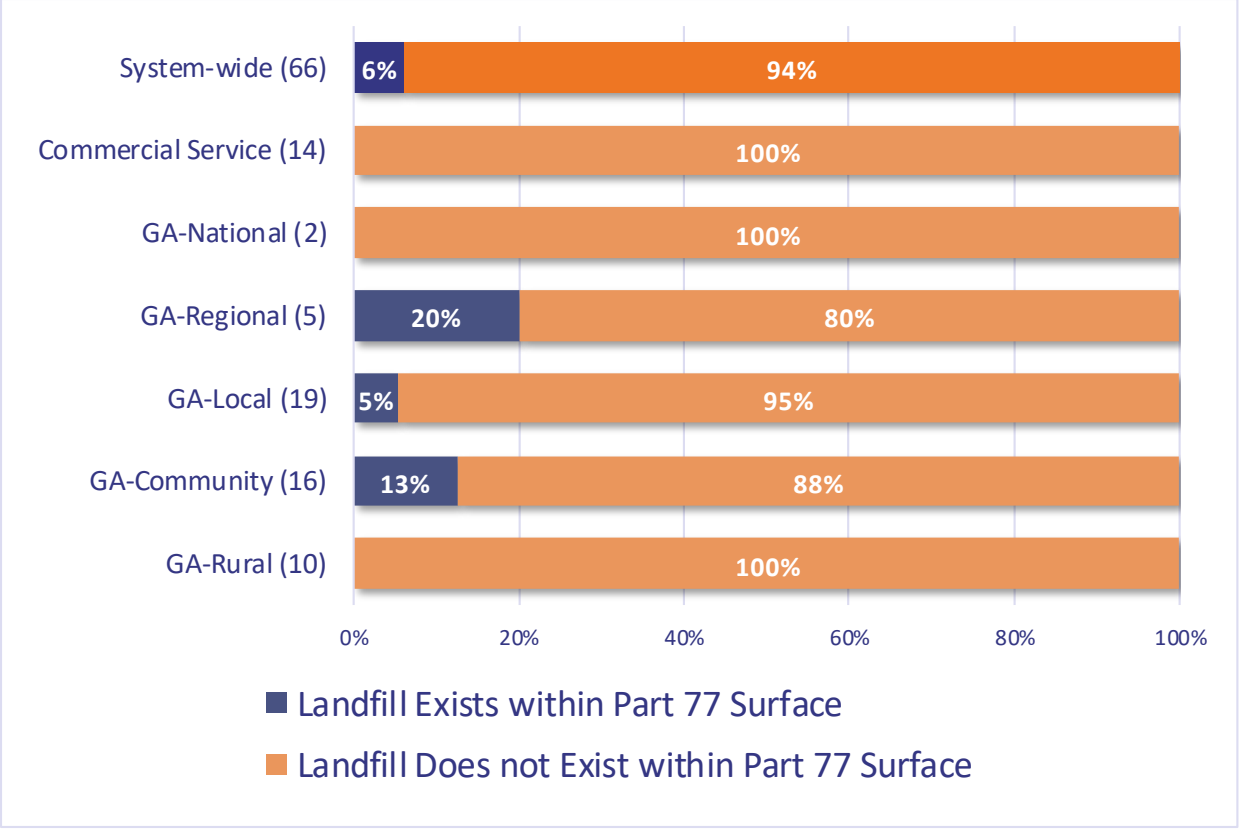
A.1.4. Landfills

Similar to water bodies, landfills pose a significant threat to aircraft operations as they attract wildlife, particularly birds, increasing the chance for wildlife strikes. To limit the impact of these wildlife attractants, the FAA discourages the development of hazardous wildlife attractants within 5,000 feet of runways serving piston-powered aircraft, 10,000 feet of runways serving turbine-powered aircraft, and five miles away from any runway if they initiate bird movement across aircraft pathways and

circulation.[3] Data obtained from the Colorado Department of Public Health and Environment (CDPHE) was used to determine the existence of landfill facilities within a five-mile buffer of Colorado system airports. The location of each landfill facility was then compared against the airport's land use compatibility map using Google Earth to determine if the landfill facility also fell within the Part 77 surface area. **Figure A.5** shows the findings of the analysis of landfills within Part 77 surfaces by airport classification.

Of the airports analyzed for the CASP, six percent or four airports system-wide have a landfill which exists within their Part 77 surfaces. Commercial Service, GA-National, and GA-Rural airports do not have landfills that exist within this boundary. Airport classifications that currently have a landfill within their Part 77 surfaces are GA-Regional, GA-Local, and GA-Community with 20 percent, five percent, and 13 percent, respectively.

Figure A.5. Percent of Airports by Classification with a Landfill within Part 77



Sources: CDPHE, 2019; Google Earth, Kimley-Horn, 2019

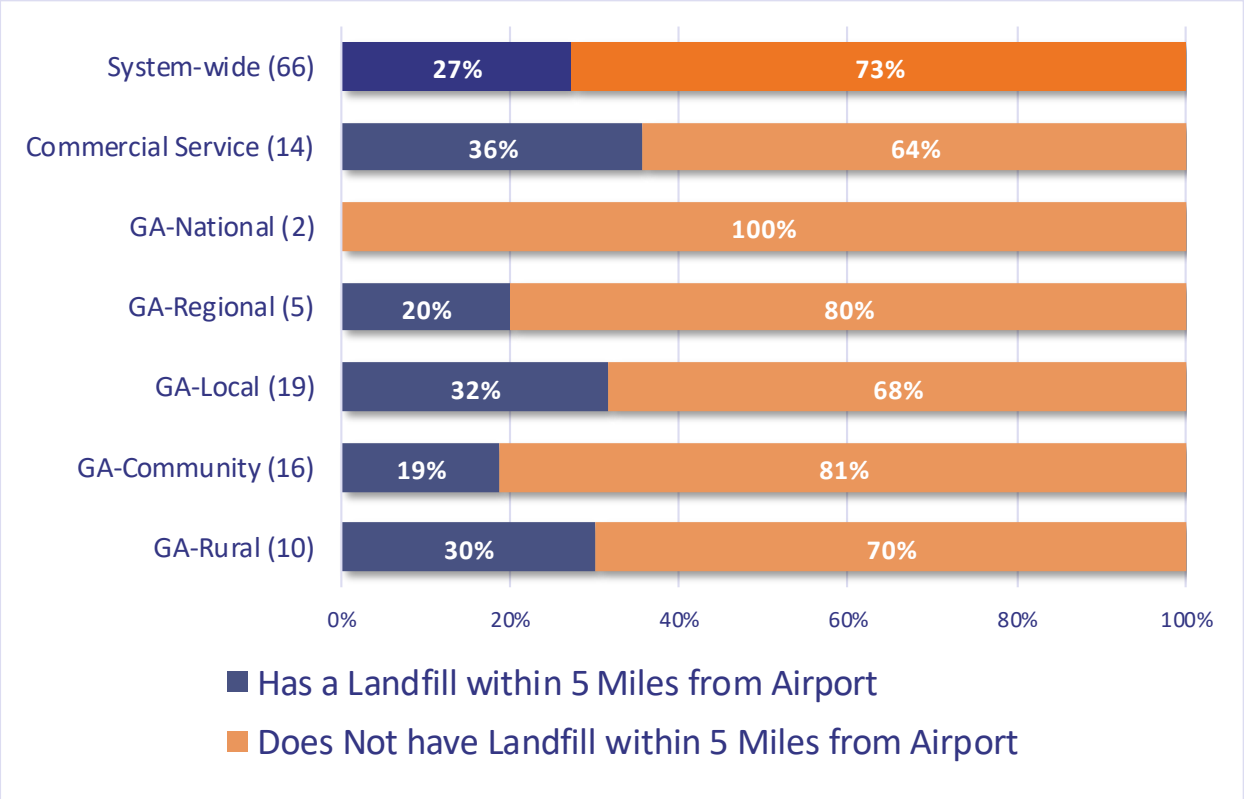
Upon increasing this distance to extend out to five statute miles from the airports' air operations area (AOA) per the direction of the FAA's AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports*, the number of airports that have a landfill within this proximity increases. An airport's AOA

[3] FAA AC 150/5200-33B *Hazardous Wildlife Attractants on or Near Airports*. August 2007.

incudes the area where aircraft operate, including runways, taxiways, aprons, and any other infrastructure within the secured and fenced-in area of an airport.

System-wide, the percent of airports with a landfill within five miles increased to 27 percent or 18 airports as a larger area is being evaluated. Commercial Service airports affected by landfills within five miles from their location increased to 36 percent. Thirty-two percent of GA-Local airports currently have a landfill within five statute miles from their AOA. It is important to note that it is unknown if any of the airports with landfills within the five-mile separation distances have been negatively impacted by bird movement. Therefore, it is possible that these landfills may not be directly generating wildlife issues despite their proximity to an airport. **Figure A.6** presents the results of airports with landfills within five statute miles from the end of their AOAs.

Figure A.6. Percent of Airports by Classification with a Landfill within Five Miles



CDPHE, 2019; Google Earth, Kimley-Horn, 2019

A.1.5. Runway Protection Zones

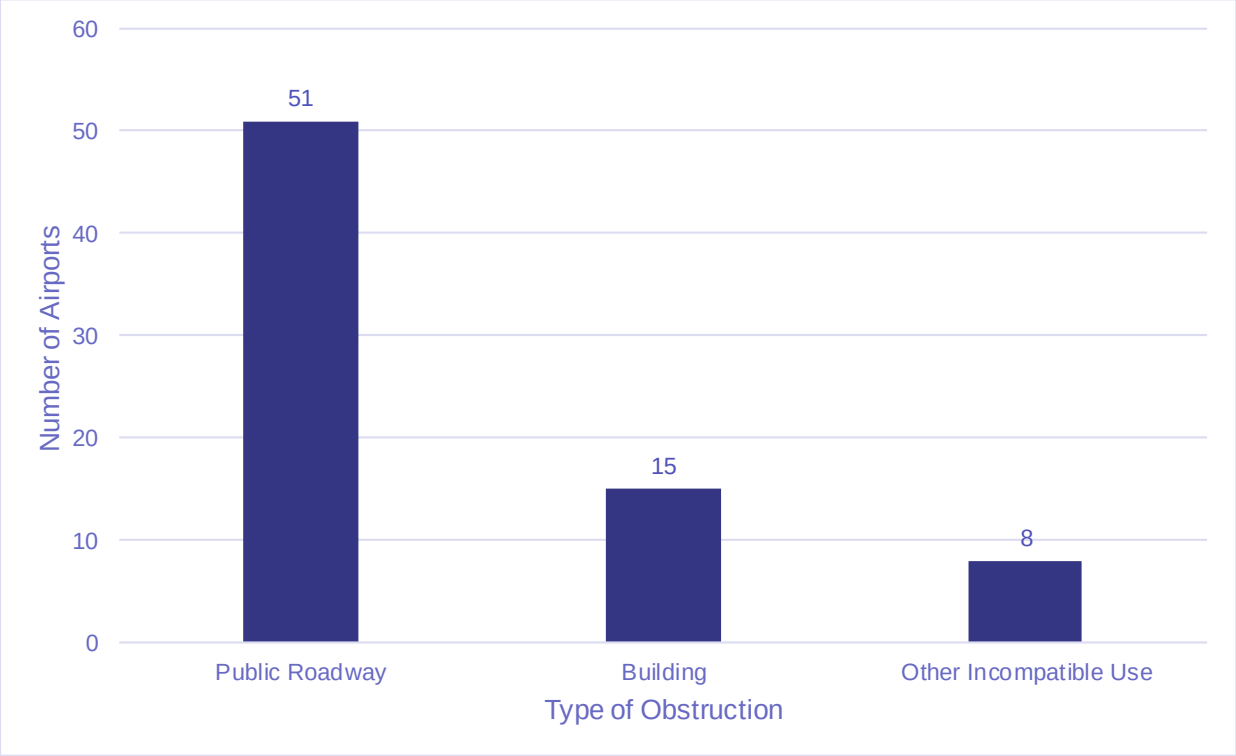
RPZs are trapezoidal areas located at either end of a runway and designed to accommodate the most demanding aircraft operating at each airport. RPZs are intended to minimize damage to people and property in the event of an aircraft overrun or undershoot.[4] According to FAA AC 150/5300-13A, Change 1, *Airport Design*, airports are recommended, if possible, to control the land within each RPZ. This

[4] FAA AC 150/5300-13A, Change 1, *Airport Design*. February 2014

gives airports the ability needed to maintain these critical safety areas clear of development and incompatible uses. Complete control over RPZs through fee simple ownership and avigation easements is not always possible for a variety of reasons. It is important to note that the FAA's guidance on RPZs has changed over time so land uses such as roadways, structures, and sometimes others that are now deemed incompatible (water bodies, residential developments, recreational facilities, etc.) were permitted based on prior guidance.

Figure A.7 shows the number of CASP airports that have public roadways, buildings, and/or an incompatible land use within their existing RPZs. The existence of one obstruction may not be exclusive of others (e.g., an airport that has a public roadway may also have a building in their RPZ) and therefore, a combination of obstructions may occur. Public roadways are the most common obstructions with 51 airports having some sort of public roadway in the RPZ. Fifteen airports were identified as having buildings, and eight had some other incompatible land use present.

Figure A.7. Evaluation of Incompatible Uses or Structures in RPZs



Sources: Google Earth; Kimley-Horn, 2019

As previously identified, 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 ensure new development or modifications of existing

development in RPZs conform with regulations and best practices when the following changes are made:[5]

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

New or proposed public roadways, structures, and land uses 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.

A.1.6. Close-In Obstructions

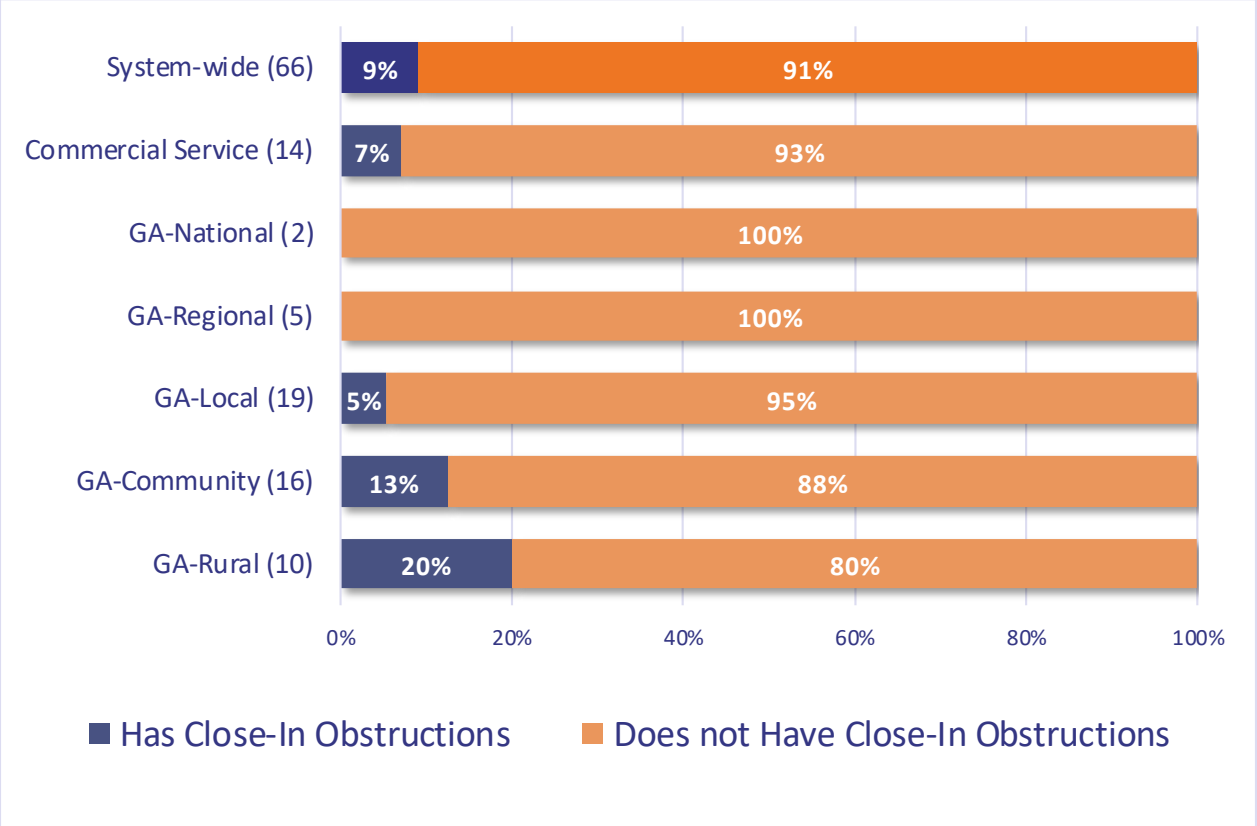
Data was gathered from each CASP airport's FAA Form 5010 Master Record to determine whether individual runway approaches were negatively impacted by incompatible land use. Obstacles existing within one nautical mile and less than 200 feet above the Departure End of Runway (DER) are considered "low, close-in obstructions." For pilots to safely clear these obstructions during take-off, the FAA recommends the following methods be followed:[6]

- Clear visibility of the obstruction to allow pilots to avoid and maneuver around the obstruction
- Perform early liftoff and ascent to safely clear the obstruction
- Note obstructions in the Takeoff Minimums and (Obstacle) Departure Procedures
- Consider turns or maneuvers during preflight planning to avoid the object if it is not visible during departure

For aircraft that liftoff close to the DER or climb at a minimum rate, it is critical to ensure that these additional rules are implemented to avoid impact. Additionally, it is also imperative to consider the close-in obstructions during Instrument Meteorological Conditions (IMC) where cloud ceiling and visibility can impact a pilot's ability to see and avoid the obstacle. **Figure A.8** shows the percentage of airports with close-in obstructions. Nine percent or six airports system-wide have a close-in obstruction. GA-National and GA-Regional airports do not have close-in obstructions affecting their airports. GA-Community and GA-Rural airports represent the classifications with the highest percentages of airports with close-in obstructions at 13 percent and 20 percent, respectively.

[5] FAA Memorandum Interim Guidance on Land Uses Within a Runway Protection Zone. September 2012.
[6] FAA-H-8038-16B *Instrument Procedures Handbook*. September 2017.

Figure A.8. Airports with Close-In Obstructions

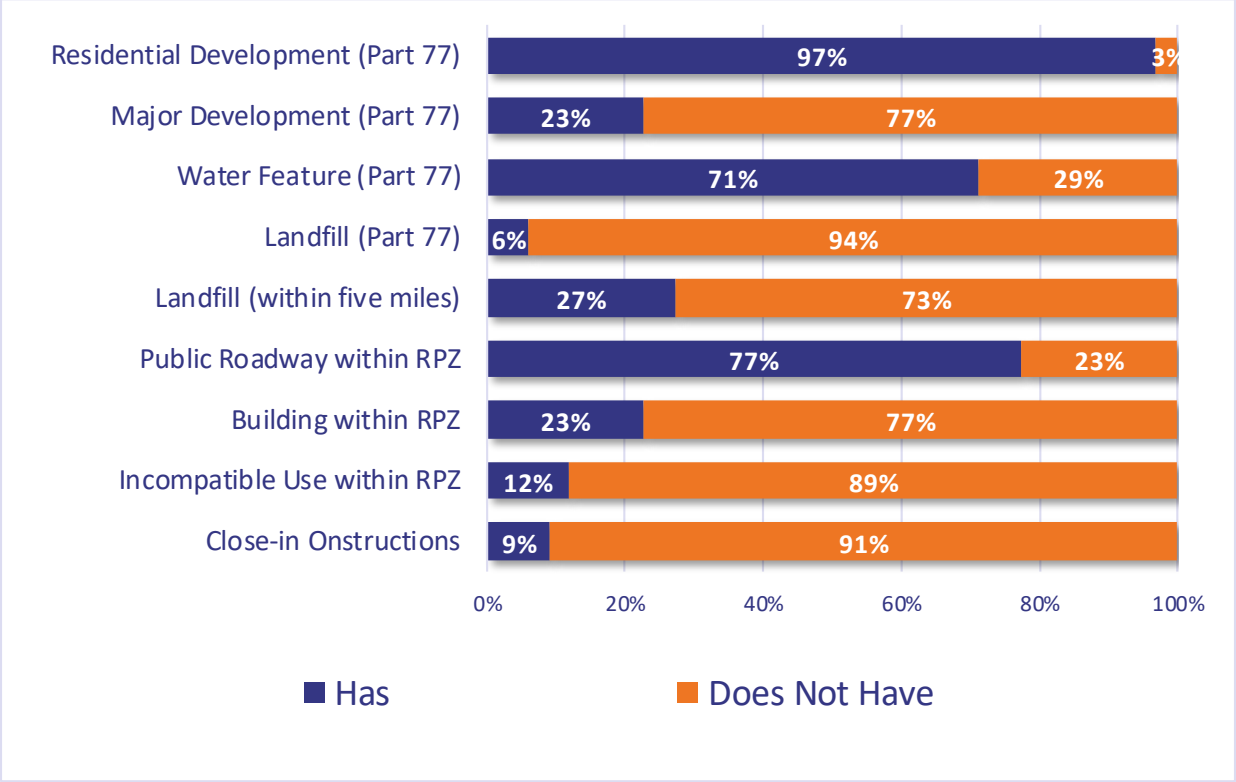


Source: FAA 5010 Master Record

A.2. Summary

This appendix identified various levels of incompatible uses which may negatively impact the safe and efficient operation of aircraft at CASP airports. Identification of incompatible land uses can lead to recommendations that airports can use to mitigate such occurrences in the future. All airports that indicated having land use controls (41) during the on-site visits were found to have some sort of incompatible land use present. **Figure A.9** summarizes the findings of the system-wide land use evaluation. **Table A.1** displays all the results of the land use evaluation for each airport. A check mark (✓) indicates that an incompatible land use was found during the land use evaluation.

Figure A.9. Land Use Evaluation Summary



Sources: Google Earth; 2018 Inventory & Data Form; FAA 5010 Master Record; Kimley-Horn, 2019

Table A.1. Summary of Airports' Land Use Evaluation

Associated City	Airport Name	FAA ID	Within Part 77				Landfill Within 5 Miles	Within RPZ			Close-in Obstructions
			Residential	Major Development	Water Feature	Landfill		Public Roadway	Building or Structure	Incompatible Land Use	
Commercial Service											
Alamosa	San Luis Valley Regional	ALS	✓	✓	✓			✓			
Aspen	Aspen-Pitkin County	ASE	✓	✓	✓		✓				✓
Colorado Springs	Colorado Springs Municipal	COS	✓	✓	✓			✓			
Cortez	Cortez Municipal	CEZ	✓				✓	✓			
Denver	Denver International	DEN	✓			✓	✓	✓			
Durango	Durango-La Plata County	DRO	✓	✓	✓						
Eagle	Eagle County Regional	EGE	✓		✓			✓			
Fort Collins/Loveland	Northern Colorado Regional	FNL	✓	✓	✓						
Grand Junction	Grand Junction Regional	GJT	✓	✓				✓		✓	
Gunnison	Gunnison-Crested Butte Regional	GUC	✓	✓	✓		✓	✓	✓	✓	
Hayden	Yampa Valley	HDN	✓	✓	✓			✓			
Montrose	Montrose Regional	MTJ	✓		✓		✓				
Pueblo	Pueblo Memorial	PUB	✓		✓			✓			
Telluride	Telluride Regional	TEX	✓		✓						
GA-National											
Denver	Centennial	APA	✓	✓	✓			✓	✓	✓	
Denver	Rocky Mountain Metropolitan	BJC	✓	✓	✓			✓		✓	
GA-Regional											
Colorado Springs	Meadow Lake	FLY	✓		✓			✓			
Denver	Front Range Airport/Colorado Air and Space Port	FTG					✓	✓			
Greeley	Greeley-Weld County	GXY	✓	✓	✓			✓			
Longmont	Vance Brand	LMO	✓	✓	✓			✓			
Rifle	Rifle Garfield County	RIL	✓		✓			✓			
GA-Local											
Boulder	Boulder Municipal	BDU	✓		✓			✓		✓	
Buena Vista	Central Colorado Regional	AEJ	✓		✓			✓			
Burlington	Kit Carson County	ITR	✓				✓				
Canon City	Fremont County	1V6	✓	✓	✓		✓				
Craig	Craig-Moffat	CAG	✓		✓		✓	✓		✓	
Del Norte	Astronaut Kent Rominger	RCV	✓					✓			
Delta	Blake Field	AJZ	✓		✓	✓	✓	✓			
Erie	Erie Municipal	EIK	✓		✓		✓	✓			
Fort Morgan	Fort Morgan Municipal	FMM	✓				✓	✓			

Associated City	Airport Name	FAA ID	Within Part 77				Landfill Within 5 Miles	Within RPZ			Close-in Obstructions
			Residential	Major Development	Water Feature	Landfill		Public Roadway	Building or Structure	Incompatible Land Use	
Glenwood Springs	Glenwood Springs Municipal	GWS	✓		✓			✓			✓
Kremmling	Mc Elroy Airfield	20V	✓		✓			✓	✓		
La Junta	La Junta Municipal	LHX	✓		✓			✓			
Lamar	Lamar Municipal	LAA	✓		✓			✓			
Limon	Limon Municipal	LIC	✓		✓			✓	✓	✓	
Pagosa Springs	Stevens Field	PSO	✓		✓			✓			
Salida	Harriet Alexander Field	ANK	✓		✓						
Steamboat Springs	Steamboat Springs	SBS	✓		✓			✓	✓		
Sterling	Sterling Municipal	STK	✓								
Walsenburg	Spanish Peaks Airfield	4V1						✓			
GA-Community											
Akron	Colorado Plains Regional	AKO	✓					✓	✓		
Creede	Mineral County Memorial	C24	✓		✓	✓	✓	✓			
Granby	Granby-Grand County	GNB	✓						✓	✓	
Holyoke	Holyoke	HEQ	✓					✓			
Las Animas	Las Animas-Bent County	7V9	✓		✓			✓			✓
Leadville	Lake County	LXV	✓		✓	✓	✓				
Meeker	Meeker/Coulter Field	EEO	✓	✓	✓						
Monte Vista	Monte Vista Municipal	MVI	✓					✓	✓		
Nucla	Hopkins Field	AIB	✓		✓						
Paonia	North Fork Valley	7V2	✓		✓			✓			✓
Rangely	Rangely	4V0	✓	✓	✓			✓			
Springfield	Springfield Municipal	8V7	✓					✓			
Trinidad	Perry Stokes	TAD	✓		✓			✓			
Westcliffe	Silver West	C08	✓		✓		✓	✓			
Wray	Wray Municipal	2V5	✓								
Yuma	Yuma Municipal	2V6	✓					✓	✓		
GA-Rural											
Blanca	Blanca	05V	✓		✓			✓	✓		
Brush	Brush Municipal	7V5	✓					✓	✓		✓
Center	Leach	1V8	✓						✓		
Eads	Eads Municipal	9V7	✓		✓		✓	✓	✓		
Haxtun	Haxtun Municipal	17V	✓					✓	✓		
Holly	Holly	K08	✓		✓		✓	✓			
Julesburg	Julesburg Municipal	7V8	✓		✓		✓	✓	✓		✓
La Veta	Cuchara Valley	07V	✓		✓			✓			

Associated City	Airport Name	FAA ID	Within Part 77				Landfill Within 5 Miles	Within RPZ			Close-in Obstructions
			Residential	Major Development	Water Feature	Landfill		Public Roadway	Building or Structure	Incompatible Land Use	
Saguache	Saguache Municipal	04V	✓		✓			✓			
Walden	Walden-Jackson County	33V	✓		✓			✓			
System-wide Totals			**64**	**15**	**47**	**4**	**18**	**51**	**15**	**8**	**6**