



FINAL
AIR INSTALLATION COMPATIBLE
USE ZONE (AICUZ) STUDY
at
Grissom Air Reserve Base,
Indiana



JULY 2014

ABBREVIATIONS AND ACRONYMS

434 ARW	434th Air Refueling Wing
AFI	Air Force Instruction
AICUZ	Air Installation Compatible Use Zone
APZ	Accident Potential Zone
ARB	Air Reserve Base
ARS	Air Refueling Squadron
CZ	Clear Zone
dBA	A-weighted decibel
DNL	Day-Night Average Sound Level
DOD	Department of Defense
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FICUN	Federal Interagency Committee on Urban Noise
FY	Fiscal Year
HUD	U.S. Department of Housing and Urban Development
IC	Indiana Code
JLUS	Joint Land Use Study
MOA	Military Operations Area
MSL	mean sea level
NLR	Noise Level Reduction
NM	nautical mile
SLUCM	Standard Land Use Coding Manual
USAF	U.S. Air Force
USAFR	U.S. Air Force Reserve
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency



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FOR GRISSOM AIR RESERVE BASE, INDIANA**

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1. INTRODUCTION

This document is an update to the Grissom Air Reserve Base (ARB) Air Installation Compatible Use Zone (AICUZ) Study completed in 1995. It presents a description of the current noise environment around Grissom ARB. It reaffirms the U.S. Air Force (USAF) policy of promoting public health, safety, and general welfare in areas in close proximity to USAF installations. This study identifies changes in flight operations that have occurred since the 1995 study, and provides current noise zones and compatible use guidelines for land areas adjacent to the installation. It is provided as a tool to assist local communities in future planning and zoning activities.

The changes requiring an updated AICUZ Study are attributed to the following:

1. Changes in assigned and transient aircraft operations and profiles since the 1995 AICUZ Study.
2. Modifications to the Department of Defense (DOD)-approved NOISEMAP software program (USAF 2011) made subsequent to the release of the 1995 AICUZ Study.

1.1 Purpose and Need

As stated in the 1995 AICUZ Study, the purpose of the AICUZ Program is to promote compatible land development in areas subject to aircraft noise and accident potential due to aircraft overflight operations. Military airfields and installations attract development to adjacent areas. The goal of the AICUZ Program is to protect the public's health, safety, and welfare and to protect military airfields from encroachment by incompatible uses and structures. Guidelines for compatible land uses are presented in **Section 3**. These guidelines should be considered in the various planning processes to prevent incompatibility that might compromise the ability of Grissom ARB to fulfill its mission requirements. Accident potential and aircraft noise in the vicinity of military airfields should be major considerations in all planning processes.

AICUZ land use guidelines reflect land use recommendations for Clear Zones (CZs), Accident Potential Zones (APZs) I and II, and four noise zones. A description of these zones is provided in **Sections 3.3** and **3.4**. These guidelines have been established on the basis of studies prepared and sponsored by several Federal agencies, including the U.S. Department of Housing and Urban Development (HUD), the U.S. Environmental Protection Agency (USEPA), the USAF, and state and local agencies. The guidelines recommend land uses that are compatible with airfield operations, as described in **Section 4**. The USAF has no desire to recommend land use regulations that render property economically useless. It does, however, have an obligation to the inhabitants of the Grissom ARB environs and to the citizens of the United States to identify ways to protect the people in adjacent areas and the public investment in Grissom ARB.



The primary mission of Grissom Air Reserve Base is to provide a combat ready force for combatant commanders in order to execute the taskings of the National Command Authority. To do this, the base supports and develops the 434th Air Refueling Wing's (434 ARW) 16 KC-135R Stratotanker unit-equipped aircraft and more than 2,300 personnel. The 434 ARW is the largest KC-135 unit in the Air Force Reserve Command and is accountable for manning, equipping, and training 17 subordinate units to provide combat-ready assets in support of conventional global air refueling operations and nuclear mission support of Operations



The AICUZ Program uses the latest technology to define noise levels in areas near USAF installations. An analysis of Grissom ARB's flying operations was performed, including specific details on types of aircraft, flight patterns used, variations in altitude, power settings, number of operations, and hours of operations. This information was used to develop the noise contours presented in this study. The DOD NOISEMAP methodology and the Day-Night Average Sound Level (DNL) noise metric were used to define the noise zones for Grissom ARB. A description of the DNL metric is provided in **Section 3.3** and **Appendix C**.

This AICUZ Study provides current noise zones and compatible land use guidelines for areas near the installation.

1.2 Process and Procedure

Preparation and presentation of this update to the Grissom ARB's AICUZ Study is part of the continuing USAF participation in the local planning process. It is recognized that, as local communities prepare land use plans and zoning ordinances, the USAF has the responsibility of providing input on its activities relating to the community. To support that responsibility, a companion document called a Citizen's Brochure was created for public dissemination of the information presented in this AICUZ Study. The Citizen's Brochure provides a synopsis of this AICUZ Study and offers the local community the opportunity to learn about the AICUZ Program. **Appendices A through D** of this AICUZ Study contain detailed information about the AICUZ Program.

This AICUZ Study was prepared using the guidelines established by the USAF and described in Air Force Instruction (AFI) 32-7063, *Air Installation Compatible Use Zone Program*, 13 September 2005 (USAF 2005) and Air Force Handbook 32-7084, *AICUZ Program Manager's Guide*, 1 March 1999 (USAF 1999). DOD Instruction 4165.57 describes the procedures by which the AICUZ Program can be defined, including the land use compatibility guidelines for the APZs (DODI 1977). In addition, height restrictions have been recommended so that potential airspace obstructions can be identified. **Section 3.2** provides information on height restrictions. AFI 32-7063 implemented the policies set forth in DOD Instruction 4165.57. Land use guidelines set forth in AFI 32-7063 reflect recommended land use classifications for those areas impacted by aircraft noise and potential aircraft safety concerns.

Data collection was conducted at Grissom ARB in December 2013. Aircraft operational and maintenance information was obtained to derive average annual operations by runway and type of aircraft. This information was supplemented by flight track data (where we fly), flight profile information (how we fly), and aircraft engine run-ups. After verification for accuracy, information was entered into the NOISEMAP program to produce DNL noise contours. These contours were plotted on a map of the airfield vicinity and overlaid with the CZ and APZ areas.



2. INSTALLATION DESCRIPTION

Grissom ARB is located in Miami and Cass counties in north-central Indiana. The installation is approximately 8 miles southwest of the city of Peru and 12 miles north of the city of Kokomo (see **Figure 2-1**). It is one of five Air Force Reserve Command bases in the nation. The 434th Air Refueling Wing (434 ARW) is the host unit at Grissom ARB. The primary mission of Grissom ARB is to provide a combat ready force for combatant commanders to execute the taskings of the National Command Authority. To do this, the base supports and develops the 434 ARW's 16 KC-135R Stratotanker unit-equipped aircraft and more than 2,300 personnel. The 434 ARW is the largest KC-135 unit in the Air Force Reserve Command and is accountable for manning, equipping, and training 17 subordinate units to provide combat-ready assets in support of conventional global air refueling operations and nuclear mission support of Operations Plan 8010.

The 434 ARW consists of three major organizations: the 434th Operations Group, the 434th Maintenance Group, and the 434th Mission Support Group. These organizations perform flight operations, aircraft maintenance, plans and programs, safety, airfield management, security police, communications, medical support, information management, administration, and civil engineering.

The 434th Operations Group flies the KC-135R Stratotanker aircraft. The operations group commander is responsible for all of the KC-135R operational matters within the wing. There are two flying units assigned to the 434 ARW: the 72nd Air Refueling Squadron (ARS) and the 74th ARS. These squadrons train and provide KC-135R aircrew members in support of the Air Mobility Command and its aerial refueling mission. The members of these squadrons operate throughout the United States and around the world to carry out the air refueling mission.

The 434th Maintenance Group is responsible for aircraft maintenance and support activities. These responsibilities include avionics, fabrication, systems, jet propulsion, inspection, logistics management, maintenance control, maintenance supply, plans and scheduling, resource management, and ground support equipment.

The 434th Mission Support Group is made up of a number of squadrons that provide support to the 434 ARW and the KC-135R aircraft. Units include the Aerospace Medicine Squadron, Civil Engineer Squadron, Communication Squadron, Logistics Readiness Squadron, Operational Contracting Flight, Security Forces Squadron, Services Flight, and Aerial Port Flight.

As shown in **Figure 2-2**, the airfield at Grissom ARB includes one runway (Runway 05/23), taxiways, multiple aircraft nose docks, and an air traffic control tower.



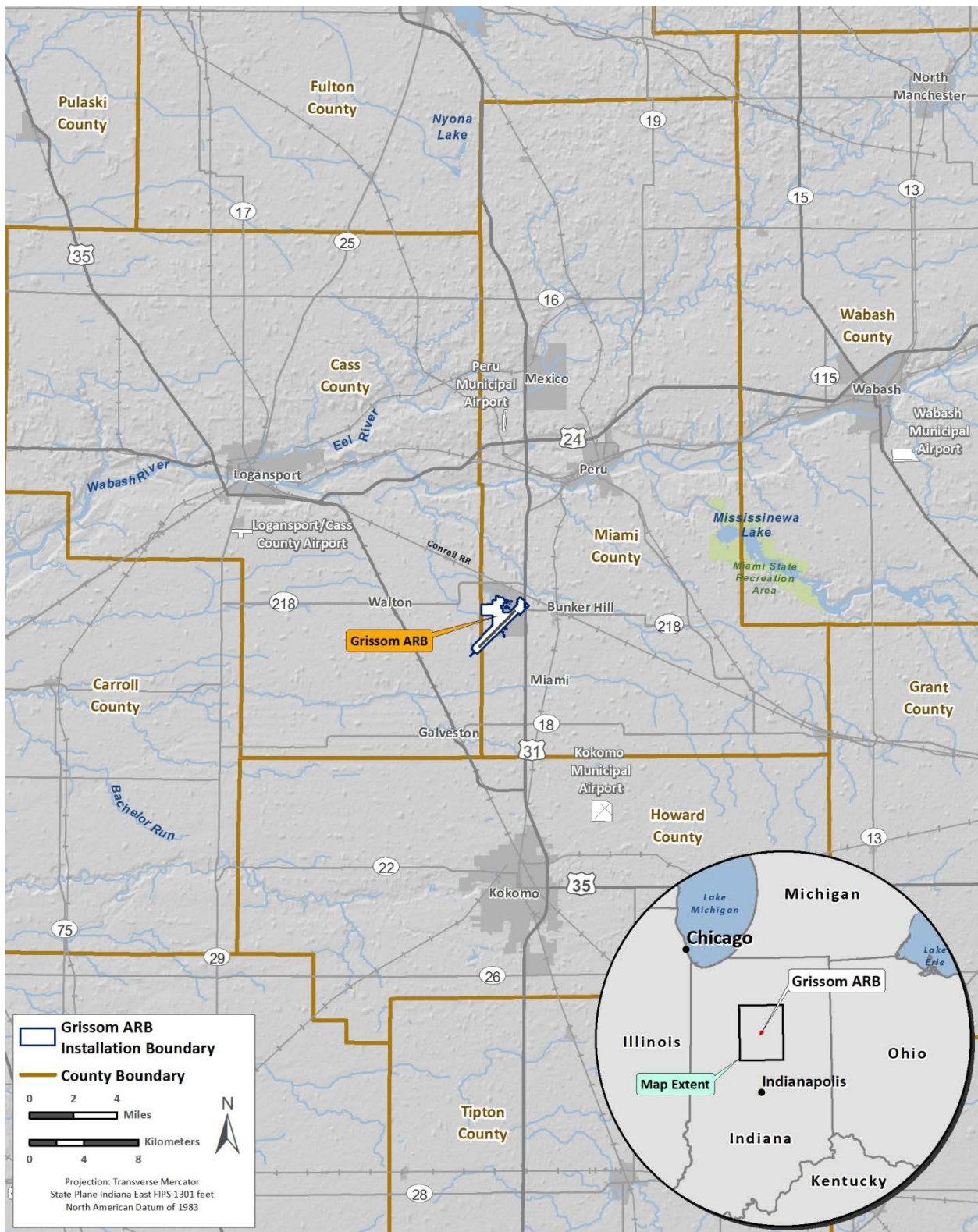
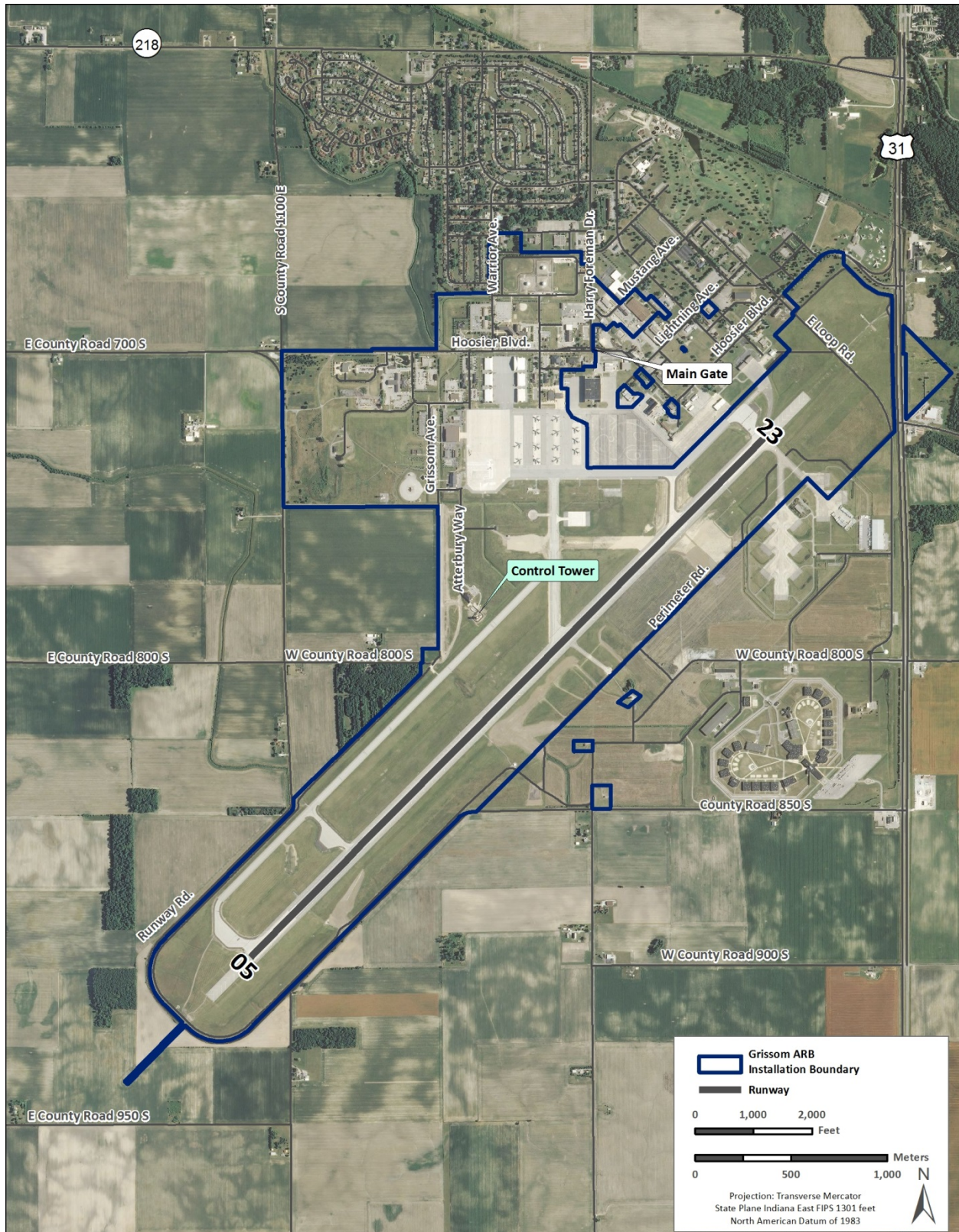


Figure 2-1. Grissom ARB Vicinity Map



Sources: ESRI Streetmap 2010, NAIP 2012 Imagery, and Grissom ARB.

Figure 2-2. Grissom ARB Installation Map



2.1 History

The U.S. Navy opened Grissom ARB on July 1, 1942, as Bunker Hill Naval Air Station. It served as a training base for Navy, Marine, and Coast Guard pilots. After World War II, the base was closed and was returned to farmland. On June 22, 1954, at the beginning of the Korean Conflict, the base was reopened by the USAF as Bunker Hill Air Force Base. It was under the direction of the Tactical Air Command and home to the 433rd Air Base Squadron and the 323rd Fighter-Bomber Wing.

In the mid-1950s, the Strategic Air Command arrived and assumed jurisdiction of the base on September 1, 1957. In May 1959, the 305th Bomb Group and its B-47 aircraft arrived. Later that same year, the first KC-135 Stratotankers were assigned to the base. Two years later, the B-58 bomber began to be replaced by the B-47 bomber.

On May 12, 1968, the base was renamed Grissom Air Force Base in honor of Lieutenant Colonel Virgil I. “Gus” Grissom, a native of Mitchell, Indiana. Lieutenant Colonel Grissom was one of the original seven astronauts and was killed during a fire in his Apollo 1 capsule at Cape Kennedy, Florida.

In January 1970, 305th ARW replaced the 305th Bomb Group, making the installation one of the largest tanker bases in the country. The Air Force Reserve became part of the installation in 1971 when the 434th Special Operations Wing and its A-37 aircraft relocated to Indiana. For the next 23 years, Grissom Air Force Base was home to both active-duty and reserve personnel. In 1978, a second Air Force Reserve unit (the 931st Air Refueling Group) was established at the installation. In September 1994, as part of the Base Realignment and Closure Act of 1991, the installation was realigned. In October of that year, Grissom Air Force Base was realigned as an Air Force Reserve Command facility. Today, the host unit at Grissom ARB is the 434 ARW.

While the USAF has the largest number of personnel at the base, it is also home to organizations from other branches of the military. The U.S. Army Reserve has been at the installation since the 1970s and a U.S. Marine Corps Reserve unit relocated to the base in 2001. In 2008, Grissom ARB entered into a joint-use agreement and opened its runway to civilian operations. As a result, the Grissom Aeroplex was established. Today, the Grissom Aeroplex is a Federal Aviation Administration (FAA) and Transportation Security Administration certified air carrier facility where Montgomery Aviation and Dean Baldwin Painting are located.

2.2 Economic Impact

The former Grissom Air Force Base property consisted of 2,722 acres. Today, Grissom ARB occupies approximately 1,387 acres. Part of the former installation property, about 870 acres, consists of the Grissom Aeroplex, which is managed by the Miami County Economic Development Authority.

The history of Grissom ARB is important to understand the fluctuations in the noise environment in the areas near the installation.



Grissom ARB is one of three public-use airports within Miami County, and one of the county's largest employers. There are several small communities (e.g., Galveston, Walton, Bunker Hill) in the vicinity of Grissom ARB; however, the greatest population density is to the south in the city of Kokomo. Kokomo had an estimated population of 54,402 in 2012 (U.S. Census Bureau 2012). The number of people employed by the 434 ARW is approximately 4 percent of the population of Kokomo.

Table 2-1 shows the factors that influenced 434 ARW's total economic impact on the surrounding area for Fiscal Year (FY) 2013. The economic impact includes the annual payroll for military and civilian personnel, the annual expenditures, and the estimated value of jobs created.

Table 2-1. 434 ARW's Economic Impact for FY 2013

Personnel Category	Number of Personnel and Economic Impact
Active-Duty and Traditional Reserve	1,600 +/-
DOD Civilian Employees	600 +/-
Civilian Contractors	100 +/-
Total Personnel	2,300 +/-
Annual Military and Civilian Payroll	\$70.9 M
Annual Expenditures (e.g., equipment, supplies, service contracts, minor construction)	\$23.8 M
Local Community Job Creation	\$23.3 M

Source: 434 ARW 2013

2.3 Flying Activity

To describe the relationship between aircraft operations and land use, it is necessary to understand fully the exact nature of flying activities. Information was collected at Grissom ARB that included where the aircraft fly, how high they fly, how many times they fly over a given area, and at what time of day they operate. An operation is defined as a single aircraft movement, such as an arrival or a departure. A closed pattern accounts for two operations, an arrival and a departure. Pilots commonly use closed patterns to practice takeoffs and landings, and closed patterns usually remain close to the airfield.

Section 3 presents a detailed description of APZs and current noise zones.

2.3.1 Airfield and Airspace Planning

Airfield environs planning is concerned with three primary aircraft operational/land use determinants: (1) hazards to operations from land uses (e.g., height obstructions), (2) aircraft noise, and (3) accident potential to land users. Each of these concerns is addressed in conjunction with mission requirements and safe aircraft operation to determine the optimum flight track for each aircraft type. Data supporting this AICUZ Study was provided according to flight track (i.e., where they fly), flight profile (i.e., how they



fly), flight occurrence (i.e., how often they fly), and ground run-up (i.e., engine maintenance activities).

2.3.1.1 Regional Airspace

As shown in **Figure 2-3**, controlled airspace has been established around Grissom ARB to manage air traffic. Class D airspace extends from the surface up to 3,300 feet above mean sea level (MSL) within a 5.6-nautical mile (NM) radius around the installation. Class D airspace is designed to provide control into and out of primary airports that have an operational control tower and radar approach capabilities, and where aircraft operations are periodically at high-density levels.

There are two Military Operations Areas (MOAs) shown in **Figure 2-3**. A MOA is a special use airspace designated for military training activities. MOAs consist of airspace with defined vertical and lateral limits established for the purpose of separating nonparticipating aircraft from certain military training activities. The Twelve East MOA is northwest of Grissom ARB and extends from 500 feet above ground level to 9,999 feet above MSL. The Hill Top MOA is above and west of the airfield and extends from 10,000 to 18,000 feet above MSL. Based and transient military aircraft that fly in and out of Grissom ARB periodically train in these MOAs.

2.3.1.2 Grissom ARB Airfield

Runway Use. The airfield at Grissom ARB includes one runway (Runway 05/23). The runway is oriented in a northeast/southwest direction. Runway 05/23 is 12,500 feet (3,810 meters) long and 200 feet (61 meters) wide. Aircraft operating at Grissom ARB use Runway 05 approximately 25 percent of the time and Runway 23 approximately 75 percent of the time.

Flight Patterns. The flight patterns in **Figures 2-4**, **2-5**, and **2-6** represent the way aircraft arrive, depart, and perform training and closed-pattern operations at Grissom ARB. As shown in **Figures 2-4** and **2-5**, aircraft arrive to and depart from Runway 05/23 from numerous directions; however, the majority of the time they fly to the west and the southwest. Some of the flight tracks represent pattern work that is completed at the airfield, usually by transient C-17 and C-5 aircraft. These aircraft complete training patterns such as low straight-ins and teardrops that are modeled as arrivals. The teardrop flight tracks start north or south of the airfield and head perpendicular towards the runway before the aircraft circle to the runway end. As shown in **Figure 2-6**, closed-pattern flight tracks are flown to the north and south of the airfield. Most of the time, approximately 70 percent, closed patterns are flown to the north of the airfield; therefore, approximately 30 percent of the time they are flown to the south. Flight tracks were designed to minimize conflict with civilian populations to the greatest extent possible. As a result, aircraft generally avoid the more densely populated areas, such as the city of Kokomo to the south.

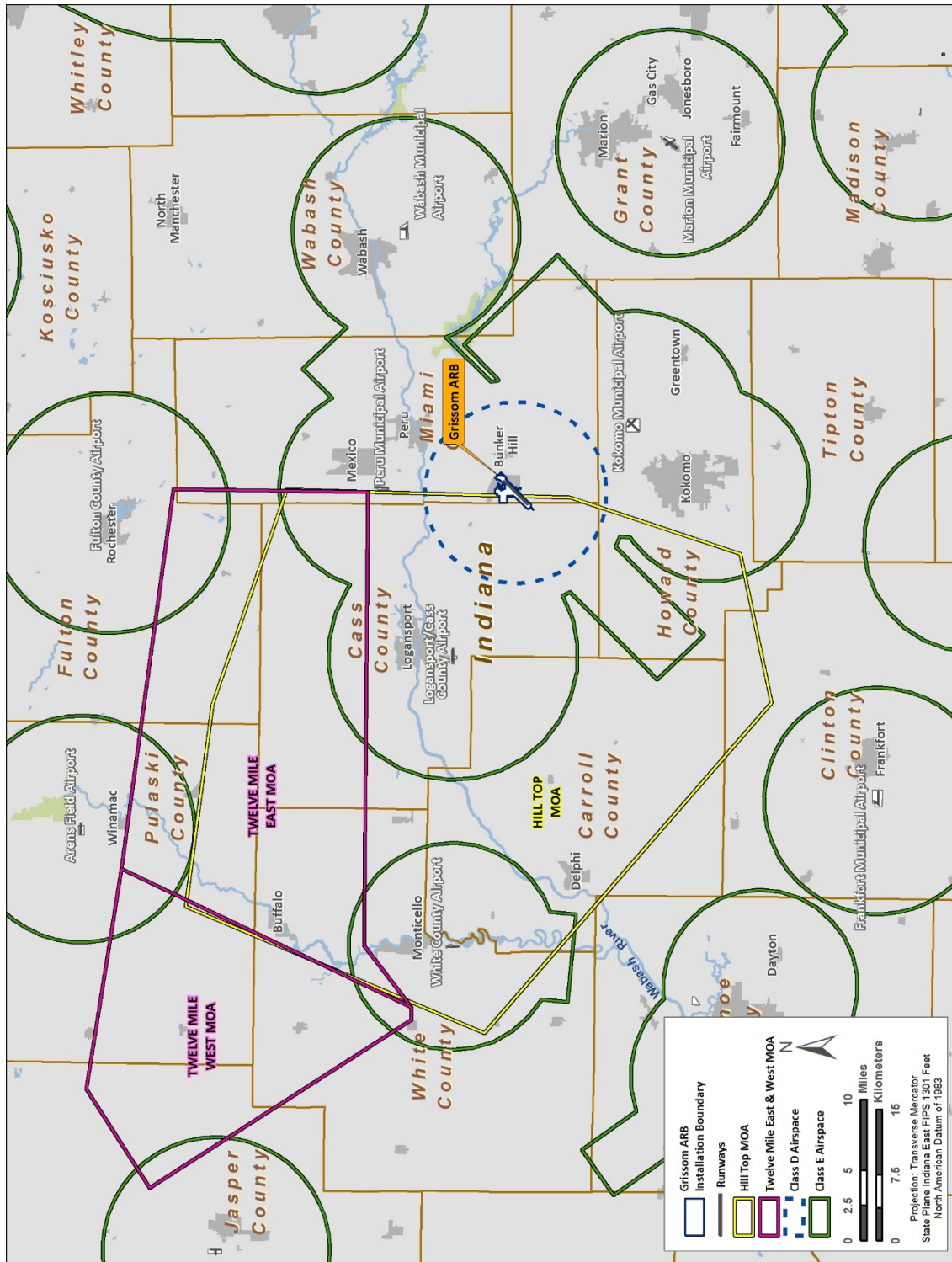
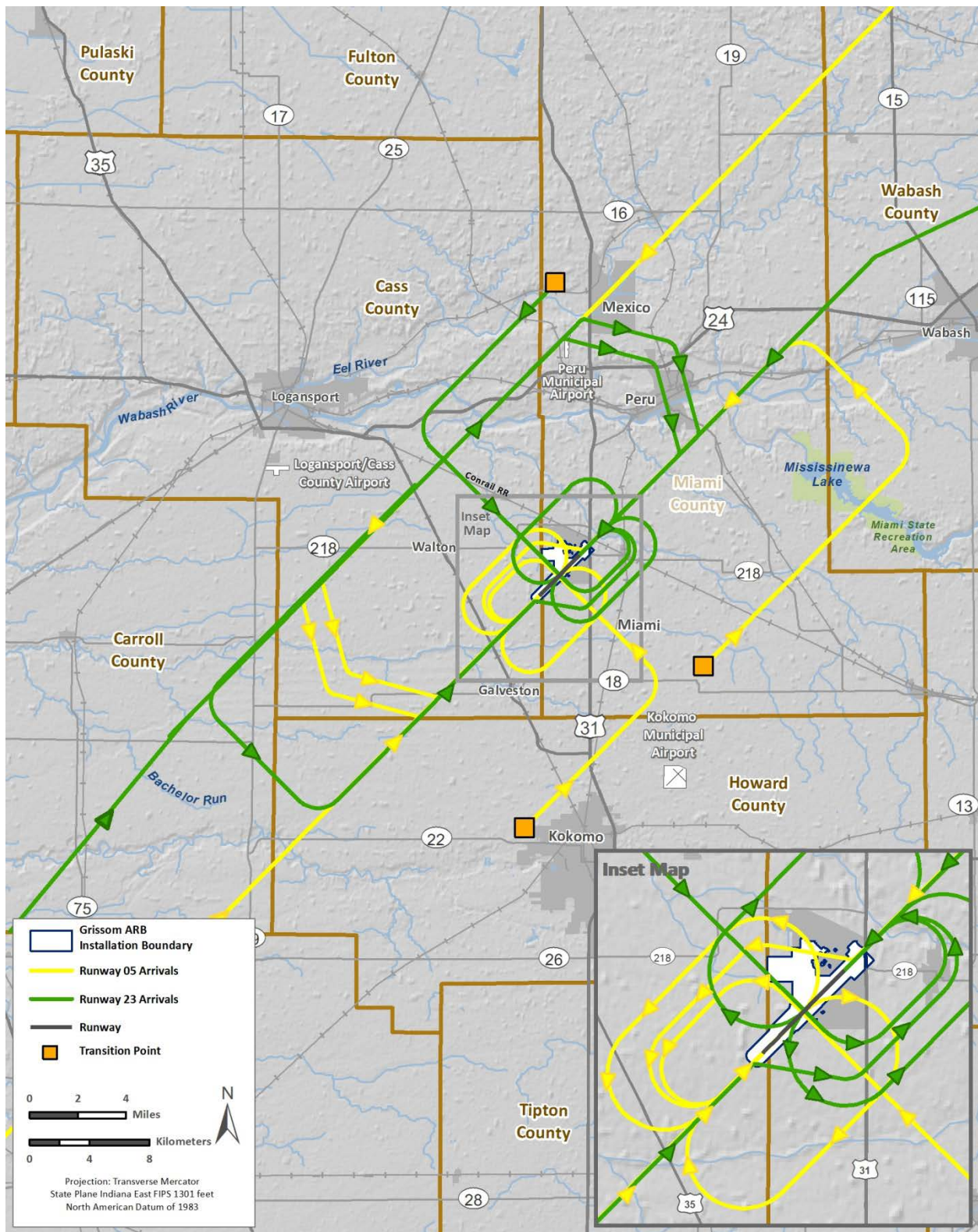
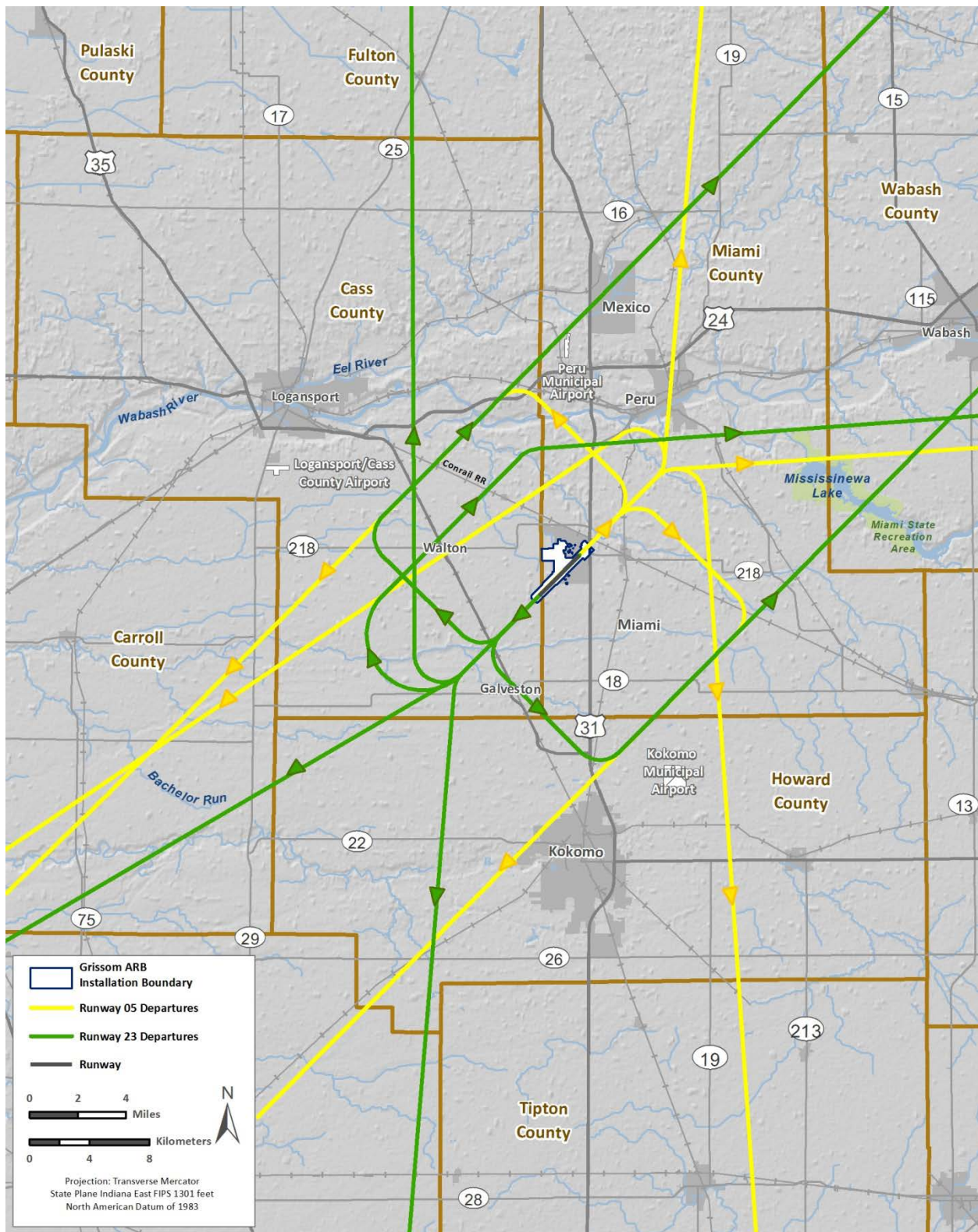


Figure 2-3. Controlled Airspace in the Vicinity of Grissom ARB



Source: ESRI Streetmap 2010

Figure 2-4. Arrival Flight Tracks



Source: ESRI Streetmap 2010

Figure 2-5. Departure Flight Tracks

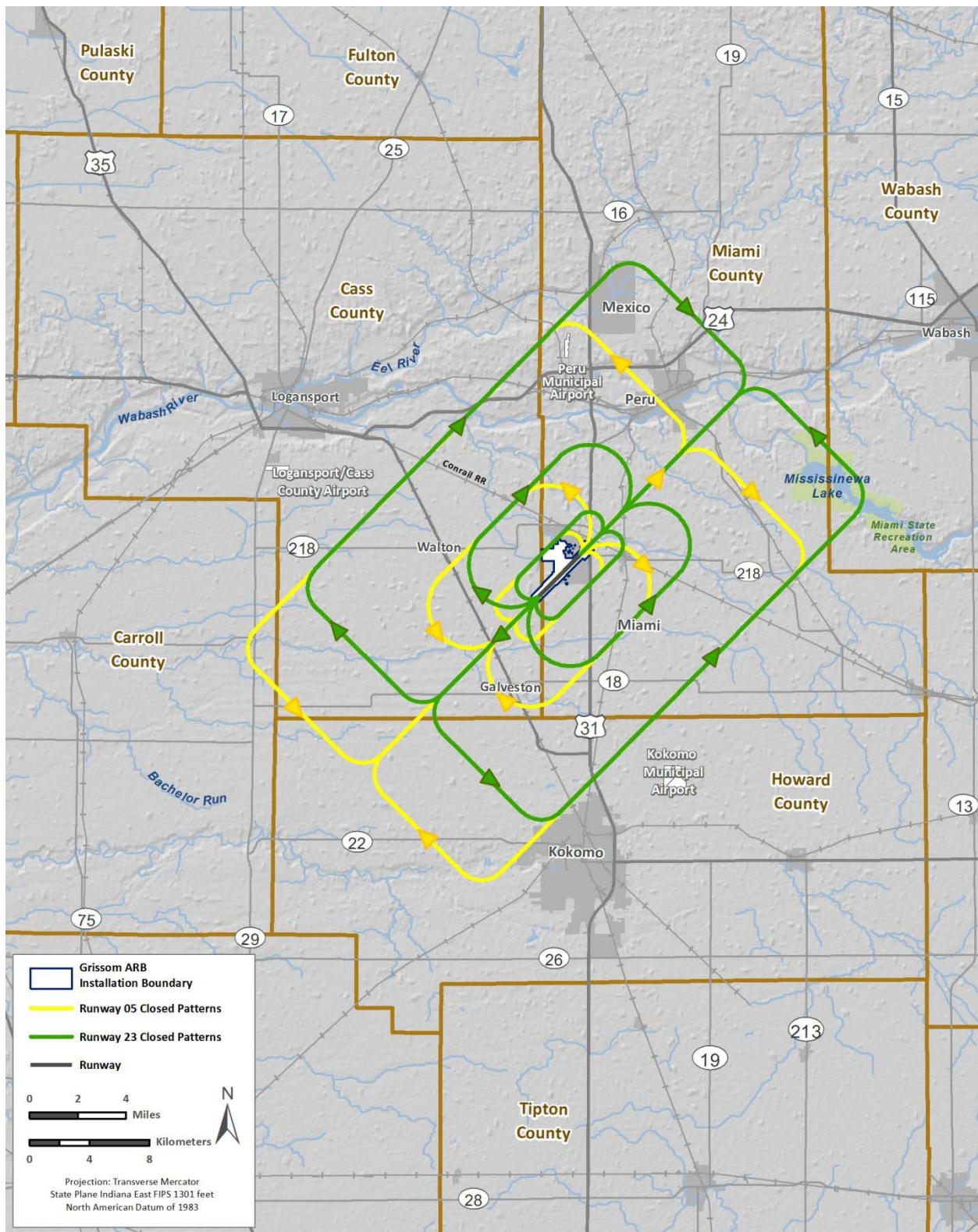


Figure 2-6. Closed-Pattern Flight Tracks



Maintenance Engine Run-ups. Maintenance engine run-ups are performed on based aircraft at Grissom ARB. These run-ups are normally performed at the parking apron on the north side of the airfield and are conducted during the day (between 7 a.m. and 10 p.m.). Idle engine runs, ground/flight idle engine runs, and high-power engine runs are performed on the based aircraft.

2.3.2 Grissom ARB Aircraft Operations

Flying activities at Grissom ARB have been grouped into three general categories: 434 ARW, transient operations, and civilian operations. The U.S. Marine Corps Reserves and U.S. Army Reserves are tenant units at Grissom ARB; however, neither organization has aircraft based at the installation. Flight track and profile information was collected in 2013.

2.3.2.1 434th Air Refueling Wing Aircraft Operations

The 434 ARW has 16 assigned KC-135R aircraft, 8 with the 72nd ARS and 8 with the 74th ARS. As shown on **Table 2-2**, the 72nd and 74th ARS conduct approximately 15 operations per day. Aircraft operations were divided by 365 days per year to obtain annual operations as recommended by USAF policy. Approximately 85 percent of these operations complete training patterns at the airfield for about 30 to 45 minutes. Day operations occur from 7:00 a.m. to 10:00 p.m. and night operations occur from 10:00 p.m. to 7:00 a.m. Approximately 68 percent of the 434 ARW aircraft operations occur during the day; therefore, approximately 32 percent occur at night.



The KC-135R primarily provides mid-air refueling to long-range bomber, fighter, and cargo aircraft for U.S. Air Force, U.S. Navy, U.S. Marine Corps, and allied nations. It is also capable of transporting litter and ambulatory patients during aeromedical evacuations.

Table 2-2. Average Daily Based Aircraft Operations

Based KC-135R Aircraft Operations	
Type of Operation	Daily Operations
Arrivals	2.95
Departures	2.95
Closed Patterns	4.38
Total Operations	14.66

Total daily operations = arrivals + departures + (2 x closed patterns).

2.3.2.2 Military Transient Aircraft

Over the course of a year, numerous military transient aircraft arrive and depart from Grissom ARB. Multiple types of transient military aircraft operate from the airfield in the given time period, some of which include A-10, C-130, C-17, C-5, and F-18 aircraft; and CH-46 and UH-60 helicopters.

Military transient aircraft complete approximately six operations per day at Grissom ARB in an average year (see **Table 2-3**). A small percentage of these operations include closed patterns, some of which are completed by A-10 and F-18 aircraft. C-17 and C-5 aircraft complete training patterns


Table 2-3. Average Daily Military Transient Aircraft Operations

Military Transient Aircraft Operations	
Type of Operation	Daily Operations
Arrivals	2.77
Departures	2.77
Closed Patterns	0.27
Total Operations	6.08

Total daily operations = arrivals + departures + (2 x closed patterns).

such as low straight-ins and teardrops that are modeled as arrivals. Approximately 79 percent of these operations occur during daytime hours (i.e., 7:00 a.m. to 10:00 p.m.); therefore, approximately 21 percent occur during nighttime hours (i.e., 10:00 p.m. to 7:00 a.m.).

2.3.2.3 Civilian Aircraft

Montgomery Aviation has approximately 11 aircraft based at their facility and has room for up to 4 more aircraft. The facility hosts regular events several times a year. These events can have as many as 75 aircraft on site; however, most of these aircraft are small and can include ultra-lights and experimental crafts. Representative general aviation aircraft include the Beech King Air 200, Cessna Citation Jet, and the Cessna 172 aircraft.

There are no aircraft permanently based at the Dean Baldwin Painting facility. Currently, three to four planes are in the process of being repainted at any one time; however, this facility can house up to six planes at one time. Aircraft that typically rotate through the facility include the Boeing 777, Boeing 767, Boeing 737, Embraer 145, and the Canadian Regional Jet 200.

The number of civilian aircraft operations that fly in and out of Grissom ARB on an average daily basis is shown in **Table 2-4**. The majority of these operations occur with general aviation aircraft. Civilian aircraft do not complete closed-pattern operations. Approximately 98 percent of these operations occur during daytime hours (i.e., 7:00 a.m. to 10:00 p.m.); therefore, 2 percent occur during nighttime hours (i.e., 10:00 p.m. to 7:00 a.m.).

Table 2-4. Average Daily Civilian Aircraft Operations

Civilian Aircraft Operations	
Type of Operation	Daily Operations
Arrivals	6.325
Departures	6.325
Total Operations	12.65



2.3.2.4 Total Operations at Grissom ARB

The estimated number of annual operations at Grissom ARB is shown in **Table 2-5**. These numbers have been rounded and are approximate. The based KC-135Rs complete approximately 5,350 operations, military transient aircraft complete 2,219 operations, and civilian aircraft complete 4,617 operations, for a total of 12,186 operations in an average year. All of the daily operations were calculated using 365 flying days per year, as recommended by USAF policy.

Table 2-5. Total Annual Aircraft Operations at Grissom ARB

	Daily Operations	Annual Operations
Based KC-135R Aircraft	14.66	5,350
Military Transient	6.08	2,219
Civilian Operations	12.65	4,617
Total Aircraft Operations		12,186



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3. LAND USE COMPATIBILITY GUIDELINES

3.1 Introduction

The DOD developed the AICUZ Program for military airfields. Using this program, DOD works to protect aircraft operational capabilities at its installations and to assist local government officials in protecting and promoting the public health, safety, and quality of life. The goal is to promote compatible land use development around military airfields by providing information on aircraft noise exposure and accident potential.

An AICUZ Study describes three basic types of constraints that affect, or result from, flight operations. As discussed in **Section 3.2**, the first constraint involves areas that the FAA and DOD have identified for height limitations (see Height Obstruction Criteria in **Appendix D**). USAF obstruction criteria are based upon those contained in Federal Aviation Regulation (FAR) Part 77, Subpart C, *Objects Affecting Navigable Airspace* (U.S. Code 1965). These obstruction criteria are defined for all military airfields regardless of the current flying mission. The height restrictions are to prevent man-made structures from creating an obstruction that could prevent aircraft from accessing airports or pose an accident hazard. Aircraft approach and depart from airports on a diagonal line that gets farther from the ground as distance from the airport increases. The height obstruction criteria reflect this principle, and permit the placement of taller structures as the distance from the airport increases.

Airfield planning is concerned with three primary constraints:

1. Height obstructions
2. Aircraft noise
3. Accident potential.

The second constraint involves noise zones associated with aircraft operations. As discussed in **Section 3.3**, using the NOISEMAP program, noise contour lines are produced depicting the noise exposure levels generated by Grissom ARB aircraft operations. Noise contours are used as the basis for making land use and zoning decisions at the local level.

The third constraint involves military APZs, which are based on statistical analyses of past DOD aircraft accidents. As discussed in **Section 3.4**, DOD analyses have determined that the areas immediately beyond the ends of runways and along the approach and departure flight paths have significant potential for aircraft accidents. Based on these analyses, DOD developed three zones that have high relative potential for accidents: CZs and APZs I and II.

3.2 Areas Identified for Height Restrictions

Areas identified for height restrictions result from the application of criteria for height and obstruction clearance given in FAR Part 77 and in USAF design standards. FAR Part 77 applies to all DOD military facilities in the United States. FAR Part 77.13 stipulates that modifications to existing facilities and construction of new facilities must consider navigable airspace, and could require that a Notice of Proposed Construction or Alteration be filed with the FAA (DOD 2008). Such a filing is required for any structure



that extends 200 feet above the surface of the ground and is within 10 NM of an airfield. The FAA's height obstruction criteria are outlined in FAA Advisory Circular 150/5300-13, which classifies an obstruction to air navigation as an object of greater height than any of the heights or surfaces presented in FAR Part 77.

The standards in FAR Part 77.28, which is specifically for military airfields, states that the area around a runway must be kept clear of objects that might damage an aircraft and therefore the area is bounded by imaginary airspace control surfaces that are defined in detail in **Appendix D**. The purpose of these imaginary airspace control surfaces is to provide a planning tool to depict airspace management concepts graphically in a way that can enhance the safety and efficiency of aircraft operations. These regulations can prevent the construction of structures whose height could compromise the ability of aircraft to land safely, particularly in adverse weather conditions or during military training operations.

Although the FAA sets airspace heights, the FAA does not have the authority to control the height of structures under the imaginary airspace control surfaces. Therefore, to protect the health, safety, and welfare of populations around airfields, the local communities must enforce the obstruction height restriction guidelines established by the FAA. The local communities around DOD airfields should regulate the land areas outlined by these criteria to prevent uses that might otherwise be hazardous to aircraft operations.

3.3 Noise Zones

Cumulative noise levels, resulting from multiple single events, are used to characterize effects from aircraft operations. The cumulative noise metric, DNL, is expressed in A-weighted decibels (dBA) and presented in the form of noise contours. The DNL metric in this study was calculated using the computerized noise model, NOISEMAP. This noise metric incorporates a "penalty" for nighttime noise events to account for increased annoyance. DNL is the energy-averaged sound level measured over a 24-hour period, with a 10-dBA penalty assigned to noise events occurring between 10:00 p.m. and 7:00 a.m. DNL values are obtained by averaging sound exposure level values over a given 24-hour period.

The DNL noise metric incorporates a penalty for nighttime (10 p.m. to 7 a.m.) noise events to account for increased annoyance.

DNL is a time-averaged noise metric, which takes into account both the noise levels of individual events that occur during a 24-hour period and the number of times those events occur. The logarithmic nature of the decibel unit results in the noise levels of the loudest events controlling the 24-hour average. For an example of this characteristic using an aircraft flyover, consider a case in which one flyover occurs during daytime hours creating a sound level of 100 dBA for 1 second. The DNL for this 24-hour period would be 50.6 dBA. If there were 30 flyovers at 100 dBA for 1 second each, the DNL for this 24-hour period would be 65.5 dBA. The averaging of noise over a 24-hour period does not ignore the louder single events. This is the basic concept of a time-averaged sound metric, and specifically the DNL.



The actual sound levels that a person hears fluctuate throughout the 24-hour period. DNL is the designated noise metric of the FAA, HUD, USEPA, U.S. Department of Transportation (USDOT), and the DOD for determining land use compatibility in the airport environment.

The USAF has adopted the DOD-approved NOISEMAP software program, and uses it in predicting noise exposure that would result from aircraft operations in the vicinity of an airfield. Using the NOISEMAP program (Version 7.358), the DOD produced noise contours showing the noise exposure levels generated by current Grissom ARB aircraft operations. NOISEMAP visually creates continuous contours that connect all points of the same noise exposure level, in much the same way as ground contours on a topographic map visually represent lines of equal elevation. These noise contours are drawn in 5 dBA DNL increments from the airfield, ranging from 65 dBA DNL up to 80 dBA DNL, and are overlaid on a map of the airport vicinity. The area encompassed by two noise contours is known as a noise zone. This updated AICUZ Study contains guidelines for compatible land uses in relation to four DNL noise zones, listed as follows:

- 65–69 dBA DNL
- 70–74 dBA DNL
- 75–79 dBA DNL
- 80+ dBA DNL.

DNL noise levels are depicted visually as noise contours that connect points of equal value. The area encompassed by two noise contours is known as a noise zone.

3.3.1 Understanding the Historical Noise Environment

The 1995 and 2014 AICUZ noise contours associated with Grissom ARB were plotted on an aerial map and are shown in **Figure 3-1** to illustrate how noise exposure has fluctuated over time from varying aircraft-related factors (i.e., aircraft type, number of operations, performance, flight track). Noise contours were developed for the 2014 AICUZ Study to reflect the changes in flight operations, assigned aircraft types, and the estimated transient operations since the original AICUZ Study in 1995. The 65 dBA DNL noise contours depicting the 1995 and 2014 aircraft operations were plotted on an aerial map and are shown in **Figure 3-1**. The 65 dBA DNL is considered the level where land use planning recommendations begin. As shown, the noise contours extend a similar distance from the airfield to the east and west. The 1995 noise contour extends farther to the southwest than the 2014 noise contour. The noise contours are larger to the southwest because the majority of operations occur on Runway 23 (departing to and arriving from the southwest). Since 1995, there has been a reduction in the number of aircraft assigned to the 434 ARW, and a corresponding reduction in the number of based aircraft operations (Grissom ARB 1995). Grissom ARB has also seen the introduction of civilian aircraft businesses and, consequently, an increase in civilian operations. Civilian aircraft are generally quieter than military aircraft.

The 1995 and 2014 noise contours are shown to demonstrate that noise zones are not static, but are dependent on aircraft type, number, performance, and flight path.

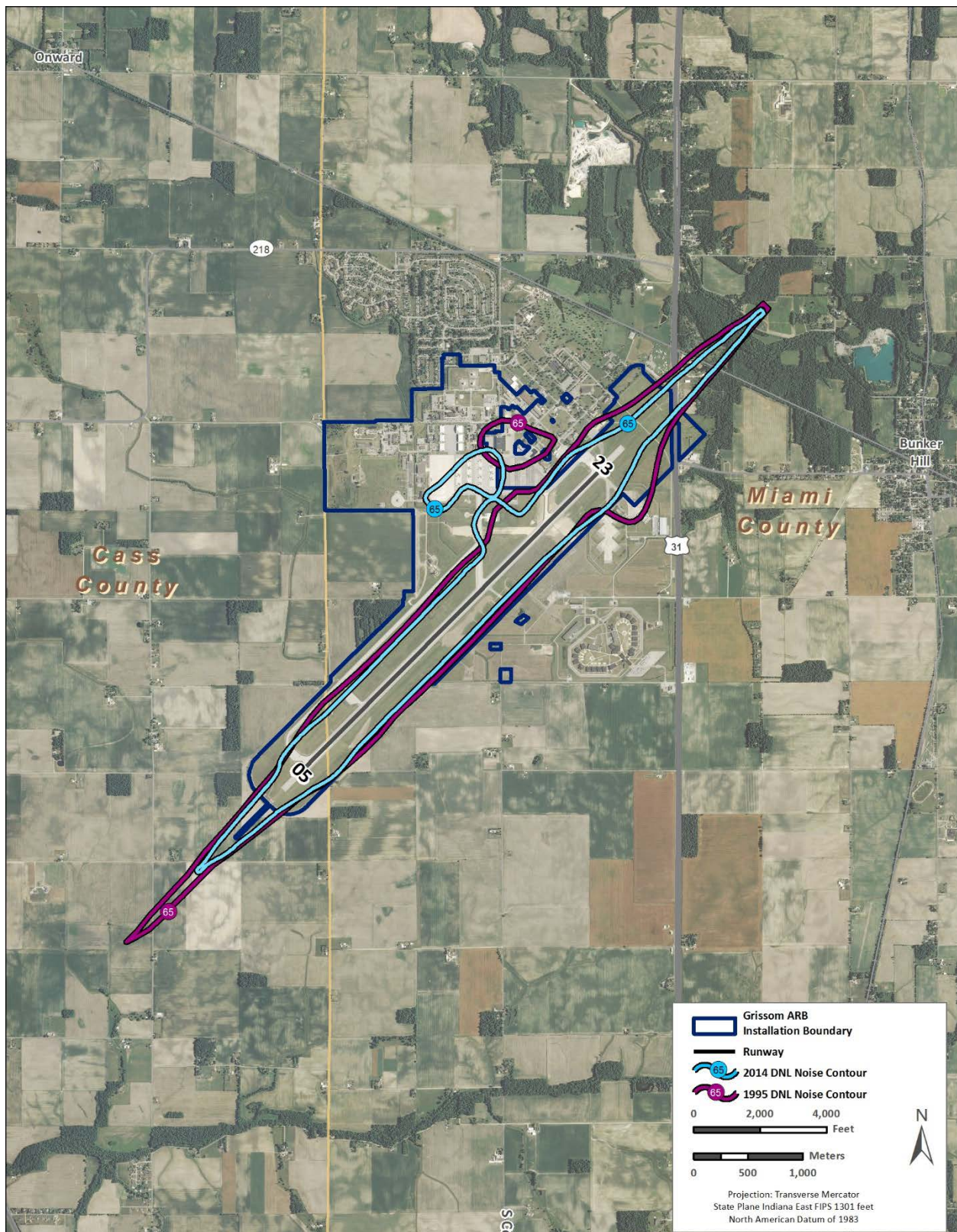


Figure 3-1. Comparison of 65 DNL Noise Contours at Grissom ARB (1995 and 2014)



The noise contour bubbles on the north side of the installation are the result of aircraft maintenance activities. The maintenance engine run-ups, including high power runs, are performed at the parking apron on the north side of the airfield.

3.3.2 2014 Noise Zones

As shown on **Figure 3-2**, the 2014 DNL noise zones extend along the runway centerline to the northeast and southwest. As expected, the noise zones follow the same general path as the flight tracks that are shown in **Figures 2-4** through **2-6**. The 2014 DNL noise zones encompass land outside of the installation in both Miami and Cass counties. Noise zones greater than 70 DNL are generally within the installation's boundary. A small number of residences to the northeast and southwest of Grissom ARB are within the 65–69 dB DNL noise zone. Agricultural land surrounding Grissom ARB is also within the 65–69 dB DNL.

3.4 Accident Potential Zones

Runway 05/23 Accident Potential Zones. DOD analyses have determined that the areas immediately beyond the ends of military runways and along the approach and departure flight paths have significant potential for aircraft accidents (see **Appendix B**). Based on these analyses, DOD has defined three levels of relatively high accident potential: the Clear Zone (CZ), Accident Potential Zone (APZ) I and APZ II. CZs and APZs are not predictors of accidents; rather they are areas where an accident is most likely to occur if one occurs.

The CZ, the area closest to the runway end, is potentially the most hazardous. The overall risk is high enough that the DOD generally acquires the land through purchase in fee or acquiring restrictive easements to prevent development. The CZ is 3,000 feet wide and 3,000 feet long from the end of the runway. As shown on **Figure 3-3**, the majority of the eastern CZ is within the Grissom ARB boundary; however, the majority of the western CZ is outside of the installation's boundary in Cass County.

APZ I is an area beyond the CZ that has significant potential for accidents. APZ I is 3,000 feet wide and extends 5,000 feet from the CZ. APZ II is an area beyond APZ I with a lesser, but still significant, potential for accidents. APZ II is 3,000 feet wide and extends 7,000 feet from APZ I. While aircraft accident potential in APZs I and II does not warrant acquisition by the USAF, land use planning and controls are strongly encouraged in these areas for the protection of the public. As shown on **Figure 3-3**, a few residences are scattered throughout the APZs in Miami and Cass counties.

3.5 Land Use Compatibility Guidelines

This AICUZ Study contains general land use guidelines related to safety and noise associated with aircraft operations. **Table 3-1** lists the USAF land use



compatibility guidelines in relation to noise zones and APZs. The information presented in the table is adapted from the June 1980 publication by the Federal Interagency Committee on Urban Noise (FICUN) entitled *Guidelines for Considering Noise in Land Use Planning Control* (FICUN 1980). The USDOT publication *Standard Land Use Coding Manual* (SLUCM) has been used for identifying and coding land use activities in the compatibility table (USDOT 1965). Some of the land use guidelines require the user to reference additional information that is included in the Legend and Notes section at the end of the table. For example, in SLUCM row No. 11.11, Single units/detached, Y¹ (in APZ II) means land use and related structures are compatible without restriction at a suggested maximum density of one to two dwelling units per acre, possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent. However, if single units/detached are proposed or located in APZ II and within the 75 dBA DNL noise zone or higher, this land use should be prohibited because the land use and related structures are not compatible in the 75 dBA DNL noise zone or higher.

3.6 Relationship between Noise and Annoyance Levels

Ambient noise levels in residential areas vary depending on the housing density and location. The noise level in a quiet suburban residential area in the daytime is about 50 dBA DNL, which increases to 60 dBA DNL in an urban residential area, and to 80 dBA DNL in a downtown area of a major city during the daytime (USEPA 1974). Studies of community annoyance in response to transportation noise (e.g., aircraft, street/expressway, and railroad) show that DNL correlates well with human annoyance. Most people are exposed to sound levels of 50 to 55 dBA DNL or higher on a daily basis.

Table 3-2 presents the percentage range of people projected to be “highly annoyed” when exposed to various levels of noise measured in DNL. This table presents the results of more than a dozen studies of the relationship between noise and annoyance levels. The data shown provide a perspective on the level of annoyance that might be anticipated and show that as noise levels increase, so does the percentage of people highly annoyed. For example, 12 to 22 percent of persons exposed on a long-term basis to 65–69 dBA DNL are expected to be highly annoyed by noise events.

3.7 Participation in the Planning Process

As local communities prepare their land use plans, the USAF must be ready to provide additional data and information. At Grissom ARB, the 434 ARW Public Affairs Office should be contacted regarding planning matters as they might affect, or be affected by, activities at Grissom ARB. The Public Affairs Office will send out news releases and participate in public hearings about the AICUZ Program, and educate local communities and their officials about it.

Please visit
<http://www.grissom.afrc.af.mil>
for information on how to
contact personnel at the
installation.

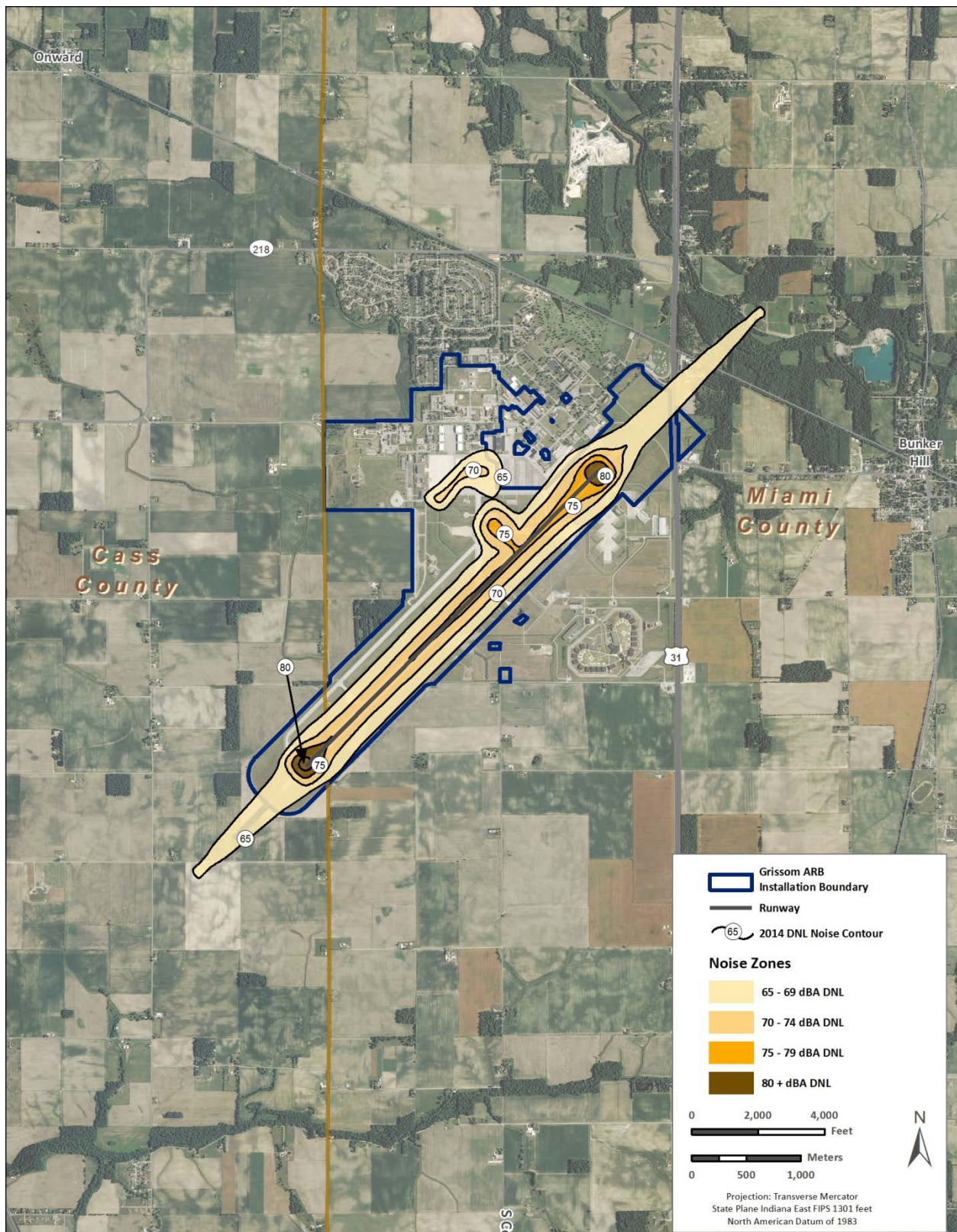


Figure 3-2. 2014 DNL Noise Zones at Grissom ARB

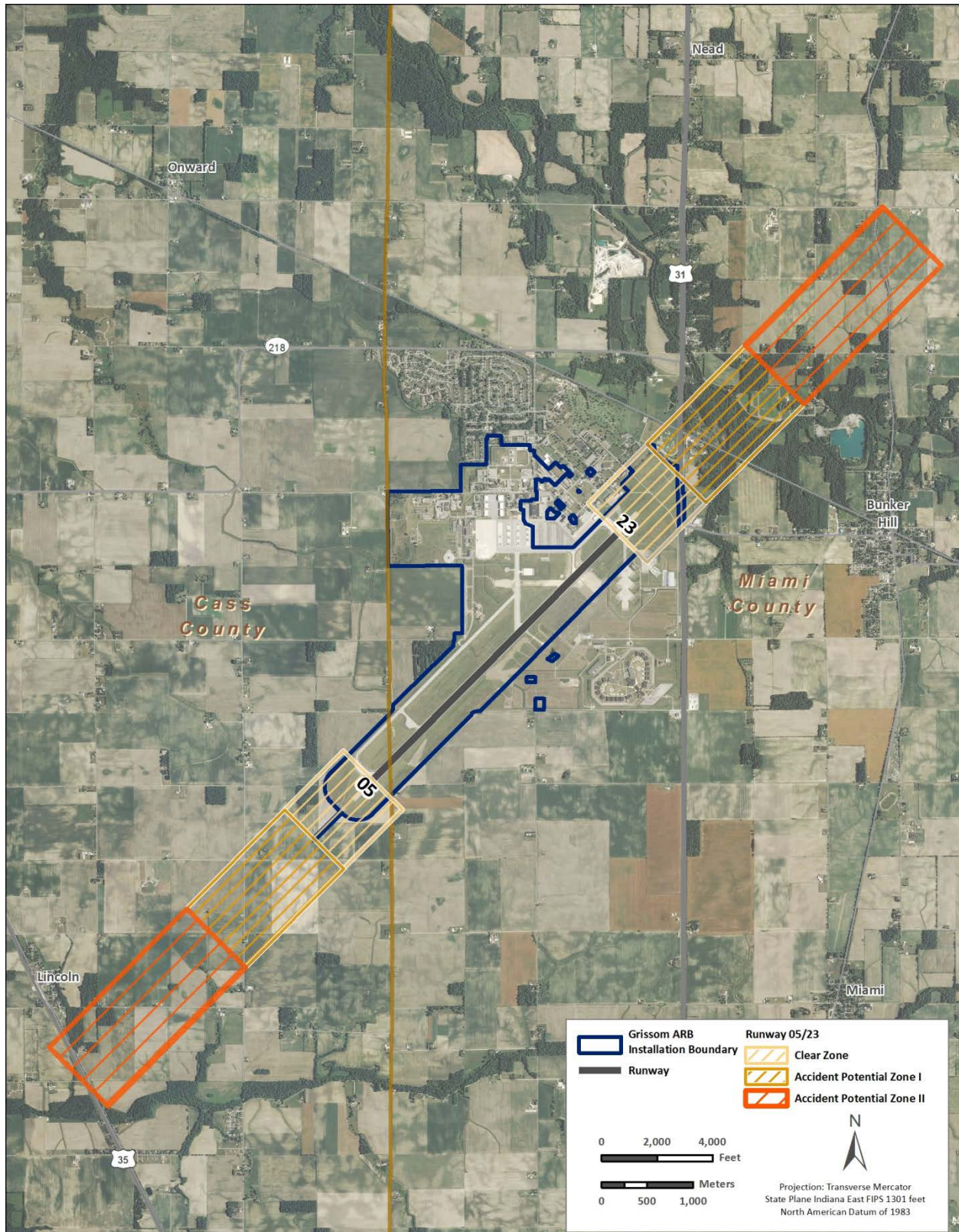


Figure 3-3. Clear Zones and Accident Potential Zones at Grissom ARB



Table 3-1. USAF Land Use Compatibility Guidelines

Land Use		APZs			DNL Noise Zones			
SLUCM No.	Name	CZ	APZ I	APZ II	65–69 dBA	70–74 dBA	75–79 dBA	80+ dBA
10	Residential							
11	Household units							
11.11	Single units: detached	N	N	Y ¹	A ¹¹	B ¹¹	N	N
11.12	Single units: semidetached	N	N	N	A ¹¹	B ¹¹	N	N
11.13	Single units: attached row	N	N	N	A ¹¹	B ¹¹	N	N
11.21	Two units: side-by-side	N	N	N	A ¹¹	B ¹¹	N	N
11.22	Two units: one above the other	N	N	N	A ¹¹	B ¹¹	N	N
11.31	Apartments: walk-up	N	N	N	A ¹¹	B ¹¹	N	N
11.32	Apartments: elevator	N	N	N	A ¹¹	B ¹¹	N	N
12	Group quarters	N	N	N	A ¹¹	B ¹¹	N	N
13	Residential hotels	N	N	N	A ¹¹	B ¹¹	N	N
14	Mobile home parks or courts	N	N	N	N	N	N	N
15	Transient lodgings	N	N	N	A ¹¹	B ¹¹	C ¹¹	N
16	Other residential	N	N	N ¹	A ¹¹	B ¹¹	N	N
20-30	Manufacturing							
21	Food and kindred products: manufacturing	N	N ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
22	Textile mill products: manufacturing	N	N ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
23	Apparel and other finished products made from fabrics, leather, and similar materials: manufacturing	N	N	N ²	Y	Y ¹²	Y ¹³	Y ¹⁴
24	Lumber and wood products (except furniture): manufacturing	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
25	Furniture and fixtures: manufacturing	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
26	Paper and allied products: manufacturing	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
27	Printing, publishing, and allied industries	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
28	Chemicals and allied products: manufacturing	N	N	N ²	Y	Y ¹²	Y ¹³	Y ¹⁴
29	Petroleum refining and related industries	N	N	N	Y	Y ¹²	Y ¹³	Y ¹⁴
31	Rubber and misc. plastic products: manufacturing	N	N ²	N ²	Y	Y ¹²	Y ¹³	Y ¹⁴
32	Stone, clay, and glass products manufacturing	N	N ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
33	Primary metal industries	N	N ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
34	Fabricated metal products: manufacturing	N	N ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴



Land Use		APZs			DNL Noise Zones			
SLUCM No.	Name	CZ	APZ I	APZ II	65–69 dBA	70–74 dBA	75–79 dBA	80+ dBA
20-30	Manufacturing (continued)							
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks: manufacturing	N	N	N ²	Y	A	B	N
39	Miscellaneous manufacturing	N	Y ²	Y ²	Y	Y ¹²	Y ¹³	Y ¹⁴
40	Transportation, communications, and utilities							
41	Railroad, rapid rail transit, and street railroad transportation	N ³	Y ⁴	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
42	Motor vehicle transportation	N ³	Y	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
43	Aircraft transportation	N ³	Y ⁴	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
44	Marine craft transportation	N ³	Y ⁴	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
45	Highway and street right-of-way	N ³	Y	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
46	Automobile parking	N ³	Y ⁴	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
47	Communications	N ³	Y ⁴	Y	Y	A ¹⁵	B ¹⁵	N
48	Utilities	N ³	Y ⁴	Y	Y	Y	Y ¹²	Y ¹³
49	Other transportation communications and utilities	N ³	Y ⁴	Y	Y	A ¹⁵	B ¹⁵	N
50	Trade							
51	Wholesale trade	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
52	Retail trade: building materials, hardware, and farm equipment	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
53	Retail trade: general merchandise	N	N ²	Y ²	Y	A	B	N
54	Retail trade: food	N	N ²	Y ²	Y	A	B	N
55	Retail trade: automotive, marine craft, aircraft, and accessories	N	Y ²	Y ²	Y	A	B	N
56	Retail trade: apparel and accessories	N	N ²	Y ²	Y	A	B	N
57	Retail trade: furniture, home furnishings, and equipment	N	N ²	Y ²	Y	A	B	N
58	Retail trade: eating and drinking establishments	N	N	N ²	Y	A	B	N
59	Other retail trade	N	N ²	Y ²	Y	A	B	N
60	Services							
61	Finance, insurance, and real estate services	N	N	Y ⁶	Y	A	B	N
62	Personal services	N	N	Y ⁶	Y	A	B	N
62.4	Cemeteries	N	Y ⁷	Y ⁷	Y	Y ¹²	Y ¹³	Y ^{14,21}
63	Business services	N	Y ⁸	Y ⁸	Y	A	B	N
64	Repair services	N	Y ²	Y	Y	Y ¹²	Y ¹³	Y ¹⁴
65	Professional services	N	N	Y ⁶	Y	A	B	N
65.1	Hospitals, nursing homes	N	N	N	A*	B*	N	N
65.1	Other medical facilities	N	N	N	Y	A	B	N



Land Use		APZs			DNL Noise Zones			
SLUCM No.	Name	CZ	APZ I	APZ II	65–69 dBA	70–74 dBA	75–79 dBA	80+ dBA
50	Services (continued)							
66	Contract construction services	N	Y ⁶	Y	Y	A	B	N
67	Governmental services	N	N	Y ⁶	Y*	A*	B*	N
68	Educational services	N	N	N	A*	B*	N	N
69	Miscellaneous services	N	N ²	Y ²	Y	A	B	N
70	Cultural, entertainment, and recreational services							
71	Cultural activities (including churches)	N	N	N ²	A*	B*	N	N
71.2	Nature exhibits	N	Y ²	Y	Y*	N	N	N
72	Public assembly	N	N	N	Y	N	N	N
72.1	Auditoriums, concert halls	N	N	N	A	B	N	N
72.11	Outdoor music shell, amphitheaters	N	N	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	N	N	N	Y ¹⁷	Y ¹⁷	N	N
73	Amusements	N	N	Y ⁸	Y	Y	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y ^{8,9,10}	Y	Y*	A*	B*	N
75	Resorts and group camps	N	N	N	Y*	Y*	N	N
76	Parks	N	Y ⁸	Y ⁸	Y*	Y*	N	N
79	Other cultural, entertainment, and recreational activities	N	Y ⁹	Y ⁹	Y*	Y*	N	N
80	Resources production and extraction							
81	Agriculture (except livestock)	Y ¹⁶	Y	Y	Y ¹⁸	Y ¹⁹	Y ²⁰	Y ^{20,21}
81.5 to 81.7	Livestock farming and animal breeding	N	Y	Y	Y ¹⁸	Y ¹⁹	Y ²⁰	Y ^{20,21}
82	Agriculture-related activities	N	Y ⁵	Y	Y ¹⁸	Y ¹⁹	N	N
83	Commercial forestry activities and related services	N ⁵	Y	Y	Y ¹⁸	Y ¹⁹	Y ²⁰	Y ^{20,21}
84	Commercial fishing activities and related services	N ⁵	Y ⁵	Y	Y	Y	Y	Y
85	Mining activities and related services	N	Y ⁵	Y	Y	Y	Y	Y
89	Other resources production and extraction	N	Y ⁵	Y	Y	Y	Y	Y

Sources: DODI 1977, FICUN 1980, and USDOT 1965

Legend:

SLUCM = Standard Land Use Coding Manual, USURA.

Y = Yes – Land uses and related structures are compatible without restriction.

N = No – Land use and related structures are not compatible and should be prohibited.

Y* = Yes with restrictions – Land use and related structures generally compatible; see notes indicated by the superscript.

N* = No with exceptions – See notes indicated by the superscript.

NLR = Noise Level Reduction (NLR) (outdoor to indoor) to be achieved through incorporation of noise attenuation measures into the design and construction of the structures.



Legend: (continued)

A, B, or C = Land use and related structures generally compatible; measures to achieve NLR for A (65–69 dBA DNL), B (70–74 dBA DNL), and C (75–79 dBA DNL) need to be incorporated into the design and construction of structures.

A*, B*, and C* = Land use generally compatible with NLR; however, measures to achieve an overall noise level reduction do not necessarily solve noise difficulties and additional evaluation is warranted. See appropriate notes below.

* = The designation of these uses as “compatible” in this zone reflects individual Federal agencies and program considerations of general cost and feasibility factors, past community experiences, and program objectives. Localities, when evaluating the application of these guidelines to specific situations, might have different concerns or goals to consider.

Notes:

1. Suggested maximum density of one to two dwelling units per acre, possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent.
2. Within each land use category, uses exist where further deliberating by local authorities might be needed due to the variation of densities in people and structures. Shopping malls and shopping centers are considered incompatible use in any accident potential zone (CZ, APZ I, or APZ II).
3. The placement of structures, buildings, or aboveground utility lines in the CZ is subject to severe restrictions. In a majority of the CZs, these items are prohibited. See AFI 32-7063, *Air Installation Compatible Use Zone Program* (USAF 2005), and United Facilities Criteria 3-260-1, *Airfield and Heliport Planning Criteria* (DOD 2008), for specific guidance.
4. No passenger terminals and no major aboveground transmission lines in APZ I.
5. Factors to be considered: labor intensity, structural coverage, explosive characteristics, and air pollution.
6. Low-intensity office uses only. Meeting places, auditoriums, and the like are not recommended.
7. Excludes chapels.
8. Facilities must be low-intensity.
9. Clubhouse not recommended.
10. Areas for gatherings of people are not recommended.
11. (a) Although local conditions might require residential use, it is discouraged within the 65–69 dBA DNL noise zone and strongly discouraged within the 70–74 dBA DNL noise zone. The absence of viable alternative development options should be determined and an evaluation should be conducted prior to approvals indicating a demonstrated community need for residential use would not be met if development were prohibited in these zones.
(b) Where the community determines the residential uses must be allowed, measures to achieve outdoor to indoor NLR for the 65–69 dBA DNL noise zone and the 70–74 dBA DNL noise zone should be incorporated into building codes and considered in individual approvals.
(c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, and design and use of berms and barriers can help mitigate outdoor exposure, particularly from near ground-level sources. Measures that reduce outdoor noise should be used whenever practical in preference to measures that only protect interior spaces.
12. Measures to achieve the same NLR as required for facilities within the 65–69 dBA DNL noise zone must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
13. Measures to achieve the same NLR as required for facilities within the 70–74 dBA DNL noise zone must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
14. Measures to achieve the same NLR as required for facilities within the 75–79 dBA DNL noise zone must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
15. If noise-sensitive, use indicated NLR; if not, the use is compatible.
16. No buildings.
17. Land use is compatible provided special sound reinforcement systems are installed.
18. Residential buildings require the same NLR as required for facilities within the 65–69 dBA DNL noise zone.
19. Residential buildings require the same NLR as required for facilities within the 70–74 dBA DNL noise zone.
20. Residential buildings are not permitted.
21. Land use is not recommended. If the community decides the use is necessary, personnel should wear hearing protection devices.



Table 3-2. Percentage of Population Highly Annoyed by DNL Noise Zones

DNL Noise Zones	Percentage Range of Persons Highly Annoyed	
	<i>Low</i>	<i>High</i>
65–69 dBA	12	22
70–74 dBA	22	36
75–79 dBA	36	54
80+ dBA	> 54	

Source: Finegold et al. 1994



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4. LAND USE ANALYSIS

4.1 Introduction

Land use planning and control is a dynamic, rather than static, process. The specific characteristics of land use determinants will always reflect, to some degree, the changing conditions of the economic, social, and physical environment of a community; and changing public concerns. The planning process accommodates this fluidity in that decisions are normally not based on boundary lines, but rather on more generalized area designations.

Computer models and geographic information systems technology enables Grissom ARB to display its flight tracks and noise zones more precisely for land use planning purposes. This same technology allows the installation a means to communicate the extent to which Grissom ARB's flight operation impacts extend into Miami and Cass counties, the town of Bunker Hill, and the cities of Peru and Kokomo. For the purposes of this study, existing land uses within the 2014 DNL noise zones and APZs have been classified into the following categories:

- **Commercial:** Offices, retail, restaurants, businesses, and other types of commercial activity.
- **Industrial:** Areas and the facilities they contain that are owned or used for industrial purposes, such as manufacturing, mining, warehousing, and other similar uses.
- **Open-Space/Low-Density:** Undeveloped land areas, forested land, agricultural land, grazing areas, water or wetland areas, and areas with residential activity at densities less than or equal to one dwelling per acre.
- **Public/Semi-Public:** Publicly owned lands or lands to which the public has access, such as public buildings, schools, churches, cemeteries, hospitals, or institutional facilities.
- **Recreational:** Land areas designated for recreational activity, including local parks; wilderness areas and reservations; conservation areas; and areas designated for trails, hikes, camping, and other similar uses.
- **Residential:** All types of residential activity, such as single and multifamily residences and mobile homes, at a density greater than one dwelling unit per acre.
- **Grissom ARB:** Land within the current Grissom ARB installation boundary.

Research on aircraft accident potential, noise, and land use compatibility is ongoing at a number of Federal and other agencies. The results of these studies and other compatibility guidelines must not be considered inflexible standards. They are the framework within which land use compatibility questions can be addressed and resolved.

4.2 Existing Land Use

The predominant land use surrounding Grissom ARB is agriculture, with the exception of local towns and cities and portions of the U.S. Highway 31



corridor. Land uses in the local communities, including Peru, Walton, Galveston, Bunker Hill, and Logansport; and the unincorporated communities of Lincoln, Onward, and Nead; consist primarily of low-density residential, along with some commercial and industrial property.

Noise Zones. The majority of land within the 2014 DNL noise zones (approximately 86 percent) consists of installation property. As shown in **Table 4-1** and **Figure 4-1**, only the 65–69 dBA DNL noise zone encompasses off-installation land. This land consists primarily of open-space/agricultural/low-density property (70 acres). There are 12 acres of industrial land north of the installation and 6 acres of commercial property to the northeast. There is no off-installation property within the 70–80+ DNL noise zones.

Table 4-1. Existing Off-Installation Land Use Acreage within the 2014 DNL Noise Zones

DNL Noise Zone	Land Use Category	Acres
65–69 dBA	Commercial	6
	Industrial	12
	Open-Space/Agricultural/Low-Density	70
	Transportation/Right-of-Way	10
	<i>Subtotal</i>	98
70–74 dBA	Off-Installation	0
75–79 dBA	Off-Installation	0
80+ dBA	Off-Installation	0
Total		98

Accident Potential Zones. The majority of land in the northern CZ is within the installation boundary (approximately 169 acres). Approximately 2 acres of commercial and 23 acres of industrial property are present to the northeast of the installation (see **Table 4-2**). The majority of off-installation land in APZ I consists of open-space/agricultural/low-density property. There are 17 acres of residential land north of Pipe Creek; 11 acres of commercial and 1 acre of industrial land adjacent to U.S. Highway 31. Similar to APZ I, land within the northern APZ II consists mostly of open-space/agricultural/low-density property; however, there are 36 acres of residential land in the southern region of the APZ.

About 75 acres of land in the southern CZ are within the installation boundary. The off-installation land in the CZ consists of open-space/agricultural/low-density and transportation property. Off-installation land within APZ I includes 6 acres of scattered residential property and open-space/ agricultural/low-density and transportation use. Off-installation land within APZ II includes 21 acres of residential and open-space/agricultural/low-density and transportation property.

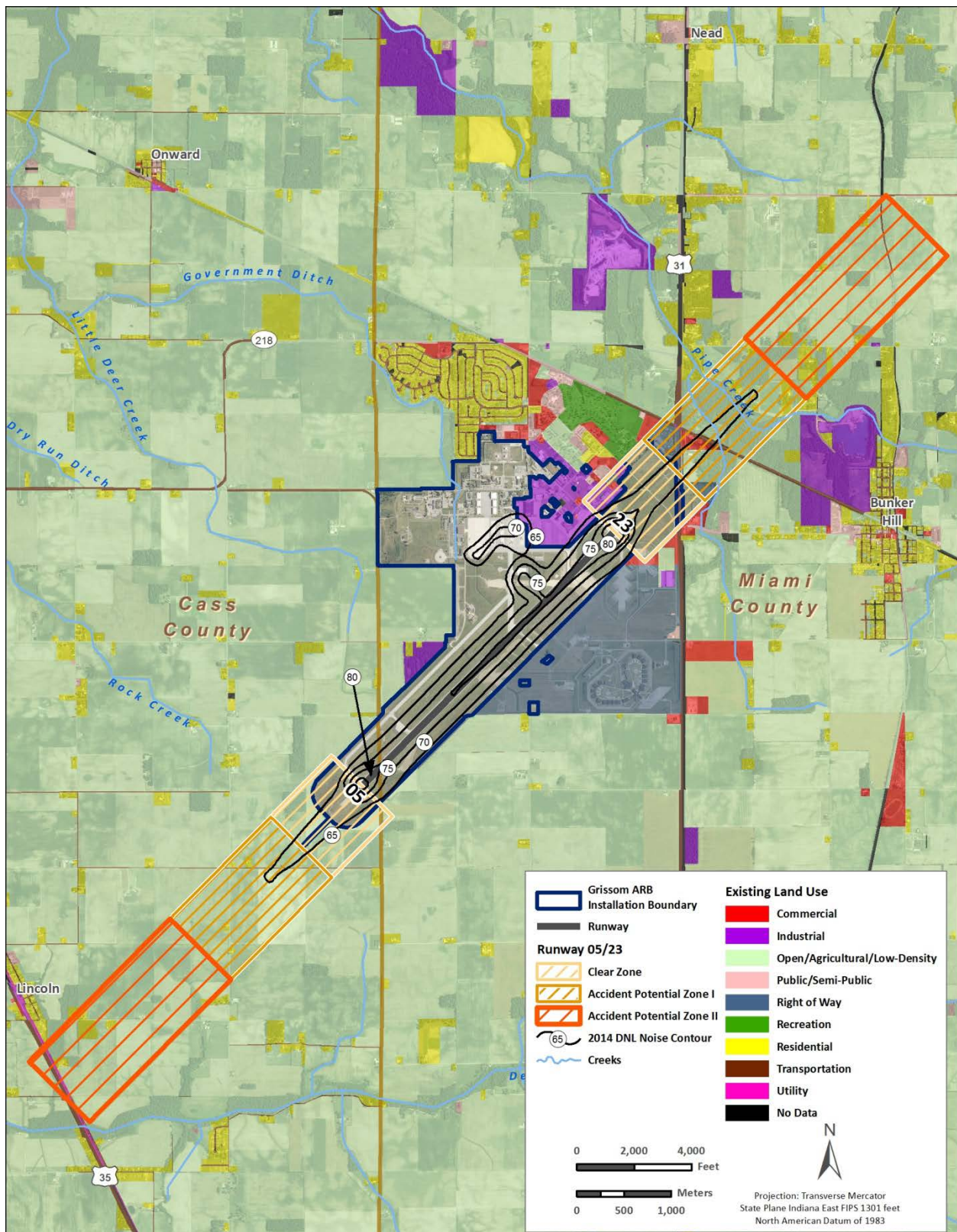


Figure 4-1. 2014 Noise Contours and APZs on Existing Land Use Map



Table 4-2. Existing Off-Installation Land Use Acreage within the Accident Potential Zones

APZ	Land Use Category	Acres
Northeast End (Runway 23)		
CZ	Commercial	2
	Industrial	23
	Transportation/Right-of-Way	12
	<i>Subtotal</i>	37
APZ I	Commercial	11
	Industrial	1
	Open-Space/Agricultural/Low-Density	262
	Residential	17
	Transportation/Right-of-Way	50
	<i>Subtotal</i>	341
APZ II	Open-Space/Agricultural/Low-Density	443
	Residential	36
	Transportation/Right-of-Way	3
	<i>Subtotal</i>	482
Total		860
Southwest End (Runway 05)		
CZ	Open-Space/Agricultural/Low-Density	126
	Transportation/Right-of-Way	5
	<i>Subtotal</i>	131
APZ I	Open-Space/Agricultural/Low-Density	336
	Residential	6
	Transportation/Right-of-Way	2
	<i>Subtotal</i>	344
APZ II	Open-Space/Agricultural/Low-Density	450
	Residential	21
	Utility/Transportation/Right-of-Way	11
	<i>Subtotal</i>	482
Total		957

4.2.1 State of Indiana

Regional Planning Procedures. Indiana Code (IC) Section 36-7-7, *Regional Planning Commissions*, establishes regional planning standards and procedures for all regional planning commissions in Indiana. This statute is intended to provide a framework to facilitate and encourage coordinated, comprehensive planning and development at the local, regional, and state government level. However, neither Miami nor Cass counties are currently members of a regional planning commission.



4.2.2 Miami County

Land Use Policies. Miami County is currently in the process of developing a new Comprehensive Plan. The current plan was completed in 1999. The Miami County Economic Department Authority prepared an *Economic Development Strategy* in 2006. The Development Strategy includes a plan and improvements for the Grissom Aeroplex, which is adjacent to Grissom ARB. The Grissom Aeroplex consists of a number of parcels and buildings acquired by Miami County after realignment of the installation (MCEDA 2006).

The Miami County 1999 Master Plan included a policy related to airport noise impacts (Miami County 1999). The Plan affirmed support for the efforts of the Grissom Redevelopment Authority concerning land use and development criteria in areas that are impacted by airport noise. Specifically, the Plan supported Grissom Redevelopment Authority's criteria that discouraged incompatible land uses at Grissom Aeroplex.

Existing Land Use. Most of the land within the 2014 DNL noise zones and APZs to the north, east, and west are within Miami County. The primary land use surrounding Grissom ARB in Miami County is agriculture and open-space. Generally, residential, commercial, and industrial property is concentrated in town centers and adjacent to major transportation routes; although, residential property is also scattered throughout the region.

Land uses associated with the Grissom Aeroplex to the northeast of the installation include commercial and industrial. To the northwest and adjacent to both Grissom ARB and the Grissom Aeroplex is a residential area, which was part of former base housing. To the east of the installation is a state prison operated by the Indiana State Department of Corrections (MCEDA 2006).

4.2.3 Cass County

Land Use Policies. The *Cass County Comprehensive Plan* was adopted in July 2009. It does not serve as a development ordinance, but rather as a growth management guide for unincorporated areas of the county. This plan provides an analysis of existing development patterns and a public participation program. It also contains the vision, goals, policies, and an implementation program. The community assessment within the *Comprehensive Plan* provides an analysis of existing development patterns within the county. The county has grouped land uses into five standard categories: agricultural, residential, commercial, public/semi-public, and industrial (Cass County 2009). Grissom ARB encompasses a small portion of Cass County.

Existing Land Use. Agriculture accounts for the largest portion of land use in the county, composing 96 percent of the area outside of Logansport. It includes crops, grazing lands, woodlands, farmsteads, and other agriculture-related uses. As such, most of the land within the 2014 DNL noise zones and APZs southwest of the installation in Cass County is



agricultural; although residential land uses are scattered throughout the region.

4.2.4 Town of Bunker Hill

Land Use Policies. The town of Bunker Hill prepared the *Growth Management Plan* in 1997. This plan was prepared to guide the town's growth and land use decisions. The plan discusses current land use, proposed growth management, and implementation strategies (Bunker Hill 1997).

The *Growth Management Plan* recognizes the installation as an opportunity for economic growth (Bunker Hill 1997); however, the plan was prepared prior to Grissom Air Force Base being realigned as Grissom ARB.

Existing Land Use. The town of Bunker Hill is east of Grissom ARB. The town is made up primarily of residential, commercial, and public land uses. The town does not fall within the 2014 DNL noise zones or APZs.

4.3 Existing Zoning

The 2014 DNL noise zones and APZs at Grissom ARB are depicted on a zoning map as shown in **Figure 4-2**. The information illustrated on this map consists of zoning data provided by Miami and Cass counties and the town of Bunker Hill. Roadways and their associated rights-of-way are zoned separately.

Noise Zones. As shown on **Figure 4-2**, the 70–80+ DNL noise contours are entirely within the installation boundary. The 65–69 DNL noise zone encompasses approximately 70 acres of agricultural zoning, 12 acres of industrial/aviation/agricultural zoning, and 16 acres of roads and their associated rights-of-way to the northeast and southwest.

Accident Potential Zones. As shown on **Figure 4-2**, the majority of the land in the northern CZ is within the installation boundary; however, approximately 29 acres are zoned for industrial/aviation/agricultural and light industrial/general business (as part of the Grissom Aeroplex) and 9 acres of transportation and their associated rights-of-way are present in Miami County. Land within the northern APZ I includes approximately 285 acres of agricultural zoned land. In addition, there are 15 acres of light industrial/general business zoned land (primarily the Grissom Aeroplex), and 42 acres of roads and their associated rights-of-way. The northern APZ II primarily encompasses agricultural zoning (approximately 477 acres); along with a small area of transportation (5 acres) within Miami County.

The southern CZ includes 75 acres within the installation boundary. Off-installation, there are approximately 131 acres of agricultural zoning primarily in Cass County; less than 1 acre of land is zoned for transportation.

A Land Use Plan is an element of a jurisdiction's overarching development-related policy (guidance) document called a Comprehensive Plan. The primary tool used to implement a Land Use Plan is known as Zoning, a set of regulations intended to preserve the health, safety, and welfare of the general public.

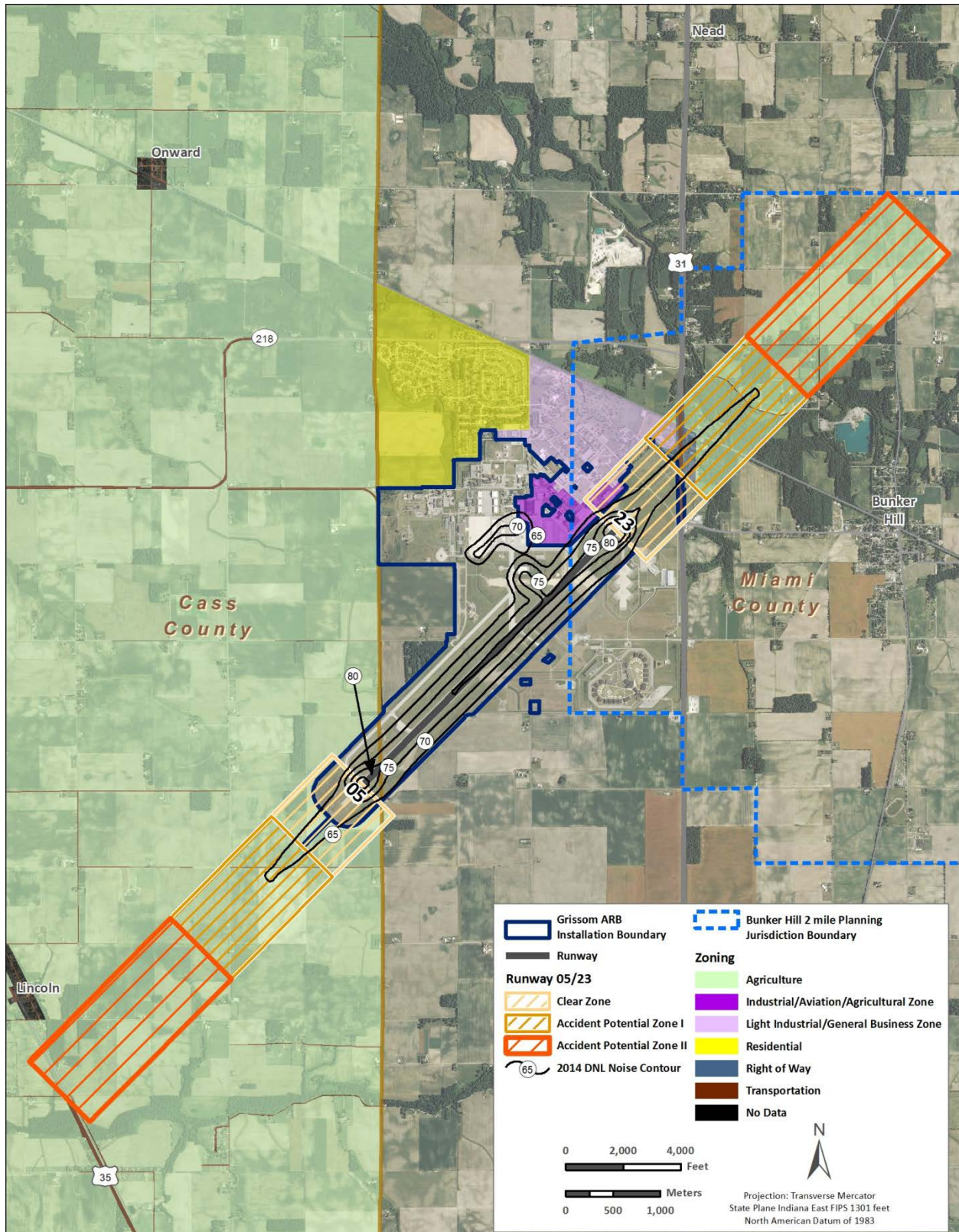


Figure 4-2. 2014 Noise Contours and APZs on Zoning Map



The southern APZ I consists of agricultural zoning (342 acres), with an additional 26 acres of transportation zoning in Cass County. Land within APZ II is also predominately agricultural (481 acres), with transportation making up less than 1 acre.

4.3.1 Miami County

Zoning Ordinance. The *County of Miami Zoning Ordinance* was enacted in 1979 and most recently updated in 2009 (Miami County 2009). The ordinance regulates lots, structures, and uses within unincorporated limits of Miami County. It consists of 13 zoning districts, including multiple types of agricultural, residential, and commercial areas.

Existing Zoning. Zoning in Miami County takes into account airports and provides special exceptions for the size of the facility; minimum setbacks and distances from residences; minimum distances from churches, schools, and towns; and parking. No special zoning ordinances have been enacted for Grissom ARB. In Miami County, the zoning around Grissom ARB consists of industrial/aviation/agricultural and light industrial/general business within the Grissom Aeroplex; residential zoning north of the installation; and agriculture.

4.3.2 Cass County

Zoning Ordinance. The *Cass County Zoning Ordinance* was enacted in 1986 and most recently updated in 2013 (Cass County 2013). The ordinance regulates building construction and land use within Cass County. The county is divided into 13 zoning districts, including multiple types of residential, business, and industrial areas. Only a small portion of Grissom ARB falls within Cass County.

Existing Zoning. The zoning in Cass County includes the Logansport/Cass County Airport Overlay District. However, this district is geared towards the airport adjacent to Logansport and includes inner sections of airport approach areas and aircraft circling areas as defined by the Airport Master Plan prepared by the Board of Aviation Commissioners of the City of Logansport (Cass County 2013). The district states that all uses and structures shall also comply with the Indiana Tall Structure Act (IC, 8-21-10, as amended). This district does not currently apply to Grissom ARB.

4.3.3 Town of Bunker Hill

Zoning Ordinance. The *Town of Bunker Hill Zoning Ordinance* was updated in 2007 (Bunker Hill 2007). The ordinance regulates building construction and land use within Bunker Hill. The town is divided into seven zoning districts, including agricultural, residential, commercial/business, and industrial areas. Grissom ARB is not within the town of Bunker Hill.



In 1998, an amendment was created establishing a 2-mile jurisdiction for the Town of Bunker Hill (see **Figure 4-2**). This amendment modified Miami County's zoning ordinance to establish the jurisdiction for Bunker Hill. Within the 2-mile jurisdiction, proposed construction or reconstruction requires approval from the Town of Bunker Hill before it can begin (Bunker Hill 1998).

Existing Zoning. No noise zones or APZs encompass any land within the Bunker Hill town limits; however, the northern noise zones and APZs fall within the Bunker Hill 2-mile jurisdiction.

4.4 Future Land Use

The noise zones and APZs on the future land use map are shown in **Figure 4-3**. Information was obtained from the *Bunker Hill Growth Management Plan*, the *Miami County Future Land Use Policy Map*, and the *Cass County Comprehensive Plan*.

4.4.1 Miami County

As discussed in **Section 4.2.2**, the *Economic Development Strategy* provides recommendations for future development at the Grissom Aeroplex and the area surrounding Grissom ARB. The future land use for this area includes residential, industrial, commercial, agricultural, and open space (golf course) (MCEDA 2006). Industrial land use surrounds Grissom ARB and includes the Grissom Aeroplex. Large areas of land to the northeast and south of the installation are listed as commercial and industrial mixed use; commercial and residential mixed use are east of the installation; and residential land use surrounds Bunker Hill. The *Miami County Future Land Use Policy Map* does not have a specific designation for Grissom ARB or the APZs.

4.4.2 Cass County

The *Cass County Comprehensive Plan* includes a future development plan for the portion of Cass County that surrounds Grissom ARB. The future land use in this area is primarily agriculture with scattered residences (Cass County 2009).

4.4.3 Town of Bunker Hill

Grissom ARB AICUZ environs would not impact future land use in the current town limits of Bunker Hill; however, the noise zones and APZs fall within the Bunker Hill 2-mile jurisdiction.

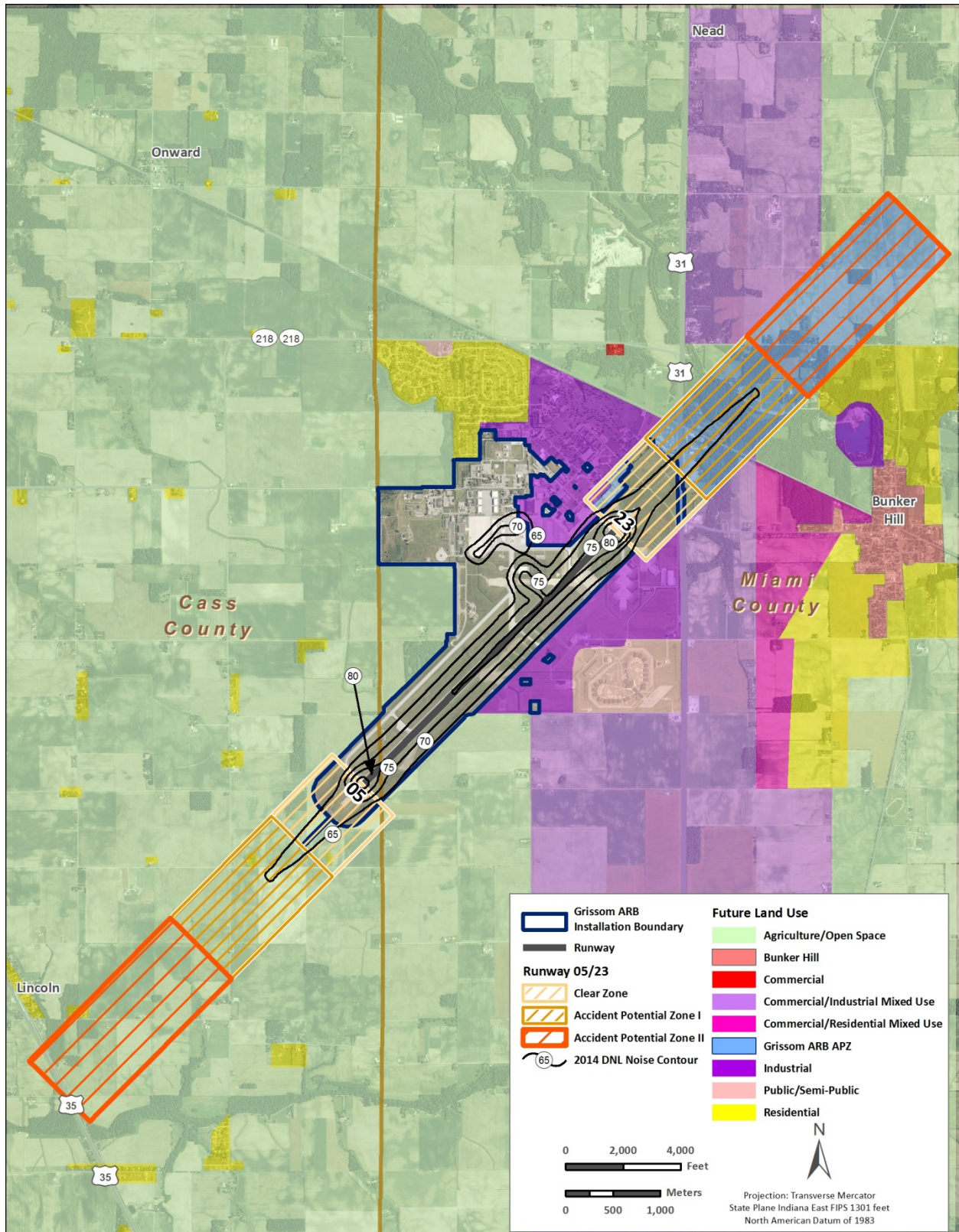


Figure 4-3. 2014 Noise Contours and APZs on Future Land Use Map



4.5 Future Transportation Issues

Major transportation improvements proposed in the vicinity of Grissom ARB include the proposed modifications of U.S. Highway 31. The final proposed project would include a 122-mile corridor improvement between Interstate 465 in Indianapolis, Indiana, and the U.S. Route 20 bypass in South Bend, Indiana. The U.S. Highway 31 Kokomo bypass was recently completed and construction for the portion of U.S. Highway 31 through the rest of Miami County has not begun. It is anticipated that the improvements would eliminate traffic signals and private entrances onto U.S. Highway 31 and allow the corridor to become a stoplight-free highway. The proposed project could attract additional development along U.S. Highway 31.

4.6 Incompatible Land Uses

The USAF established compatible land use guidelines in relation to noise zones and APZs to determine if land uses around an installation were compatible in the AICUZ environs. In general, the USAF's guidelines recommend that noise-sensitive land uses be placed outside high-noise zones, and that people-intensive uses be placed outside of APZs. The compatibility status of the land within the 2014 noise zones and APZs was determined by taking the existing land use categories presented in **Figure 4-1**, choosing the respective land use classifications from **Table 3-1**, and applying the applicable land use compatibility criteria. For a land use to be considered compatible, it must meet criteria for its category for both noise and accident potential. For example, a public building (public/semi-public land use) would be considered a compatible use within the 65–69 dBA DNL noise zone. Within APZ I, public/semi-public land use is considered incompatible. Therefore, if a public building was within both the 65–69 dBA DNL noise zone and APZ I, it would be considered incompatible.

4.6.1 Noise Zones

As shown in **Table 4-1**, approximately 98 acres of off-installation land are within the Grissom ARB 65–69 DNL noise zone. There are approximately 28 acres of commercial, industrial, and transportation land uses that are considered compatible with USAF land use guidelines within that noise zone. There are approximately 70 acres of open-space/agricultural/low-density land use within Miami and Cass counties that are generally considered compatible within the 65–69 noise zone. However, residential buildings should be constructed with noise level-reduction measures. It should be noted that noise level reduction measures will not eliminate outdoor noise problems; however, proper building location and site planning can help mitigate outdoor exposure. Outdoor noise reduction measures should be considered in conjunction with indoor noise reduction measures whenever practical.

4.6.2 Accident Potential Zones

As shown in the previous figures, the APZs extend along the runway centerline to the northeast and southwest of the installation. Therefore, the



incompatible land uses were divided into northern and southern portions within the APZs in this AICUZ Study.

Northern APZs. As shown in **Table 4-3**, approximately 90 acres of land northeast of Grissom ARB within Miami County and the Bunker Hill 2-mile jurisdiction are considered incompatible with USAF land use guidelines. The majority of the incompatible land consists of industrial use within the CZ and residential use within the APZs.

Table 4-3. Existing Off-Installation Incompatible Land Use within the Northern APZs

Category	Acreage within Northern APZs			Total
	CZ	APZ I	APZ II	
Commercial	2	CO*	0	2
Industrial	23	CO*	0	23
Open-Space/Agriculture/ Low-Density	0	CO	CO	0
Residential	0	17	36	53
Transportation/Right-of-Way	12 ^a	CO*	CO	12
Total Acreage	37	17	36	90

CO = The land use is considered compatible.

CO* = The land use is considered compatible with restrictions.

^a = The placement of structures, buildings, and aboveground utilities lines are subject to severe restriction in the CZ.

0 = No acreage of this category is present.

Incompatible land use within the CZ includes 2 acres of commercial and 23 acres of industrial. In addition, the placement of structures, buildings, and aboveground utilities lines are subject to severe restriction in the CZ; as a result, 12 acres of transportation/right-of-way could be incompatible.

Within APZ I, there are 17 acres of residential land that are considered incompatible. This area is north of Pipe Creek in the north section of APZ I. Commercial and industrial land within APZ I are considered compatible with restrictions, which include the following: “Within each land use category, uses exist where deliberation by local authorities may be necessary due to the variation of densities in people and structures. Shopping malls and shopping centers are considered incompatible use in any APZ.” In addition, USAF guidelines recommend restricting passenger terminals and aboveground transmission lines in APZ I for transportation/right-of-way land uses.

The only incompatible land use within APZ II is residential land with 36 acres, which is present in the southern portion of APZ II.

Southern APZs. As shown in **Table 4-4**, approximately 32 acres of land southwest of Grissom ARB within the APZs, which is within Cass County, are considered incompatible with USAF land use guidelines. The incompatible land use consists almost entirely of residential land within the APZs.



Table 4-4. Existing Off-Installation Incompatible Land Use within the Southern APZs

Category	Acreage within Southern APZs			Total
	CZ	APZ I	APZ II	
Open-Space/Agriculture/Low-Density	CO*	CO	CO	0
Residential	0	6	21	27
Transportation/Right-of-Way	5 ^a	CO*	CO	5
Total Acreage	5	6	21	32

CO = The land use is considered compatible.

CO* = The land use is considered compatible with restrictions.

^a = The placement of structures, buildings, and aboveground utilities lines are subject to severe restriction in the CZ.

0 = No acreage of this category is present.

Approximately 5 acres of transportation/right-of-way land is within the southern CZ. As previously stated, this land use is considered incompatible if there are structures or aboveground utility lines in the CZ. There are approximately 6 acres of residential land that are considered incompatible scattered throughout APZ I. Within transportation/right-of-way land, passenger terminals and aboveground transmission lines are restricted in APZ I. The only incompatible land use within APZ II is 21 acres of residential land that is primarily in the southern portion of APZ II near the unincorporated rural community of Lincoln.

4.7 Incompatible Zoning Uses

Zoning compatibility with Grissom ARB activities should be taken into consideration when the counties of Miami and Cass make planning decisions. Because the zoning designation should determine the future land use of a parcel, it is recommended that land in the vicinity of Grissom ARB be zoned in accordance with land use guidelines (as shown in **Table 3-1**) within the 2014 noise zones and APZs. The compatibility status of the zoning within the 2014 noise zones and APZs was determined by taking the zoning categories presented in **Figure 4-2**, choosing the respective land use classifications from **Table 3-1**, and applying the recommended compatibility.

Similar to the previous section, the incompatible zoning around the installation was divided into northern and southern portions within the APZs in this AICUZ Study.

In general, the USAF's land use compatibility guidelines recommend that noise-sensitive land uses be placed outside high-noise zones, and people-intensive uses not be placed in the APZs.

4.7.1 North of Grissom ARB

Approximately 37 acres of land to the northeast of Grissom ARB is zoned with incompatible uses. This area is in Miami County and the Bunker Hill 2-mile jurisdiction and is zoned industrial/aviation/agricultural, light industrial/general business, transportation, and the associated right-of-way.



Land within the northern CZ and APZs is entirely within Miami County and the Bunker Hill 2-mile jurisdiction. Due to the high accident potential within the CZ, only open space and agricultural uses (without structures) are permitted under USAF guidelines. Currently, approximately 20 acres of industrial/aviation/agricultural, 9 acres of light industrial/general business, and 9 acres of right-of-way and transportation are within the northern CZ and are considered incompatible. Approximately 15 acres of light industrial/general business are in the northern APZ I that is considered compatible provided shopping malls or centers are not present.

As shown in **Figure 4-2**, some of the land within APZ I overlaps with a portion of the 65–69 DNL noise zone. The agricultural, industrial/aviation/agriculture, right-of-way, and transportation zoning present in this area are considered compatible. The zoning in the northern APZ II includes agriculture and transportation, both of which are considered compatible. It is recommended that Miami County enforce use restrictions for these areas. County planners should also act consistently with USAF land use compatibility guidelines when considering development proposals.

4.7.2 South of Grissom ARB

As depicted in **Figure 4-2**, land within the southern CZ, APZ I, and APZ II is almost entirely within Cass County. A small portion of the southeastern CZ is within Miami County. More than half of the southern CZ is outside of the installation boundary and a portion of that land is within the 65–69 DNL noise zone. Less than 1 acre of transportation zoning is within the CZ and is considered incompatible. Approximately 131 acres of agricultural zoning is also within the CZ; this land is considered compatible as long there are no buildings or livestock in the area.

A small portion of the southern APZ I overlaps the 65–69 DNL noise zone. None of the land is considered incompatible. The area is primarily zoned agricultural (approximately 342 acres), with approximately 2 acres zoned transportation. These areas are also considered to be compatible within the noise zone. Approximately 481 acres in APZ II are zoned agriculture, along with less than 1 acre of transportation zoning, both of which are compatible.

4.8 Planning Considerations

AICUZ noise zones describe the noise characteristics of a specific operational environment and, as such, will change if a significant operational change is made. Should a new mission be established at Grissom ARB, such as adding additional aircraft or different model types, the AICUZ could be amended.

With these thoughts in mind, Grissom ARB has revised the 1995 AICUZ Study and has provided flight track, APZ, and noise zone information in this study that reflect the most current and accurate picture of aircraft activities at the installation. Land use and zoning suggestions that could be implemented are as follows:



- A notification and comment referral process should be formalized between Grissom ARB and the neighboring jurisdictions regarding new development plans within the noise zones or APZs.
- Local municipalities should provide for Real Estate disclosures in noise zones and APZs around Grissom ARB.
- Subdivision regulations should provide for rejection of new subdivisions not compatible with AICUZ land use guidelines.
- Local municipalities should act consistently with USAF land use compatibility guidelines when regulating development in areas adjacent to the proposed U.S. Highway 31 improvements northeast of the installation.
- Capital improvement programs should be carefully reviewed to discourage incompatible land use patterns, with particular emphasis on utility extension planning.
- The installation should consider acquiring property through ownership or restrictive easements within the CZs whenever practicable.
- The local communities should consider applying for a grant from the Office of Economic Adjustment to complete a Joint Land Use Study (JLUS). A JLUS has specific implementation actions to ensure civilian growth and development are compatible with the military operations at an installation. Additional information about a JLUS can be found at the following Web site: <http://www.oea.gov/programs/compatible-use/start>.



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5. IMPLEMENTATION

5.1 Introduction

Implementation of the AICUZ Study must be a joint effort between the USAF and adjacent communities. The USAF's role is to minimize the noise impact of Grissom ARB operations on local communities. The role of the communities is to ensure that development in the surrounding areas is compatible with the accepted planning and development principles and practices.

5.2 USAF Responsibilities

In general, the USAF perceives its AICUZ-related responsibilities as encompassing the areas of flying safety, noise abatement, and participation in the land use planning process.

Well-maintained aircraft and well-trained aircrews do a great deal to avoid aircraft accidents. Despite the best aircrew training and aircraft maintenance intentions, history clearly shows that accidents do occur. It is imperative that flights be routed over sparsely populated areas as regularly as possible to reduce the exposure of lives and property to a potential accident.

Commanders are required by USAF policy to review periodically air traffic patterns, instrument approaches, minimum weather conditions under which aircraft can use the airfield (e.g., visibility, ceiling), and operating practices; and to evaluate these factors in relationship to populated areas and other local situations. This requirement is a direct result and expression of USAF policy that all AICUZ plans must include an analysis of flying and flying-related activities designed to reduce and control the effects of such operations on surrounding land areas. Noise is generated from aircraft in the air and on the ground. In an effort to reduce the noise effects of Grissom ARB operations on surrounding communities, the installation routes flight tracks to avoid populated areas.

Preparation and presentation of this Grissom ARB AICUZ Study is one phase of continuing USAF participation in the local planning process. It is recognized that as the local community updates its land use plans, the USAF must be ready to provide additional input when needed.

It is also recognized that the AICUZ Program is an ongoing activity even after compatible development plans are adopted and implemented. Grissom ARB personnel are prepared to participate in the continuing discussion of zoning and other land use matters as they might affect, or might be affected by, the installation. Grissom ARB personnel are also available to provide information, criteria, and guidelines to state, regional, and local planning bodies, civic associations, and similar groups. It is recommended that a notification and comment referral process be formalized between Grissom ARB and the neighboring jurisdictions regarding proposed off-base development-related activities within, at a minimum, the noise zones, CZs,

An overview of the USAF aircraft accident hazard study that resulted in the creation of runway CZs and APZs is provided in Appendix B.



and APZs identified in this study, to ensure that future activities will not have an adverse impact on the operation of Grissom ARB.

5.3 Local Community Responsibilities

Adoption of the following recommendations during the revision of relevant land use planning or zoning regulations will strengthen the relationships between the local jurisdictions and Grissom ARB, increase the health and safety of the public, and help protect the integrity of the installation's flying mission.

- Local governments should inform Grissom ARB of planning and zoning actions that have the potential of affecting air operations. These procedures could include the creation of a working group representing city planners, county commissioners, and Grissom ARB planners to meet regularly to discuss AICUZ concerns and major development proposals that could affect Grissom ARB operations.
- Ensure that any future adopted versions of the Miami County, Cass County, and Bunker Hill comprehensive or master plans incorporate AICUZ policies and USAF land use compatibility guidelines. In particular, the Miami County Comprehensive Plan is set to be updated in the 2014–2015 timeframe. The overlay maps of the noise zones and the compatibility guidelines presented in this AICUZ Study should be used to evaluate existing and future land use proposals.
- Planners from Grissom ARB should be included as stakeholders in the planning meetings for the proposed modification of U.S. Highway 31 (see **Section 4.5**).
- Enact fair disclosure ordinances to specify disclosure of those AICUZ items directly related to aircraft operations at Grissom ARB to the public.
- Miami and Cass counties and Bunker Hill should incorporate the CZs and APZs into their land use maps and geographic information system layers.
- Cass County should consider an Airport Overlay District for the Grissom ARB noise zones and APZs similar to the district that the County has in place for the Logansport/Cass County Airport.
- Bunker Hill and Miami County should consider zoning the land within the APZs to reflect the USAF land use compatibility guidelines presented in this Study.



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USEPA 1974	U.S. Environmental Protection Agency (USEPA). 1974. <i>Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety</i> . March 1974.

APPENDIX A

AICUZ CONCEPT, PROGRAM, METHODOLOGY, AND POLICIES

AICUZ Concept, Program, Methodology, and Policies

A.1 Concept

Federal legislation, national sentiment, and other external forces that directly affect the USAF mission have served to greatly increase the U.S. Air Force's (USAF) role in environmental and planning issues. Problems of airfield encroachment from incompatible land uses around installations, and air and water pollution and socioeconomic impacts require continued and intensified USAF involvement. The nature of these problems dictates direct USAF participation in comprehensive community and land use planning. Effective, coordinated planning that bridges the gap between the Federal government and the community requires the establishment of good working relationships with local citizens, local planning officials, and state and Federal officials. This planning depends on creating an atmosphere of mutual trust and helpfulness. The Air Installation Compatible Use Zone (AICUZ) concept has been developed in an effort to:

- Protect local citizens from the noise exposure and accident potential associated with flying activities.
- Prevent degradation of the USAF's capability to achieve its mission by promoting compatible land use planning.

The land use guidelines developed herein are a composite of a number of other land use compatibility studies that have been refined to fit the Grissom Air Reserve Base (ARB) aviation environment.

A.2 Program

Base Commanders establish and maintain active programs to achieve the maximum feasible land use compatibility between air installations and neighboring communities. The program requires that all appropriate governmental bodies and citizens be fully informed whenever AICUZ or other planning matters affecting the installation are under consideration. This includes positive and continuous programs designed to:

- Provide information, criteria, and guidelines to Federal, state, regional, and local planning bodies, civic associations, and similar groups.
- Inform such groups of the requirements of the flying activity, noise exposure, aircraft accident potential, and AICUZ plans.
- Describe the noise-reduction measures that are being used.
- Ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing activities. These measures include proper location of engine test facilities, provision for sound suppressers where necessary, adjustment of flight tracks, and techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

A.3 Methodology

The AICUZ Study identifies certain land areas upon which certain land uses might obstruct the airspace or otherwise be hazardous to aircraft operations; and land areas which are exposed to the health, safety, or welfare hazards of aircraft operations. The AICUZ includes:

- Accident Potential Zones (APZs) and Clear Zones (CZs) based on past USAF aircraft accidents and installation operational data (see **Appendix B**).
- Noise zones produced by the computerized Day-Night Average Sound Level (DNL) metric (see **Appendix C**).
- The area designated by the Federal Aviation Administration and the USAF for purposes of height limitations in the approach and departure zones of the base (see **Appendix D**).

The APZs, CZs, and DNL noise zones are the basic building blocks for land use planning with AICUZ data. The AICUZ Program provides recommendations for compatible land uses in these areas.

As part of the AICUZ Program, the only real property acquisition for which the USAF has received congressional authorization and the base and Major Commands request appropriation are the areas designated as the CZ. Real property interests are acquired by fee or easement, giving the base control over the use of the property. Fee land so acquired may be leased out for agricultural or grazing purposes. Compatible land use controls for the remaining airfield environs should be accomplished through the community land use planning processes.

A.4 AICUZ Land Use Development Policies

The basis for any effective land use control system is the development of, and subsequent adherence to, policies that serve as the standard by which all land use planning and control actions are evaluated. Grissom ARB recommends the following policies be considered for incorporation into the comprehensive plans of agencies in the vicinity of the base environs:

Policy 1. To promote the public health, safety, peace, comfort, convenience, and general welfare of the inhabitants of airfield environs, it is necessary to:

- Guide, control, and regulate future growth and development
- Promote orderly and appropriate use of land
- Protect the character and stability of existing land uses
- Prevent the destruction or impairment of the airfield and the public investment therein
- Enhance the quality of living in the areas affected
- Protect the general economic welfare by restricting incompatible land use.

Policy 2. In furtherance of Policy 1, it is appropriate to:

- Establish guidelines of land use compatibility
- Restrict or prohibit incompatible land use
- Prevent establishment of any land use that would unreasonably endanger aircraft operations and the continued use of the airfield
- Incorporate the AICUZ concept into community land use plans, modifying them when necessary
- Adopt appropriate ordinances to implement airfield environs land use plans.

Policy 3. Within the boundaries of the CZ, certain land uses are inherently incompatible. The following land uses are not in the public interest and must be restricted or prohibited:

- Uses that release into the air any substance, such as steam, dust, or smoke, which would impair visibility or otherwise interfere with the operation of aircraft
- Uses that produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision
- Uses that produce electrical emissions that would interfere with aircraft communication systems or navigation equipment
- Uses that attract birds or waterfowl, such as operation of sanitary landfills, maintenance or feeding stations, or growth of certain vegetation
- Uses that provide for structures within 10 feet of aircraft approach-departure or transitional surfaces.

Policy 4. Certain noise levels of varying duration and frequency create hazards to both physical and mental health. A limited, though definite, danger to life exists in certain areas adjacent to airfields. Where these conditions are sufficiently severe, it is not consistent with public health, safety, and welfare to allow the following land uses:

- Residential
- Retail business
- Office buildings
- Public buildings (e.g., schools, churches)
- Recreational buildings and structures.

Policy 5. Land areas below takeoff and final approach flight paths are exposed to significant danger of aircraft accidents. The density of development and intensity of use must be limited in such areas.

Policy 6. Different land uses have different sensitivities to noise. Standards of land use acceptability should be adopted, based on these noise sensitivities. In addition, a system of Noise Level Reduction guidelines for new construction should be implemented to permit certain uses where they would otherwise be prohibited.

Policy 7. Land use planning and zoning in the airfield environs cannot be based solely on aircraft-generated effects. Allocation of land used within the AICUZ should be further refined by consideration of:

- Physiographic factors
- Climate and hydrology
- Vegetation
- Surface geology
- Soil characteristics
- Intrinsic land use potential and constraints
- Existing land use
- Land ownership patterns and values

- Economic and social demands
- Cost and availability of public utilities, transportation, and community facilities
- Other noise sources.

Each runway end at Grissom ARB has a 3,000 foot by 3,000 foot CZ and two APZs (see **Appendix B**). Accident potential on or adjacent to the runway or within the CZ is sufficiently high that the necessary land use restrictions would prohibit reasonable economic use of land. As stated previously, it is USAF policy to request the U.S. Congress to authorize and appropriate funds for the necessary real property interests in this area to prevent incompatible land uses.

APZ I is less critical than the CZ, but still possesses a significant risk factor. This 3,000 foot by 5,000 foot area has land use compatibility guidelines that are sufficiently flexible to allow reasonable economic use of the land, such as industrial/manufacturing, transportation, communication/utilities, wholesale trade, open space, recreation, and agriculture. However, uses that concentrate people in small areas are not acceptable.

APZ II is less critical than APZ I, but still has potential for accidents. APZ II is 3,000 feet wide by 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable uses include those of APZ I, and low-density, single-family residential, and those personal and business services and commercial/retail trade uses of low-intensity or scale of operation. High-density functions such as multistory buildings, places of assembly (e.g., theaters, churches, schools, restaurants), and high-density office uses are not considered appropriate.

High population densities should be limited to the maximum extent possible. The optimum density recommended for residential usage (where it does not conflict with noise criteria) in APZ II is one dwelling per acre. For most nonresidential usage, buildings should be limited to one story and the lot coverage should not exceed 20 percent.

A.5 Basic Land Use Compatibility

Research on aircraft accident potential, noise, and land use compatibility is ongoing at a number of Federal and other agencies. The results of these studies and all other compatibility guidelines must not be considered inflexible standards. They are the framework within which land use compatibility questions can be addressed and resolved. In each case, full consideration must be given to local conditions such as the following:

- Previous community experience with aircraft accidents and noise
- Local building construction and development practices
- Existing noise environment due to other urban or transportation noise sources
- Time period of aircraft operations and land use activities
- Specific site analysis
- Noise buffers, including topography.

These basic guidelines cannot resolve all land use compatibility questions, but they do offer a reasonable framework within which to work.

A.6 Accident Potential

Land use guidelines for the two APZs are based on a hazard index system that compares the relationship of accident occurrence for five areas:

- On or adjacent to the runway
- Within the CZ
- In APZ I
- In APZ II
- In all other areas within a 10 nautical mile radius of the runway.

Accident potential on or adjacent to the runway or within the CZ is sufficiently high that few uses are acceptable. The risk outside APZ I and APZ II, but within the 10-nautical-mile radius area, is significant, but is acceptable if sound engineering and planning practices are followed.

Land use guidelines for APZs I and II have been developed. The main objective has been to restrict all people-intensive uses because there is greater risk in these areas. The basic guidelines aim at prevention of uses that:

- Have high residential density characteristics
- Have high labor intensity
- Involve aboveground explosive, fire, toxic, corrosive, or other hazardous characteristics
- Promote population concentrations
- Involve utilities and services required for area-wide population, such as telephone and gas, where disruption would have an adverse impact
- Concentrate people who are unable to respond to emergency situations, such as children, the elderly, and the handicapped
- Pose hazards to aircraft operations.

There is no question that these guidelines are relative. Ideally, there should be no people-intensive uses in either of these APZs. The free market and private property systems prevent this where there is land development demand. To counter these guidelines, however, substantially increases risk by placing more people in areas where there could ultimately be an aircraft accident.

A.7 Noise

Nearly all studies analyzing aircraft noise and residential compatibility recommend no residential uses in land areas associated with a DNL above 75 A-weighted decibels (dBA). Usually, no restrictions are recommended below 65 dBA DNL. Between 65 to 74 dBA DNL, there is currently no consensus or restrictions. These areas might not qualify for Federal mortgage insurance in residential categories according to U.S. Department of Housing and Urban Development (HUD) Regulation 24 Code of Federal Regulations (CFR) Section 51B. In many cases, HUD approval requires noise-attenuation measures, the Regional Administrator's concurrence, and an Environmental Impact Statement. The Department of Veterans Affairs also has airfield noise and accident restrictions, which apply to their home loan guarantee program. USAF land use recommendations also state that, whenever possible, residential land use should be located on land with a noise level below 65 dBA DNL.

Most *industrial/manufacturing* uses are compatible in the airfield environs. Exceptions are uses such as research or scientific activities, which require lower noise levels. Noise-attenuation measures are recommended for portions of buildings devoted to office use, receiving the public, or where there is a requirement for low background noise levels.

Transportation, communications, and utility categories have higher noise level compatibility because they generally are not people-intensive. When people use land for these purposes, the use is generally very short in duration; however, when these uses require buildings to be built, additional evaluation is warranted.

The *commercial/retail trade and personal and business services* categories are compatible without restriction up to 70 dBA DNL; however, they are generally incompatible above 80 dBA DNL. Between 70 to 80 dBA DNL, noise level-reduction measures should be included in the design and construction of buildings.

The nature of most uses in the *public and quasi-public services* category requires a quieter environment, and attempts should be made to locate these uses in land areas below 65 dBA DNL (i.e., a USAF land use recommendation), or else provide adequate noise level reduction.

Although *recreational* use has often been recommended as compatible with high noise levels, recent research has resulted in a more conservative view. Above 75 dBA DNL, noise becomes a factor, which limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (e.g., music shell), compatibility is limited. Buildings associated with golf courses and similar uses should be noise-attenuated.

Forestry activities, livestock farming, and uses in the resources production, extraction, and open space categories are compatible almost without restrictions within all DNL noise zones.

APPENDIX B

CLEAR ZONES AND ACCIDENT POTENTIAL ZONES

Clear Zones and Accident Potential Zones

B.1 Guidelines for Accident Potential

Urban areas around airports are exposed to the possibility of aircraft accidents even with well-maintained aircraft and highly trained aircraft crews. Despite stringent maintenance requirements and countless hours of training, past history makes it clear that accidents are going to occur.

When the AICUZ Program began, there were no current comprehensive studies on accident potential. In support of the program, the USAF completed a study of USAF accidents that occurred between 1968 and 1972 within 10 nautical miles of airfields. The study of 369 accidents revealed that 75 percent of aircraft accidents occurred on or adjacent to the runway (1,000 feet to each side of the runway centerline) and in a corridor 3,000 feet wide (1,500 feet on either side of the runway centerline), extending from the runway threshold along the extended runway centerline for a distance of 15,000 feet.

Three zones were established based on crash patterns: the CZ, APZ I, and APZ II. The CZ starts at the end of the runway and extends outward 3,000 feet. It has the highest accident potential of the three zones. The USAF has adopted a policy of acquiring property rights to areas designated as CZs because of the high accident potential. APZ I extends from the CZ an additional 5,000 feet. It includes an area of reduced accident potential. APZ II extends from APZ I an additional 7,000 feet in an area of further reduced accident potential.

The USAF research work in accident potential was the first significant effort in this subject area since 1952 when the President's Airport Commission published *The Airport and Its Neighbors*, better known as the "Doolittle Report." The recommendations of this earlier report were influential in the formulation of the APZ concept.

The risk to people on the ground of being killed or injured by aircraft accidents is small. However, an aircraft accident is a high consequence event and when a crash does occur, the result is often catastrophic. Because of this, the USAF does not attempt to base its safety standards on accident probabilities. Instead the USAF approaches this safety issue from a land use planning perspective.

B.2 Accident Potential Analysis

Military aircraft accidents differ from commercial air carrier and general aviation accidents because of the variety of aircraft used, the type of missions, and the number of training flights. In 1973, the USAF performed an aircraft accident hazard study to identify land near airfields with significant accident potential. Accidents studied occurred within 10 nautical miles of airfields.

The study reviewed 369 major USAF accidents during the period of 1968 to 1972, and found that 61 percent of the accidents related to landing operations and 39 percent related to takeoffs. It also found that 70 percent occurred in daylight, and that fighter and training aircraft accounted for 80 percent of the accidents.

Because the purpose of the study was to identify accident hazards, the study plotted each of the 369 accidents in relation to the airfield. This plotting found that the accidents clustered along the runway and its extended centerline. To further refine this clustering, a tabulation was prepared that described the cumulative frequency of accidents as a function of distance from the runway centerline along the

extended centerline. This analysis was done for widths of 2,000, 3,000, and 4,000 feet. **Table B-1** shows the results of the location analysis.

Table B-1. Location Analysis

Length From Both Ends of Runway (feet)	Width of Runway Extension (feet)		
	2,000	3,000	4,000
Percent of Accidents			
On or adjacent to runway (1,000 feet to each side of runway centerline)	23	23	23
0 to 3,000	35	39	39
3,000 to 8,000	8	8	8
8,000 to 15,000	5	5	7
Cumulative Percent of Accidents			
On or adjacent to runway (1,000 feet to each side of runway centerline)	23	23	23
0 to 3,000	58	62	62
3,000 to 8,000	66	70	70
8,000 to 15,000	71	75	77

Figure B-1 indicates that the cumulative number of accidents rises rapidly from the end of the runway to 3,000 feet, rises more gradually to 8,000 feet, and then continues at about the same rate of increase to 15,000 feet, where it levels off rapidly. The location analysis also indicates that the optimum width of the safety zones, designed to include the maximum percentage of accidents in the smallest area, is 3,000 feet (see **Figures B-2** and **B-3**).

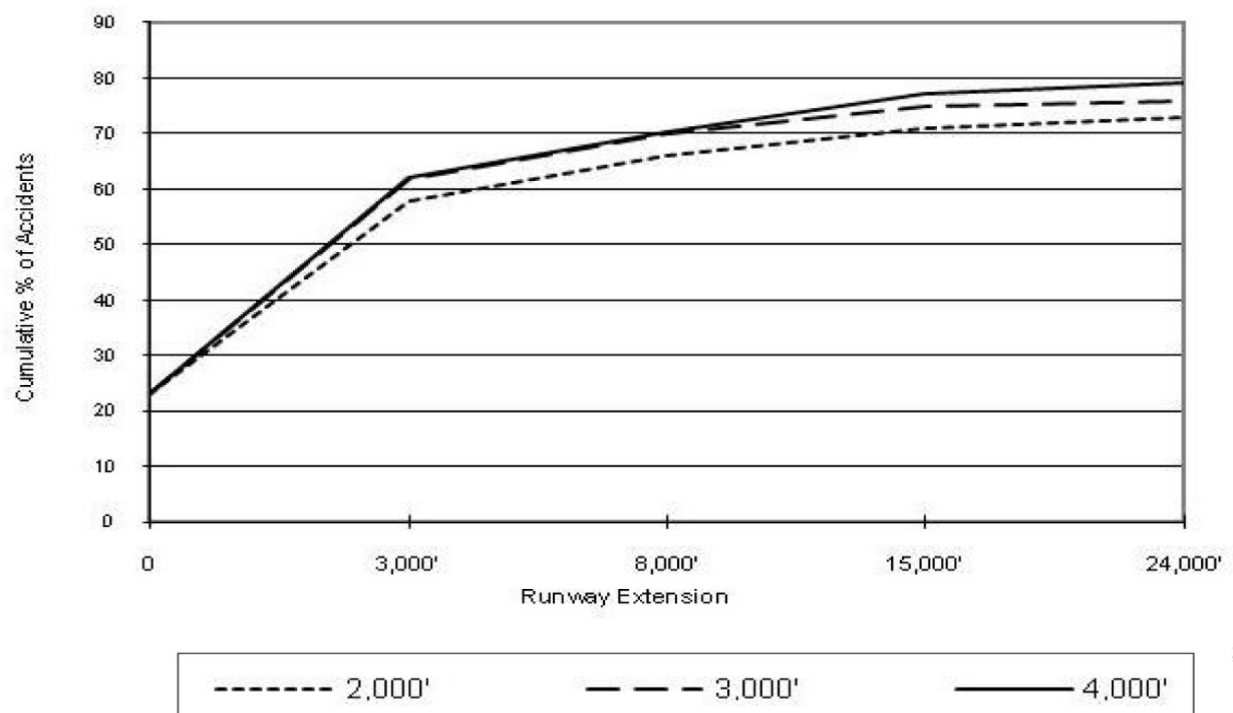


Figure B-1. Distribution of USAF Aircraft Accidents

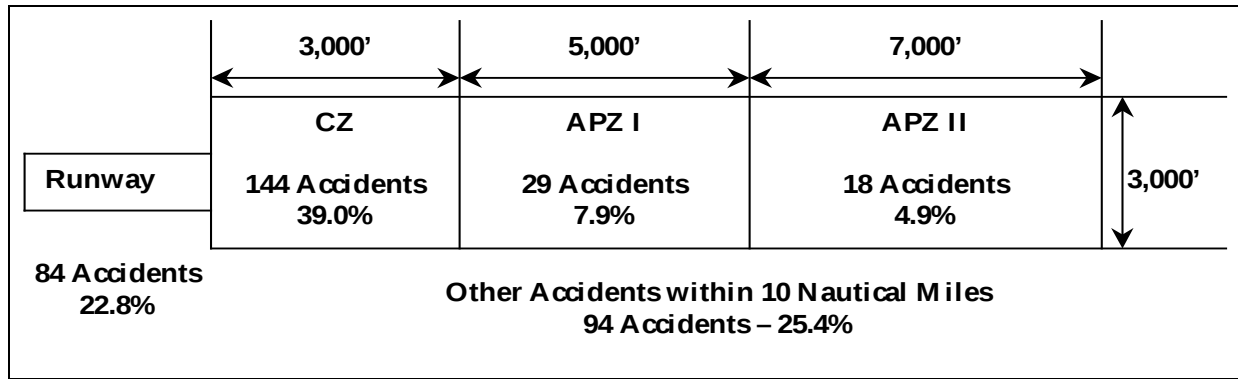


Figure B-2. USAF Accident Data (369 Accidents from 1968 to 1972)

The original study was updated to include accidents through September 1995. The updated study now includes 838 accidents during the 1968 to 1995 period. Using the optimum runway extension width of 3,000 feet, the accident statistics of the updated study are shown in **Figure B-3**.

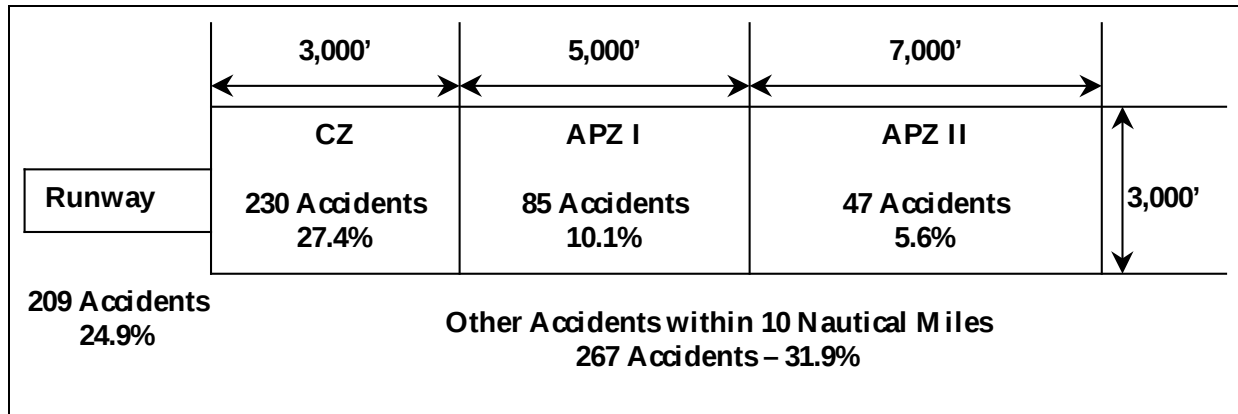


Figure B-3. USAF Accident Data (838 Accidents from 1968 to 1995)

Using the designated zones and accident data, it is possible to calculate a ratio of percentage of accidents to percentage of area size. These ratios indicate that the CZ, with the smallest area size and the highest number of accidents, has the highest ratio, followed by the runway and adjacent area, APZ I, and APZ II (see **Table B-2**).

B.3 Definable Debris Impact Areas

The USAF also determined which accidents had definable debris impact areas, and in what phase of flight the accident occurred. Overall, 75 percent of the accidents had definable debris impact areas, although they varied in size by type of accident. The USAF used weighted averages of impact areas, for accidents occurring only in the approach and departure phase, to determine the following average impact areas:

- Overall Average Impact Area
- Fighter, Trainer, and Miscellaneous Aircraft
- Heavy Bomber and Tanker Aircraft.

Table B-2. Accident to Area Ratio

Ratio of Percentage of Accidents to Percentage of Area (USAF Accident Data 1968 – 1995)						
	Area (acres) ¹	Number of Accidents ²	Accidents per Acre	% Total Area	% Total Accidents	Ratio: Accidents to Area ³
Runway Area ⁴	487	209	1 per 2.3	0.183	24.9	136.0
CZ	413	230	1 per 1.8	0.155	27.4	177.0
APZ I	689	85	1 per 8.1	0.258	10.1	39.0
APZ II	964	47	1 per 20.5	0.362	5.6	16.0
Other	264,053	267	1 per 989.0	99.042	31.9	0.3

Notes:

1. Area includes land within 10 nautical miles of runway (266,606 acres).
2. Total number of accidents is 838 (through 1995).
3. Percent total accidents divided by percent total area.
4. Runway Area dimensions are 2,000' x 10,600'.

B.4 Findings

Designation of safety zones around the airfield and restriction of incompatible land uses can reduce the public's exposure to safety hazards.

USAF accident studies have found that aircraft accidents near USAF installations occurred in the following patterns:

- 61 percent were related to landing operations
- 39 percent were related to takeoff operations
- 70 percent occurred in daylight
- 80 percent were related to fighter and training aircraft operations
- 25 percent occurred on the runway or within an area extending 1,000 feet out from each side of the runway
- 27 percent occurred in an area extending from the end of the runway to 3,000 feet along the extended centerline and 3,000 feet wide, centered on the extended centerline
- 15 percent occurred in an area between 3,000 and 15,000 feet along the extended runway centerline and 3,000 feet wide, centered on the extended centerline.

USAF aircraft accident statistics found that 75 percent of aircraft accidents resulted in definable impact areas. The sizes of the impact areas were as follows:

- 5.1 acres overall average
- 2.7 acres for fighters and trainers
- 8.7 acres for heavy bombers and tankers.

APPENDIX C

DESCRIPTION OF THE NOISE ENVIRONMENT

Description of the Noise Environment

C.1 Noise Environment Descriptor

The noise zone methodology used herein is the Day-Night Average Sound Level (DNL) metric of describing the noise environment. Efforts to provide a national uniform standard for noise assessment have resulted in adoption by the U.S. Environmental Protection Agency of DNL as the standard noise descriptor. The USAF uses the DNL descriptor in assessing the amount of aircraft noise exposure, and as a metric for community response to the various levels of exposure. The DNL values used for planning purposes are 65, 70, 75, and 80 decibels (dB). Land use guidelines are based on the compatibility of various land uses with these noise exposure levels.

It is generally recognized that a noise environment descriptor should consider, in addition to the annoyance of a single event, the effect of repetition of such events and the time of day in which these events occur. DNL begins with a single event descriptor and adds corrections for the number of events and the time of day. Because the primary development concern is residential, nighttime events are considered more annoying than daytime events and are weighted accordingly. DNL values are computed from the single event noise descriptor, plus corrections for number of flights and time of day (see **Figure C-1**).

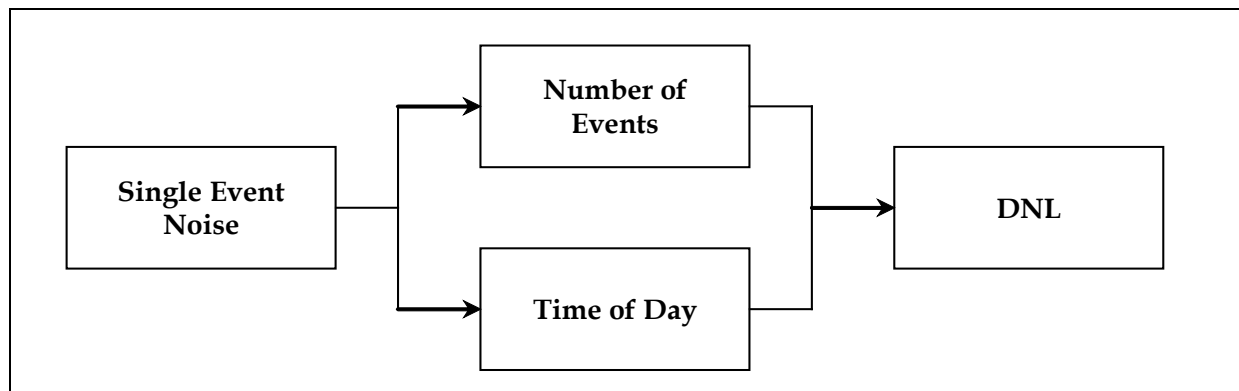


Figure C-1. Day-Night Average A-Weighted Sound Level

As part of the extensive data collection process, detailed information is gathered on the type of aircraft, and the number and time of day of flying operations for each flight track during a typical day. This information is used in conjunction with the single event noise descriptor to produce DNL values. These values are combined on an energy summation basis to provide single DNL values for the mix of aircraft operations at the base. Equal value points are connected to form the contour lines.

C.2 Noise Event Descriptor

The single event noise descriptor used in the DNL system is the Sound Exposure Level (SEL). The SEL measure is an integration of an A-weighted noise level over the period of a single event, such as an aircraft flyover, in dB.

Frequency, magnitude, and duration vary according to aircraft type, engine type, and power setting. Therefore, individual aircraft noise data are collected for various types of aircraft and engines at different

power settings and phases of flight. **Figure C-2** shows the relationship of the single event noise descriptor (SEL) to the source sound energy.

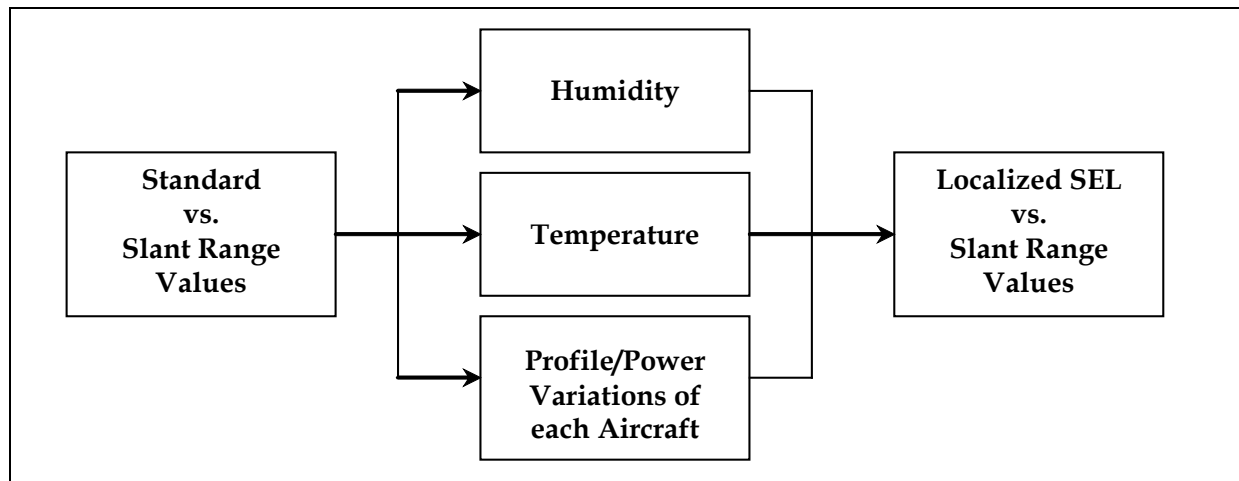


Figure C-2. Sound Exposure Level

SEL versus slant range values are derived from noise measurements made according to a source noise data acquisition plan developed by Bolt, Beranek, and Newman, Inc., in conjunction with and carried out by the USAF's Armstrong Laboratory. These standard day values form the basis for the individual event noise descriptors at any location and are adjusted to the location by applying appropriate corrections for temperature, humidity, and variations from standard profiles and power settings.

Ground-to-ground sound propagation characteristics are used for altitudes up to 500 feet absolute with linear transition between 500 and 700 feet and air-to-ground propagation characteristics above 700 feet.

In addition to the assessment of aircraft flight operations, the DNL system also incorporates noise resulting from engine and aircraft maintenance checks on the ground. Data concerning the orientation of the noise source, type of aircraft or engine, number of test runs on a typical day, power settings used and their duration, and use of suppression devices are collected for each ground run-up or test position. This information is processed and the noise contribution added (on an energy summation basis) to the noise generated by flying operations to produce DNL noise zones reflecting the overall noise environment with respect to aircraft air and ground operations.

C.3 Noise Zone Production

Data describing flight track distances and turns, altitudes, airspeeds, power settings, flight track operational utilization, maintenance locations, ground run-up engine power settings, and number and duration of runs by type of aircraft and engine were assembled for Grissom ARB. The data were screened by the Major Command (MAJCOM) and the Air Force Civil Engineer Center. Flight track maps were generated and approved by the installation and MAJCOM. After any required changes were incorporated, DNL contours were generated by the NOISEMAP software program using the supplied data and standard source noise data corrected to local weather conditions. These contours were plotted and provided in the body of this report.

C.4 Technical Information

Additional technical information on the DNL procedures is available in the following publications:

- *Community Noise Exposure Resulting from Aircraft Operations: Applications Guide for Predictive Procedure.* AMRL-TR-73-105, November 1974, from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151.
- *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with Adequate Margin of Safety.* USEPA Report 550/9-74-004, March 1974, from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
- *Adopted Noise Regulations for California Airports.* Title 4, Register 70, No. 48-11-28-70, Subchapter 6, Noise Standards.

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APPENDIX D

HEIGHT OBSTRUCTION CRITERIA

Height Obstruction Criteria

General. This appendix establishes criteria for determining whether an object or structure is an obstruction to air navigation. Obstructions to air navigation are as follows:

- Natural objects or man-made structures that protrude above the planes or surfaces as defined in the following paragraphs.
- Man-made objects that extend more than 500 feet above the ground at the site of the structure.

Explanation of Terms. The following will apply:

- *Controlling Elevation.* Whenever surfaces or planes within the obstructions criteria overlap, the controlling (or governing) elevation becomes that of the lowest surface or plane.
- *Runway Length.* Grissom ARB has one runway (Runway 05/23) that is oriented in a northeast-southwest direction. Runway 05/23 is 12,500 feet long and 200 feet wide. The runway is designed and built for sustained aircraft landings and takeoffs.
- *Established Airfield Elevation.* The elevation, in feet above mean sea level (MSL), for Grissom ARB is approximately 811 feet, at the high point (FAA 2013).
- *Dimensions.* All dimensions are measured horizontally unless otherwise noted.

For a more complete description of airspace and control surfaces for Class A and Class B runways, see Federal Aviation Regulation Part 77, Subpart C, or Unified Facilities Criteria (UFC) 3-260-01.

Planes and Surfaces. Definitions for military surfaces are as follows:

Primary Surface

- This surface defines the limits of the obstruction clearance requirements in the immediate vicinity of the landing area.
- The primary surface comprises surfaces of the runway, runway shoulders, and lateral safety zones and extends 200 feet beyond the runway end.
- The width of the primary surface for a single class “B” runway is 2,000 feet, or 1,000 feet on each side of the runway centerline.

Clear Zone Surface (Clear Zone Graded Area)

- This surface defines the limits of the obstruction clearance requirements in the vicinity contiguous to the end of the primary surface.
- The clear zone surface is located on the ground or water at each end of the primary surface, with a length of 1,000 feet and the same width as the primary surface. (This definition is for Federal Aviation Administration defined surfaces and should not be confused with the Clear Zone defined in **Section 3.3**, which is used to describe accident potential.)

Approach-Departure Clearance Surface

- This surface is symmetrical around the runway centerline extended, begins as an inclined plane (glide angle) 200 feet beyond each end of the primary surface of the centerline elevation of the runway end, and extends for 50,000 feet.
- The slope of the approach-departure clearance surface is 50:1 along the extended runway (glide angle) centerline until it reaches an elevation of 500 feet above the established airfield elevation.
- It then continues horizontally at this elevation to a point 50,000 feet from the start of the glide angle.
- The width of this surface at the runway end is 2,000 feet; it flares uniformly, and the width at 50,000 feet is 16,000 feet.

Inner Horizontal Surface

- This surface is a plane, oval in shape at a height of 150 feet above the established airfield elevation.
- It is constructed by scribing an arc with a radius of 7,500 feet above the centerline at the end of the runway and interconnecting these arcs with tangents.

Conical Surface

- This is an inclined surface extending outward and upward from the outer periphery of the inner horizontal surface for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation.
- The slope of the conical surface is 20:1.

Outer Horizontal Surface

- This surface is a plane 500 feet above the established airfield elevation.
- It extends for a horizontal distance of 30,000 feet from the outer periphery of the conical surface.

Transitional Surfaces

- These surfaces connect the primary surfaces, CZ surfaces, and approach-departure clearance surfaces to the outer horizontal surface, conical surface, other horizontal surface, or other transitional surfaces.
- The slope of the transitional surface is 7:1 outward and upward at right angles starting at 1,000 feet out from the runway centerline.
- To determine the elevation for the beginning of the transitional surface slope at any point along the lateral boundary of the primary surface, including the CZ, draw a line from this point to the runway centerline.
- This line will be at right angles to the runway axis.
- The elevation at the runway centerline is the elevation for the beginning of the 7:1 slope.

Height Restrictions

City and county agencies involved with approvals of permits for construction should require developers to submit calculations which show that projects meet the height restriction criteria of Federal Aviation Administration Part 77 as described, in part, by the information contained in this appendix.

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APPENDIX E

NOISE LEVEL REDUCTION GUIDELINES

Noise Level Reduction Guidelines

A study that provides in-depth, state-of-the-art noise level reduction guidelines was completed for the Naval Facilities Engineering Command and the Federal Aviation Administration, by Wyle Laboratories in April 2005. The study title is *Guidelines for Sound Insulation of Residences Exposed to Aircraft Operations* by Wyle Research & Consulting. Copies of this study are available for review at http://www.fican.org/pdf/Wyle_Sound_Insulation.pdf.

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