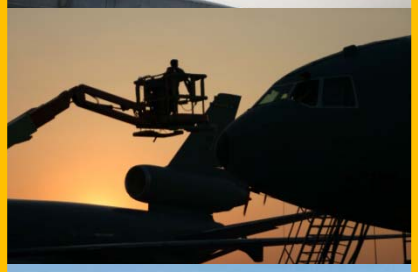
AIR INSTALLATION COMPATIBLE USE ZONE STUDY

McGUIRE AIR FORCE BASE, NEW JERSEY

August 2009



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ACRONYMS AND ABBREVIATIONS

87 ABW	87th Air Base Wing
108 ARW	108th Air Refueling Wing
305 AMW	305th Air Mobility Wing
514 AMW	514th Air Mobility Wing
AFB	Air Force Base
AFI	Air Force Instruction
AFH	Air Force Handbook
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
ALM	A-weighted sound level or maximum sound level
AMW	Air Mobility Wing
APZ	Accident Potential Zone
ARS	Air Refueling Squadron
ARW	Air Refueling Wing
AS	Airlift Squadron
BRAC	Base Realignment and Closure
cps	cycles per second
CZ	Clear Zone
dB	decibel
dBA	A-weighted sound level measured in decibels
DNL	Day-Night Average A-Weighted Sound Level
DoD	Department of Defense
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
HUD	Housing and Urban Development
Hz	Hertz
INM	Integrated Noise Model
JLUS	Joint Land Use Study
LZ	landing zone
MSA	Metropolitan Statistical Area

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MSL	mean sea level
NAES	Naval Air Engineering Station
NASJRB	Naval Air Station Joint Reserve Base
NJ	New Jersey
NJANG	New Jersey Air National Guard
NLR	Noise Level Reduction
NZ	noise zone
PA	Pennsylvania
RAPCON	Radar Approach Control
SEL	sound exposure level
SLUCM	Standard Land Use Coding Manual
the Base	McGuire Air Force Base
UCLA	University of California at Los Angeles
UFC	Unified Facilities Criteria
U.S.	United States
USEPA	United States Environmental Protection Agency
VFR	Visual Flight Rule

SECTION 1

PURPOSE AND NEED

1.1 Introduction

This study is an update of the 1999 McGuire Air Force Base (AFB), New Jersey (NJ), Air Installation Compatible Use Zone (AICUZ) Study. The update presents and documents the changes to the AICUZ for the period 1999-2009 and is based on the November 2008 aircraft operational conditions. This AICUZ Study reaffirms Air Force policy of assisting local, regional, state, and federal officials in the areas neighboring McGuire AFB by promoting compatible development within the AICUZ area of influence; and protecting Air Force operational capability from the effects of land use that are incompatible with aircraft operations. Specifically, this report documents changes in aircraft operations since the last study and provides noise contours and compatible use guidelines for land areas neighboring the installation based on the November 2008 operations, as well as the projected aircraft operations for the New Jersey Air National Guard (NJANG) after it completes an aircraft conversion. This information is provided to assist local communities and to serve as a tool for future planning and zoning activities. Changes that occurred since the 1999 McGuire AFB AICUZ Study include:

- Addition, elimination, and modification of aircraft flight tracks to correspond to flight operational changes;
- Retirement of the C-141 aircraft and the addition of the assigned C-17 aircraft operations;
- Conversion from KC-135E to KC-135R aircraft by the NJANG; and
- Technical improvements to the NOISEMAP computer-modeling program.

1.2 Purpose and Need

The purpose of the long-standing AICUZ program is to promote compatible land development in areas subject to aircraft noise and accident potential. The Air Force provides the AICUZ Study to all local communities to assist them in preparing local land use plans. As Burlington County, Ocean County and the townships of North Hanover, New Hanover, Plumsted, Wrightstown, Springfield, Jackson and Pemberton prepare and modify land use development plans, recommendations from this updated AICUZ Study should be included in the planning process to prevent incompatible land use that could compromise the ability of McGuire AFB to fulfill its mission. Accident potential and aircraft noise should be major considerations in the planning process.

Air Force AICUZ guidelines reflect land use recommendations for the clear zones (CZ), accident potential zones (APZ) I and II, and the four noise zones (Day-Night Average A-Weighted Sound Level [DNL] 65-69 decibel [dB], DNL 70-74 dB, DNL 75-79 dB, and DNL 80 dB and greater). These guidelines were established on the basis of studies prepared

and sponsored by several federal agencies, including the United States Department of Housing and Urban Development, United States Environmental Protection Agency (USEPA), United States Air Force, and state and local agencies. The guidelines recommend land uses that are compatible with airfield operations while allowing maximum beneficial use of adjacent properties. The Air Force has no desire to recommend land use regulations that render property economically useless. It does, however, have an obligation to the inhabitants of the McGuire AFB area of influence and the citizens of the United States to point out ways to protect the public investment in the installation and the people living in areas adjacent to the installation. The AICUZ area of influence includes the area within the DNL 65 dB and greater noise exposure area and the area within the CZs and APZs. This McGuire AFB AICUZ study documents aircraft operations as of November 2008.

The 2005 Base Realignment and Closure (BRAC) recommendations would bring additional missions to McGuire AFB and would transform McGuire AFB, Fort Dix, and Naval Air Engineering Station (NAES) Lakehurst into Joint Base McGuire-Dix-Lakehurst. BRAC directed realigned missions that would move to McGuire AFB include:

- All Navy and Marine Corps squadrons, their aircraft and necessary personnel, equipment and support; and the minimum amount of manpower and equipment to support intermediate maintenance workload and capacity for Tire and Wheel, non-destruction inspections, and Aviation Life Support System equipment relocate from Naval Air Station Joint Reserve Base (NASJRB) Willow Grove, Pennsylvania (PA);
- Marine Light Attack Helicopter Squadron 775 Detachment A relocates from Cambria Regional Airport, Johnstown, PA;
- The 16 KC-135E aircraft operated by the NJANG's 108th Air Refueling Wing (108 ARW) at McGuire AFB would retire and be replaced with eight KC-135R aircraft;
- Realign New Castle Airport, Delaware, by moving its flying related Expeditionary Support (Aeromedical Squadron) to McGuire AFB; and,
- The installation management functions for Fort Dix, NJ and Naval Air Engineering Station (NAES) Lakehurst, NJ will realign to McGuire AFB and establishes Joint Base McGuire-Dix-Lakehurst.

The 108 ARW conversion to KC-135R aircraft was in progress at the time data were collected for this 2009 AICUZ Study (*i.e*., June-November 2008). Thus, this AICUZ update contains KC-135R operations for the 108 ARW because the unit could reasonably project KC-135R activity. Conversely, the actions associated with the other 2005 BRAC actions (*i.e*., relocation of Navy and Marine Corps units from NASJRB Willow Grove and Cambria Regional Airport; realignment of the New Castle Airport; and establishment of Joint Base McGuire-Dix-Lakehurst) had not been initiated at the time of data collection for this AICUZ update. Therefore, the operations data for these units were not available when data were collected for the 2009 AICUZ Study. Because the operations data for these other actions could not be included in this 2009 AICUZ update, McGuire AFB has identified a need for a new AICUZ Study after all the 2005 BRAC realignments are completed and flying operations are initiated. McGuire AFB has programmed a fiscal year 2011 Joint Base McGuire-Dix-

Lakehurst AICUZ study to address joint-base aircraft flying operations after all of the 2005 BRAC actions have been completed.

1.3 Process, Procedure, and Noise Metrics

Preparation and presentation of this update to McGuire AFB's AICUZ Study is part of the continuing Air Force participation in the local planning process. Guidance for the Air Force AICUZ program is contained in Air Force Instruction (AFI) 32-7063, *Air Installation Compatible Use Zone Program*, which implements DoD Instruction 4165.57, *Air Installations Compatible Use Zones*. This AICUZ Study is accompanied by a Citizen's Brochure, which is a separate document that summarizes the study.

As local communities prepare land use plans and zoning ordinances, the Air Force recognizes it has the responsibility to provide input on its activities relating to the community. This study is presented in the spirit of mutual cooperation and assistance by McGuire AFB to aid in the land use planning process around the Base.

The AICUZ program uses the latest technology to define noise levels in areas near Air Force installations with a flying mission. Aircraft operational data used in this study were collected at McGuire AFB in June 2008. The Air Force reviewed and validated the data through a communicative process that was finalized in November 2008. Aircraft flight data were obtained to derive average daily operations by runway and type of aircraft. Analysis of McGuire AFB's flying operations included the types of aircraft, flight patterns utilized, variations in altitude, power settings, number of operations, and hours of operations. These data were supplemented by flight track information (where we fly), flight profile information (how we fly), and ground runup information. After verification for accuracy, the data were input into the NOISEMAP computer program to produce DNL noise contours. The noise contours for McGuire AFB were plotted on an area map and overlaid with the CZ and APZ areas for the airfield.

The noise contours reflect the November 2008 aircraft operational conditions (to include projected NJANG KC-135R operations after the aircraft conversion is completed) and land use data calculations in this AICUZ Study were generated by NOISEMAP. The background maps were obtained from Burlington and Ocean Counties and the Joint Base McGuire-Dix-Lakehurst Land Use Study. The land use and zoning figures presented in Section 5 were developed using the same sources.

1.4 Computerized Noise Exposure Models

The Air Force adopted the NOISEMAP computer program to describe noise impacts from aircraft operations. NOISEMAP is one of two USEPA-approved computer programs; the other is the Integrated Noise Model (INM) used by the Federal Aviation Administration (FAA) for noise analysis at civil airports. The NOISEMAP and INM programs are similar; however, while INM is designed to model aircraft operations at civil airports, NOISEMAP is specifically designed to model noise for military airfields.

NOISEMAP is a suite of computer programs and components developed by the Air Force to predict noise exposure in the vicinity of an airfield due to aircraft flight, maintenance, and ground run-up operations. The components of NOISEMAP are:

- BASEOPS is the input module for NOISEMAP and is used to enter detailed aircraft flight track and profile and ground maintenance operational data.
- NOISEFILE is a comprehensive database of measured military and civil aircraft noise data. Aircraft operational information is matched with the noise measurements in the NOISEFILE after the detailed aircraft flight and ground maintenance operational data has been entered into BASEOPS.
- NMAP is the computational module in NOISEMAP. NMAP takes BASEOPS input and uses the NOISEFILE database to calculate the noise levels caused by aircraft events at specified grid points in the airbase vicinity. The output of NMAP is a series of georeferenced data points, specific grid point locations, and corresponding noise levels.
- NMPLOT is the program for viewing and editing the sets of georeferenced data points. NMPLOT plots the NMAP output in a noise contour grid that can be exported as files that can be used in mapping programs for analyzing the noise impacts.

SECTION 2

INSTALLATION DESCRIPTION

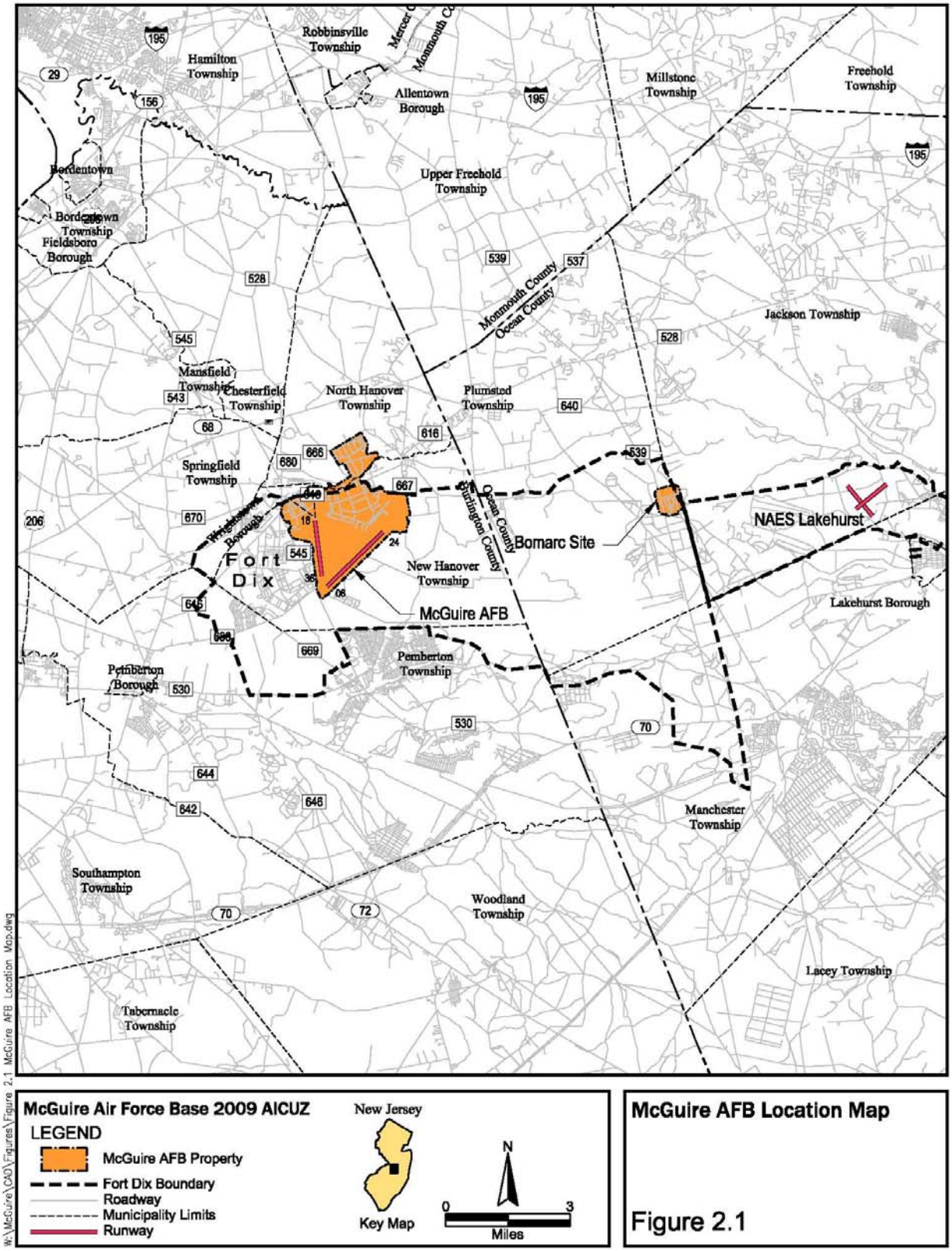
2.1 Description of McGuire Air Force Base

McGuire AFB is located in Burlington County in south central New Jersey, east of Wrightstown Borough. The base is on approximately 3,600 acres of land bounded by Fort Dix Military Reservation on the east, south, and west (see Figure 2.1). Burlington County is the largest county in the state of New Jersey, having a size of over 530,000 acres. Access to the Base from the north is via County Route 528. From the south, access is gained by way of County Route 545. The New Jersey Turnpike is to the west of the Base with a McGuire/Fort Dix exit providing access. Direct access to the Base can be had from the west via County Routes 537 and 614 directly to Gate 2. The Base is located within the northern edge of the New Jersey Pinelands National Reserve. Land uses on McGuire AFB include administrative, aircraft operations and maintenance, airfield, community, housing (family), housing (unaccompanied), industrial, medical, open space, outdoor recreation, and water. The majority of the approximately 3,600-acre base is airfield, supporting the two active runways, 06/24 and 18/36.

2.2 Mission

The 87th Air Base Wing (87 ABW) is the host unit at Joint Base McGuire-Dix-Lakehurst and reports to the Air Mobility Command, headquartered at Scott AFB, Illinois. The mission of the wing is to provide mission support to a variety of missions including airlift, airdrop, air refueling, contingency response, warfighter training, and Naval research and development, including processing and movement of troops, passengers, military equipment, cargo, and mail. During wartime, the 87 ABW supports deployment and resupply of the major combat units of the United States. The 87 ABW also provides administrative, logistical, and medical support to Major Air Mobility Wing tenants (305th Air Mobility Wing [AMW], 514th AMW [Air Force Reserve], and 108 ARW), other tenant agencies, and the Joint Base McGuire AFB – Fort Dix – Lakehurst NAES community, including retirees and their families. The organizational structure of 87 ABW consists primarily of a logistics group, medical group, and air base support group.

Major tenant units on the Base include the 305 AMW, 514 AMW, 108 ARW, the USAF Expeditionary Center, the 621st Contingency Response Wing, 21st Expeditionary Mobility Task Force, and the Noncommissioned Officers Academy, The Navy Combat Readiness Center, Ft. Dix NCO Academy, Federal Bureau of Prisons, Headquarters New Jersey Army and Air National Guard, US Coast Guard Atlantic Strike Team, Northeast Regional Response Team, US MEPCOM (Ft. Dix), Navy Expeditionary Combat Command, Urban Search and Rescue Task Force, US Army Communications – Electronics Communication Command (CECOM), Electronics Integration Directorate, Defense Reutilization and Marketing Office, Naval Air Technical Training Center, Naval Medical Clinic, Naval Criminal Investigative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Lacey Township
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NAES Lakehurst
McGuire AFB
McGuire Air Force Base 2009 AICUZ
LEGEND
McGuire AFB Property
Fort Dix Boundary
Roadway
Municipality Limits
Runway
New Jersey
Key Map
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Miles
McGuire AFB Location Map
Figure 2.1
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Service, 245th Regiment Army National Guard, New Jersey State Police, Ocean County Vocational/ Technical School, and Naval Mobile Construction Battalion 21.

The 305 AMW has three flying squadrons, the 6th Airlift Squadron (AS) and 2nd and 32nd Air Refueling Squadrons (ARS) and a Formal Training Unit (FTU) that is part of the 305 OSS. As an Air Force Reserve Associate unit, the 514 AMW possesses no aircraft and flies aircraft assigned to the 305 AMW. Flying squadrons assigned to the 514 AMW include the 732 AS, 76 ARS, and 78 ARS. The 141st ARS is assigned to the 108 ARW. Table 2.1 lists the number of aircraft assigned to each organization.

Table 2.1 Assigned Aircraft

Wing	Aircraft Type	Number of Aircraft
305 AMW	KC-10	32
305 AMW	C-17	13
108 ARW	KC-135R	8
108 ARW	C-32	2

2.3 Economic Impact

The Economic Impact Region for McGuire AFB is the geographic area subject to significant base-generated economic impacts, and is defined as the area within a 50-mile radius of the Base. This area includes the New Jersey counties of Burlington, Monmouth, and Ocean. The area most immediately impacted includes the counties of Ocean and Burlington, the boroughs of Wrightstown and Pemberton, and the townships of North Hanover, New Hanover, Plumsted, and Pemberton.

2.3.1 Local Economic Characteristics

As shown in Table 2.2, the estimated 2007 population of Burlington County stands at 446,817. The county population increased by 6.7 percent between 1990 and 2000. Of the communities surrounding McGuire AFB, small population increases are occurring in North Hanover Township and Pemberton Borough, while small population decreases are occurring in New Hanover Township, Wrightstown Borough, and Pemberton Township.

Table 2.2 Historic and Projected Population

Burlington County Population Estimates and Projections		
Area	**2000 Census**	**2007 Projection**
New Hanover Township	9,744	9,439
North Hanover Township	7,347	7,415
Wrightstown Borough	748	733
Pemberton Township	28,691	28,158
Pemberton Borough	1,210	1,668
Total	**423,394**	**446,817**

Source: 2000 US Census Bureau, Population Estimates, 2007 Population Estimates, 2008

2.3.2 Base Impact

McGuire AFB directly employs over 8,000 personnel. As shown in Table 2.3, the Base has a total population of 16,225 including military dependents. The annual payroll of the installation is over $650 million (Table 2.4). As a result of payroll expenditures and the estimated value of indirect jobs in the local area, McGuire AFB has an estimated total economic impact of nearly $1.0 billion on the local economy. The majority of this economic impact is due to payroll and contracts generated by the installation.

Table 2.3 Personnel by Classification

Classification	Total
Active Duty Military	**5,568**
Reserve and Guard	**1,623**
Total Military	**7,191**
Appropriated Fund Civilian Employees	**937**
Other Civilian Employees	**1,675**
Military Dependents	**6,422**
Total Civilian	**9,034**
Grand Total	**16,225**

Source: McGuire AFB Economic Impact Report FY05

Table 2.4 Annual Economic Impact

Category	($)
Payroll	
Military	**331,967,786**
Appropriated Fund Civilian Employees	**82,203,798**
Other Civilian	**94,246,434**
Total	**508,418,018**
Expenditures	
Base Operations and Maintenance Spending	**72,906,723**
Base Non-Operations and Maintenance Spending	**11,257,046**
Other	**136,260,068**
Total	**220,423,837**
Estimated Value of Indirect Jobs	**232,638,176**
Grand Total	**961,480,031**

Source: McGuire AFB Economic Impact Report FY03

SECTION 3

AIRCRAFT OPERATIONS

3.1 Introduction

To describe the relationship between aircraft operations and land use at and around the airfield, it is necessary to fully evaluate the exact nature of flying activities. The November 2008 inventory of McGuire AFB aircraft operations included where aircraft fly, how high they fly, how many times they fly over a given area, and the time of day they operate.

Subsection 3.2 discusses aircraft operations at McGuire AFB. Subsection 3.3 discusses runway and flight track utilization for all operations by aircraft type. Subsection 3.4 describes aircraft maintenance activity, Subsection 3.5 discusses aircraft flight profiles, and Subsection 3.6 presents climatological data.

3.2 Aircraft Operations

Approximately 38,000 annual aircraft operations occurred at McGuire AFB for the 12-month period ending June 2008 based on aircraft operations data validated in November 2008. An aircraft operation is defined as one takeoff/departure, one approach/landing, or half a closed pattern. A closed pattern consists of two portions, a takeoff/departure and an approach/landing, *i.e.,* two operations. A sortie is a single military aircraft flight from the initial takeoff through the termination landing. The minimum number of aircraft operations for one sortie is two operations, one takeoff (departure) and one landing (approach).

Table 3.1 summarizes the projected average busy-day aircraft operations for the McGuire AFB airfield based on information provided by Base staff, flying organizations, and air traffic control personnel. The Air Force and Air National Guard flying units at McGuire AFB operate four different aerial refueling and cargo aircraft types. Fourteen transient military and civilian aircraft were selected to represent the 55 different types of transient aircraft for noise modeling purposes, with selection preference based on the uniqueness of a particular aircraft or those with the greatest number of operations. Operations for the transient military and civilian aircraft types were combined with the selected aircraft based on similar characteristics (*e.g.*, number and type of engines, size of aircraft, airspeed, *etc*.). The table reflects a total of about 158 average busy-day aircraft operations based on collected operations data. Approximately 20 percent of the operations occur at night (10:00 p.m. to 7:00 a.m.).

Although the number of military and civil aircraft operations at an installation usually varies from day to day, NOISEMAP requires input of the specific numbers of daily flight and aircraft maintenance engine runup operations. The Air Force does not follow the FAA's use of the "average annual day" in which annual operations are averaged over an entire 365-day year. Neither does the Air Force use the "worst-case day" since it typically does not represent

the typical noise exposure. Instead, the Air Force uses the "average busy-day" concept in which annual operations for an aircraft type are averaged over the number of flying days per year by that aircraft type. Non-flying days (*e.g.*, weekends or holidays) are not used in computing the "average busy-day" operations. Flying by McGuire AFB flying units ranges from 100 to 365 days per year. Transient aircraft operations are based on 365 days per year.

Table 3.1 Average Busy-Day Aircraft Operations for 2007

Aircraft Type	Daily Arrival/ Departure Operations	Daily Closed Pattern Operations	Total Daily Operations
McGuire AFB Aircraft			
C-17	24.99	23.63	48.62
C-17 Weapons Instructor Course	1.12	0.00	1.12
KC-10	26.20	42.43	68.63
KC-135R	6.60	11.84	18.44
C-32	1.94	6.79	8.73
Subtotal	60.85	84.69	145.54
Transient Aircraft			
B-737	0.24	0.00	0.24
C-17	2.72	0.00	2.72
C-12	1.22	0.00	1.22
C-21	0.55	0.00	0.55
B-747	1.68	0.00	1.68
KC-135	0.35	0.00	0.35
Helicopter	0.72	0.00	0.72
KC-10	1.00	0.00	1.00
F-18	0.35	0.00	0.35
DC-8	0.98	0.00	0.98
C-130	2.24	0.00	2.24
DHC-6	0.12	0.00	0.12
B-757	0.31	0.00	0.31
C-5	0.10	0.00	0.10
Subtotal	12.58	0.00	12.58
Total	73.43	84.69	158.12

Note: An operation is one takeoff/departure or one arrival/landing. A closed pattern consists of two operations, one takeoff and one landing.

3.3 Runway and Flight Track Utilization

Runway 06/24 is 10,001 feet long and 150 feet wide. Runway 18/36 is 150 feet wide and 7,140 feet long. The overruns at the ends of runway 06/24 are approximately 1,000 feet long at each end. There are no overruns on Runway 18/36. The airfield elevation is 131 feet above mean sea level (MSL).

The McGuire AFB radar approach control (RAPCON) provides air traffic control services for aircraft arrivals and departures at the Base, other airports in the area, and aircraft transiting through RAPCON airspace. RAPCON controls airspace out to about 25 miles north and northwest, 47 miles to the east, and 20 miles to the south and southwest of the Base. Except for a small portion of airspace to the immediate west of the Base, airspace from the southwest to northwest of the Base is allocated to another control agency and used for arrivals

and departures at the Philadelphia International Airport. McGuire AFB RAPCON radar patterns, 80 percent of which are flown to the east of the Base, are normally flown at approximately 3,000 feet above ground level (AGL).

Other airports within the area of influence for aircraft arrival and departure flight tracks at McGuire AFB are the Trenton-Robbinsville Airport 12 miles north, the Allaire Airport 24 miles northeast, NAES Lakehurst 11 miles east, the Lakewood Airport 19 miles east, the Miller Airport 14 miles southeast, Atlantic City International Airport 32 miles south, Red Lion Airport 10 miles south-southwest, Flying W Airport 11 miles southwest, the South Jersey Airport 12 miles southwest, Philadelphia International Airport 30 miles southwest, and the Redwing Airport 5 miles north-northwest. Additionally, the western edge of restricted airspace (R-5001) is about 2 miles east and southeast of McGuire AFB. The location and proximity of R-5001 and these airports relative to McGuire AFB require that arriving and departing aircraft be routed to avoid conflict. Likewise, regional aircraft routings are developed, to the maximum extent practicable, to establish common tracks that serve the arrival and departure "flow" for all the airports within the area. To reduce aircraft noise in the area surrounding McGuire AFB, aircraft do not overfly Deborah Hospital located in Browns Mills, NJ.

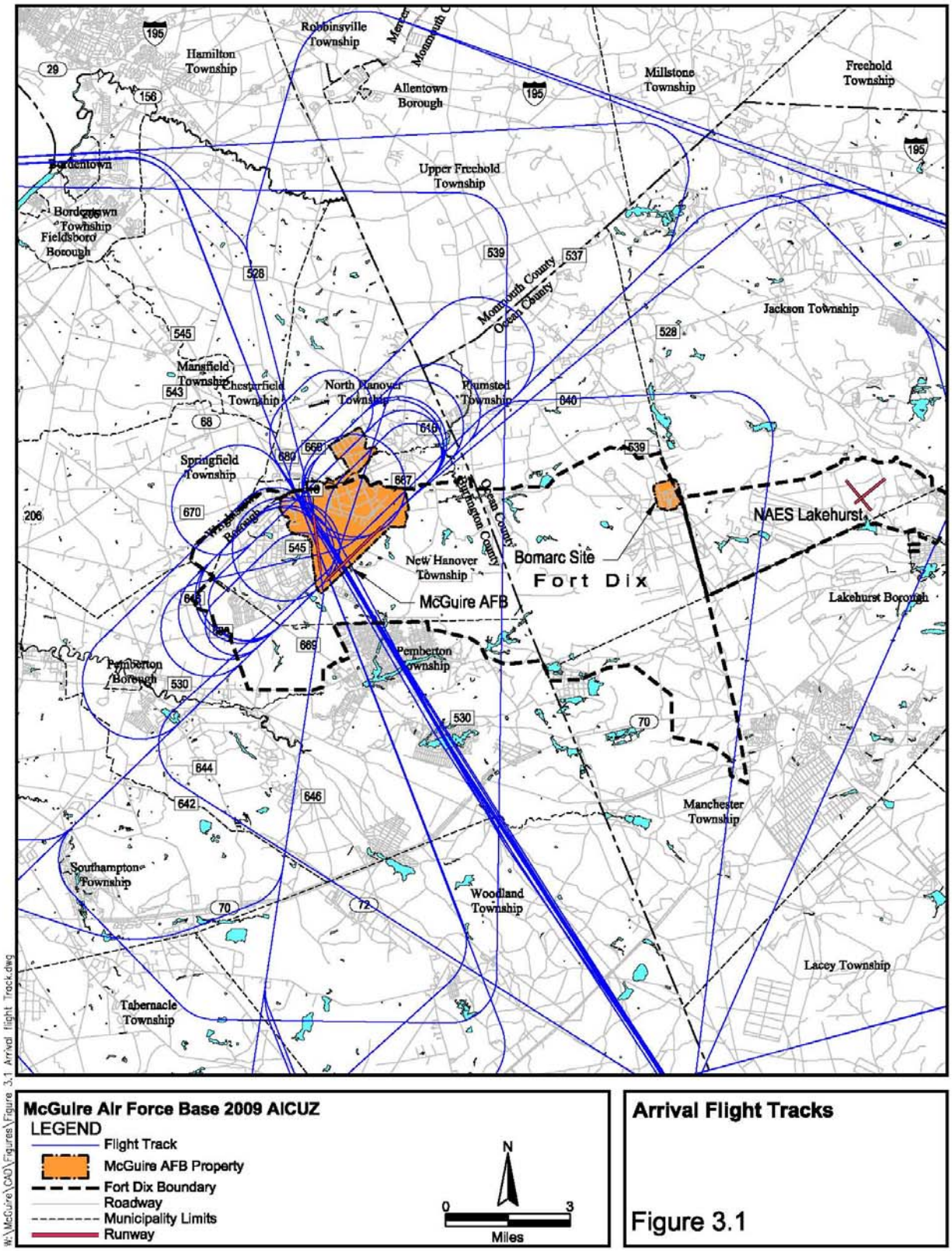
McGuire AFB aircraft use the following basic flight patterns:

- Straight-in approaches;
- Overhead landing patterns;
- Instrument Flight Rule or radar closed patterns;
- Visual Flight Rule (VFR) or closed patterns;
- Re-entry VFR patterns; and
- Tactical departures and arrivals.

Flight patterns specific to McGuire AFB result from several considerations, including:

- Departures from Runway 06 which proceed straight out about 4 miles before turning right (to avoid R-5001);
- Applicable criteria governing the speed, rate of climb, and turning radius for each type of aircraft; and
- Coordination with the FAA to minimize conflict with civilian aircraft operations.

Planning for areas surrounding an airfield considers three primary aircraft operational/ land use determinants: (1) aircraft accident potential to land users; (2) aircraft noise; and (3) hazards to operations from land uses (*e.g.*, height of structures). Each of these concerns is addressed in conjunction with mission requirements and safe aircraft operations to determine the optimum flight track for each aircraft type. The flight tracks depicted in Figures 3.1 through 3.3 are the result of such planning and depict the representative flight tracks used for noise modeling. The flight track locations represent the various types of arrivals, departures,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Lakehurst Borough
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Pemberton Borough
Manchester Township
Southampton Township
Woodland Township
Lacey Township
Tabernacle Township
Monmouth County
Ocean County
Burlington County
McGuire Air Force Base 2009 AICUZ
LEGEND
Flight Track
McGuire AFB Property
Fort Dix Boundary
Roadway
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Arrival Flight Tracks
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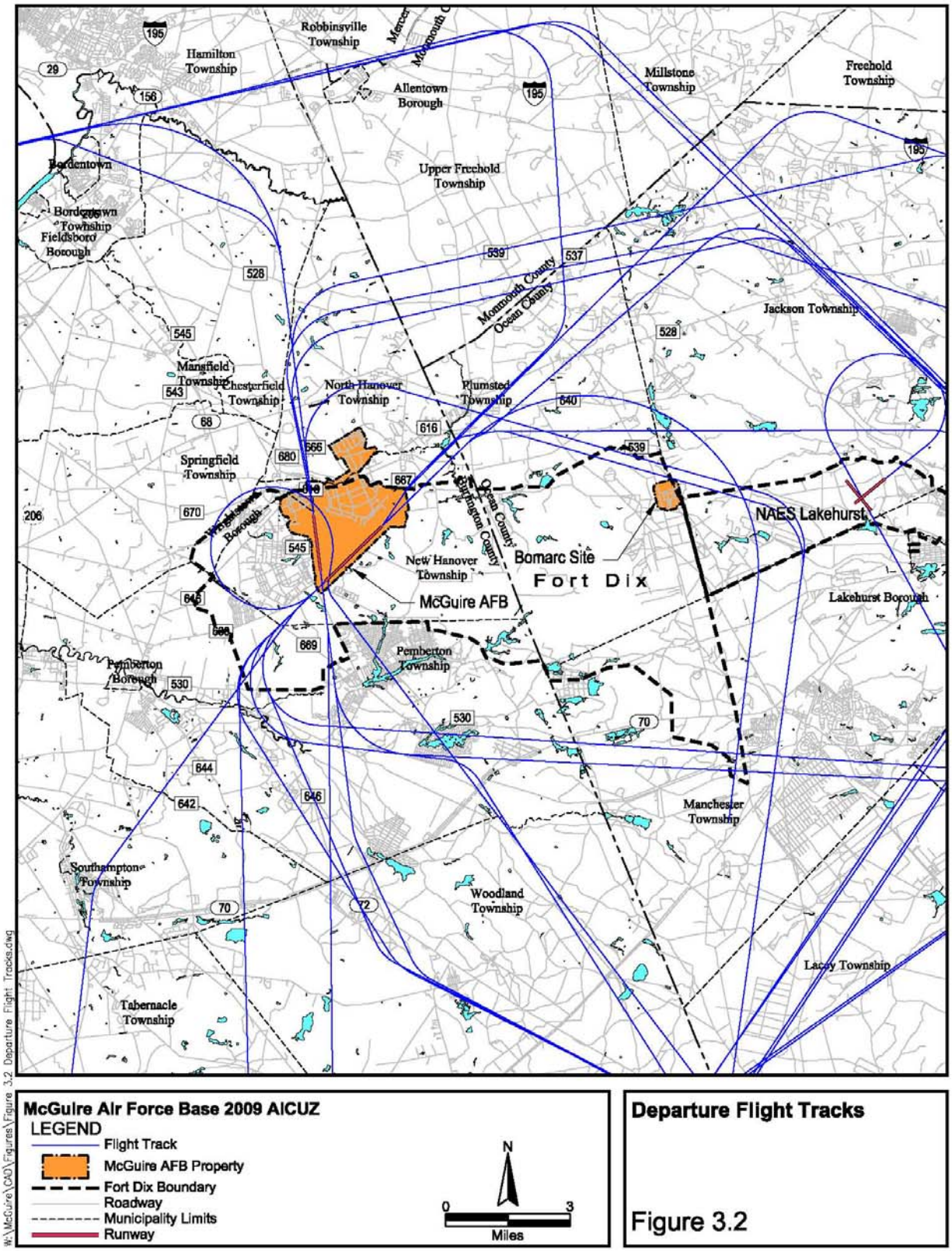
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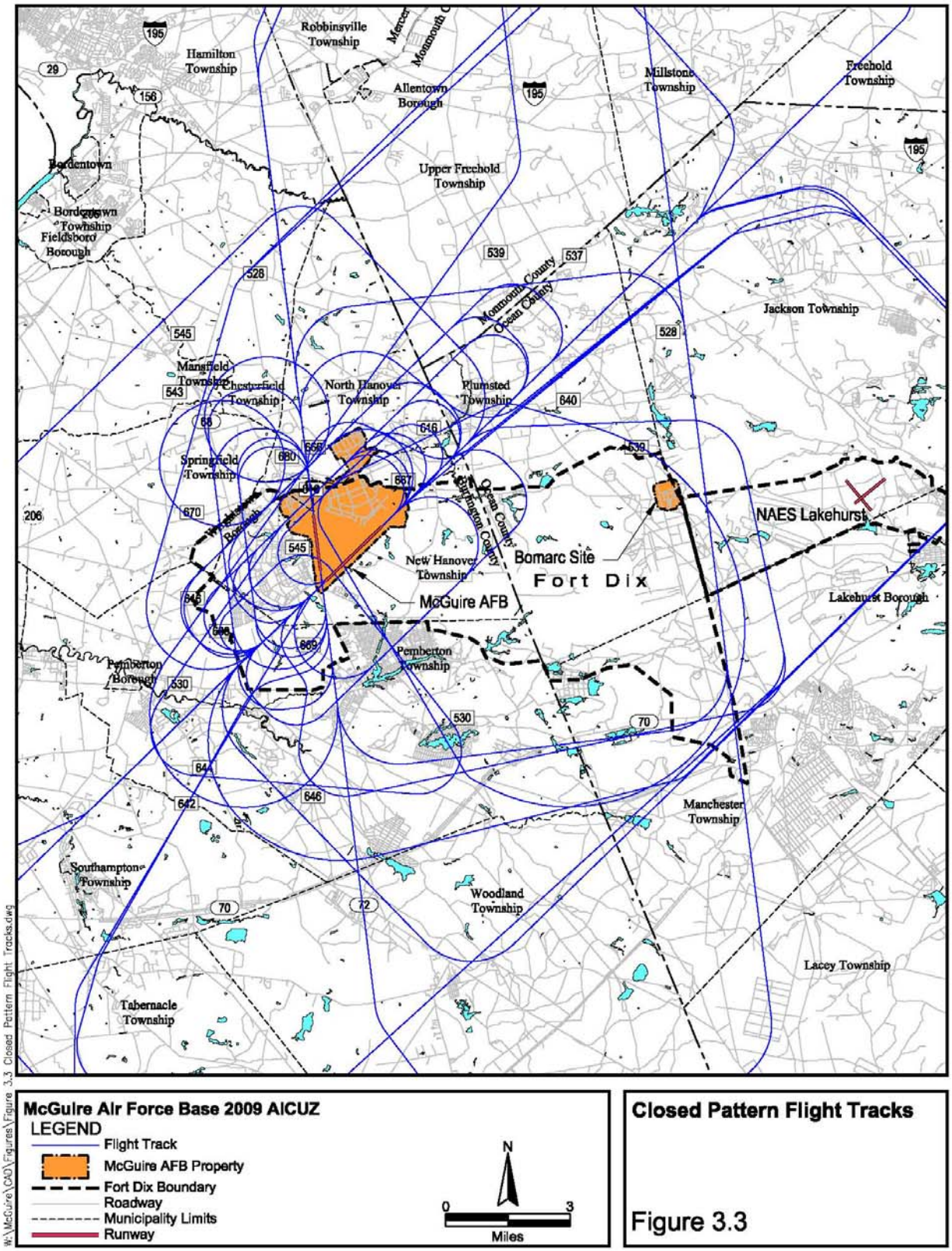
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Closed Pattern Flight Tracks
Figure 3.3
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and closed patterns accomplished at McGuire AFB. The location for each track is representative for the specific track and may vary due to air traffic control, weather, and other reasons (*e.g.*, one pilot may fly the track on one side of the depicted track, while another pilot may fly the track slightly to the other side). For this study, runway use was: Runway 06—23 percent; Runway 18—2 percent; Runway 24—72 percent; and Runway 36—3 percent (based on all runways being available and usable).

3.4 Aircraft Maintenance Runup Operations

To the maximum extent possible, aircraft maintenance engine runup locations have been established in areas to minimize noise. Base flying units and their associated maintenance functions accomplish aircraft maintenance engine runup operations.

Average busy-day aircraft maintenance runup operations were calculated similarly to flight operations described in Subsection 3.1. Weekly, monthly, or annual estimates of runups provided by McGuire AFB aircraft maintenance personnel were divided by the typical number of days runups that are performed over the respective period. Approximately 20 percent of the aircraft maintenance runups at McGuire AFB occur during the night (10:00 p.m. to 7:00 a.m.).

3.5 Aircraft Flight Profiles

For purposes of this AICUZ Study, aircraft "flight profiles" denote the aircraft power settings, altitudes above runway level, and airspeeds along each flight track. Aircraft flight profiles for C-17, KC-10, C-32, and KC-135 aircraft were obtained from McGuire AFB personnel. Generic flight profiles from the BASEOPS database were used to model operations for the other aircraft types. Noise data from the NOISEFILE database were used to model operations for all aircraft types.

3.6 Climatological Data

Weather conditions, measured by temperature and relative humidity, are an important factor in the propagation of noise. The average temperature and humidity for each month of the year are input into BASEOPS, which then calculates the sound absorption coefficient for each month. Ranking the twelve monthly sound absorption coefficients from smallest to largest, BASEOPS chooses the sixth smallest sound absorption coefficient to represent the typical weather conditions at the Base. The month with the sixth smallest sound absorption coefficient for McGuire AFB is the month with an average monthly temperature of 62 degrees Fahrenheit and 68 percent relative humidity.

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SECTION 4

EFFECTS OF AIRCRAFT OPERATIONS

4.1 Introduction

This section has two purposes. The first is to describe the imaginary surfaces associated with obstructions to air navigation, noise exposure, CZs, and APZs. The second purpose is to present applicable land use compatibility guidelines and the Air Force's participation in the land use planning process.

4.2 Runway Airspace Imaginary Surfaces

Obstructions to air navigation are considered to be:

- Natural objects or man-made structures that protrude above the planes or imaginary surfaces, and/or;
- Man-made objects that extend more than 500 feet AGL at the site of the structure.

4.2.1 Explanation of Terms

The following elevation, runway length, and dimensional criteria apply:

- Controlling Elevation—Whenever surfaces or planes within the obstruction criteria overlap, the controlling (or governing) elevation becomes that of the lowest surface or plane.
- Runway Length - McGuire AFB has two runways: 06/24 and 18/36.
- Runways 06/24 and 18/36 are 10,001 and 7,140 feet long, respectively. Both runways are Class B runways and designed and built for sustained heavy aircraft operations.
- Established Airfield Elevation is 131 feet above MSL.
- Dimensions—all dimensions are measured horizontally unless otherwise noted.

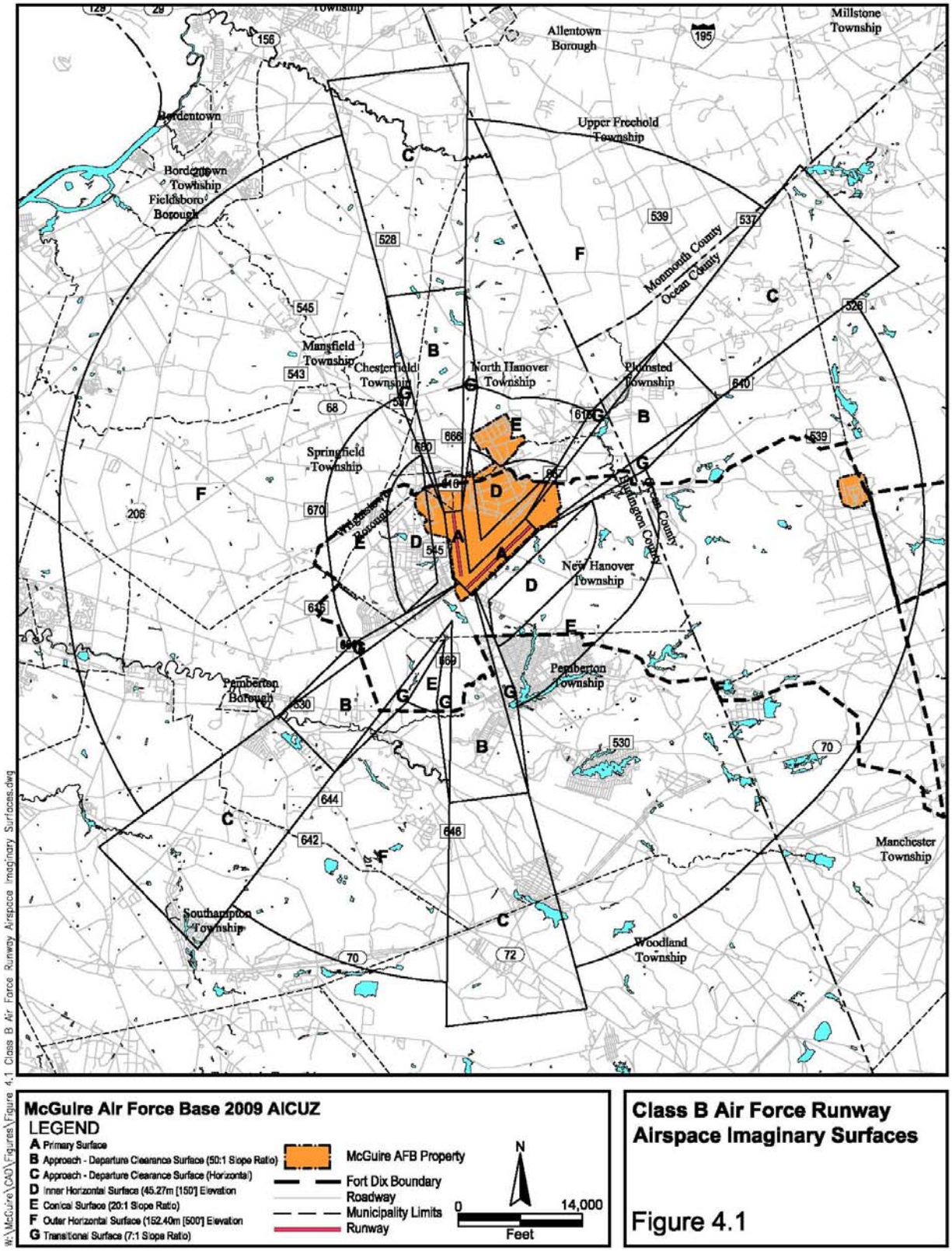
4.2.2 Runway Airspace Imaginary Surfaces

The Air Force seeks to protect all airfields from airspace encroachment by land uses that are incompatible with the Base's mission. Runway airspace imaginary surfaces, in graphical form, are the result of the application of obstruction height criteria to McGuire AFB. Imaginary surfaces are surfaces in space around airfields in relation to runways. The surfaces are designed to define the obstacle-free airspace at and around the airfield. Refer to Unified Facilities Criteria (UFC) 3-260-01, *Airfield and Heliport Planning and Design*, for a more complete description of runway airspace imaginary surfaces for Class B runways. Air Force obstruction criteria in UFC 3-260-01 are based on those contained in Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*, Subpart C. FAR Part 77

provides guidance on submittal of FAA Form 7460-1, *Notice of Proposed Construction or Alteration*. The form is used to notify the FAA of construction or alteration of structures proximate to imaginary surfaces around airfields.

Figure 4.1 depicts the runway airspace imaginary surfaces for the McGuire AFB Class B runways. The following paragraphs contain definitions of the runway airspace imaginary surfaces for Air Force class B runways:

- Primary Surface—An imaginary surface symmetrically centered on the runway, extending 200 feet beyond each runway end that defines the limits of the obstruction clearance requirements in the vicinity of the landing area. The width of the primary surface is 2,000 feet, or 1,000 feet on each side of the runway centerline.
- Clear Zone Surface—An obstruction-free surface (except for features essential for aircraft operations) on the ground symmetrically centered on the extended runway centerline beginning at the end of the runway and extending outward 3,000 feet. The CZ width is 3,000 feet (1,500 feet to either side of runway centerline).
- Accident Potential Zone Surfaces—APZ I begins at the outer end of the CZ and is 5,000 feet long and 3,000 feet wide. APZ II begins at the outer end of APZ I and is 7,000 feet long and 3,000 feet wide.
- Approach-Departure Clearance Surface—This imaginary surface is symmetrically centered on the extended runway centerline, beginning as an inclined plane (glide angle) 200 feet beyond each end of the primary surface, and extending for 50,000 feet. The slope of the approach-departure clearance surface is 50:1 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 starting point. The width of this surface at the runway end is 2,000 feet, flaring uniformly to a width of 16,000 feet at the end point.
- Inner Horizontal Surface—This imaginary surface is an oval plane at a height of 150 feet above the established airfield elevation. The inner boundary intersects with the approach-departure clearance surface and the transitional surface. The outer boundary is formed by scribing arcs with a radius 7,500 feet from the centerline of each runway end and interconnecting these arcs with tangents.
- Conical Surface—This is an inclined imaginary 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. The conical surface connects the inner and outer horizontal surfaces.
- Outer Horizontal Surface—This imaginary surface is located 500 feet above the established airfield elevation and extends outward from the outer periphery of the conical surface for a horizontal distance of 30,000 feet.
- Transitional Surface—This imaginary surface extends outward and upward at right angles to the runway centerline and extended runway centerline at a slope of 7:1. The transitional surface connects the primary and the approach-departure clearance surfaces to the inner horizontal, the conical, and the outer horizontal surfaces.


Millstone Township
Allentown Borough
Upper Freehold Township
Bordentown
Bordentown Township
Fieldsboro Borough
Monmouth County
Ocean County
Mansfield Township
Chesterfield Township
North Hanover Township
Plumsted Township
Springfield Township
Wrightstown Borough
Burlington County
New Hanover Township
Pemberton Township
Pemberton Borough
Manchester Township
Southampton Township
Woodland Township
McGuire Air Force Base 2009 AICUZ
LEGEND
A Primary Surface
B Approach - Departure Clearance Surface (50:1 Slope Ratio)
C Approach - Departure Clearance Surface (Horizontal)
D Inner Horizontal Surface (45.27m [150'] Elevation
E Conical Surface (20:1 Slope Ratio)
F Outer Horizontal Surface (152.40m [500'] Elevation
G Transitional Surface (7:1 Slope Ratio)
McGuire AFB Property
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
14,000
Feet
Class B Air Force Runway Airspace Imaginary Surfaces
Figure 4.1
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4.3 Restricted and/or Prohibited Land Uses

The land areas outlined by these criteria should be regulated to prevent uses that might otherwise be hazardous to aircraft operations. The following uses should be restricted and/or prohibited:

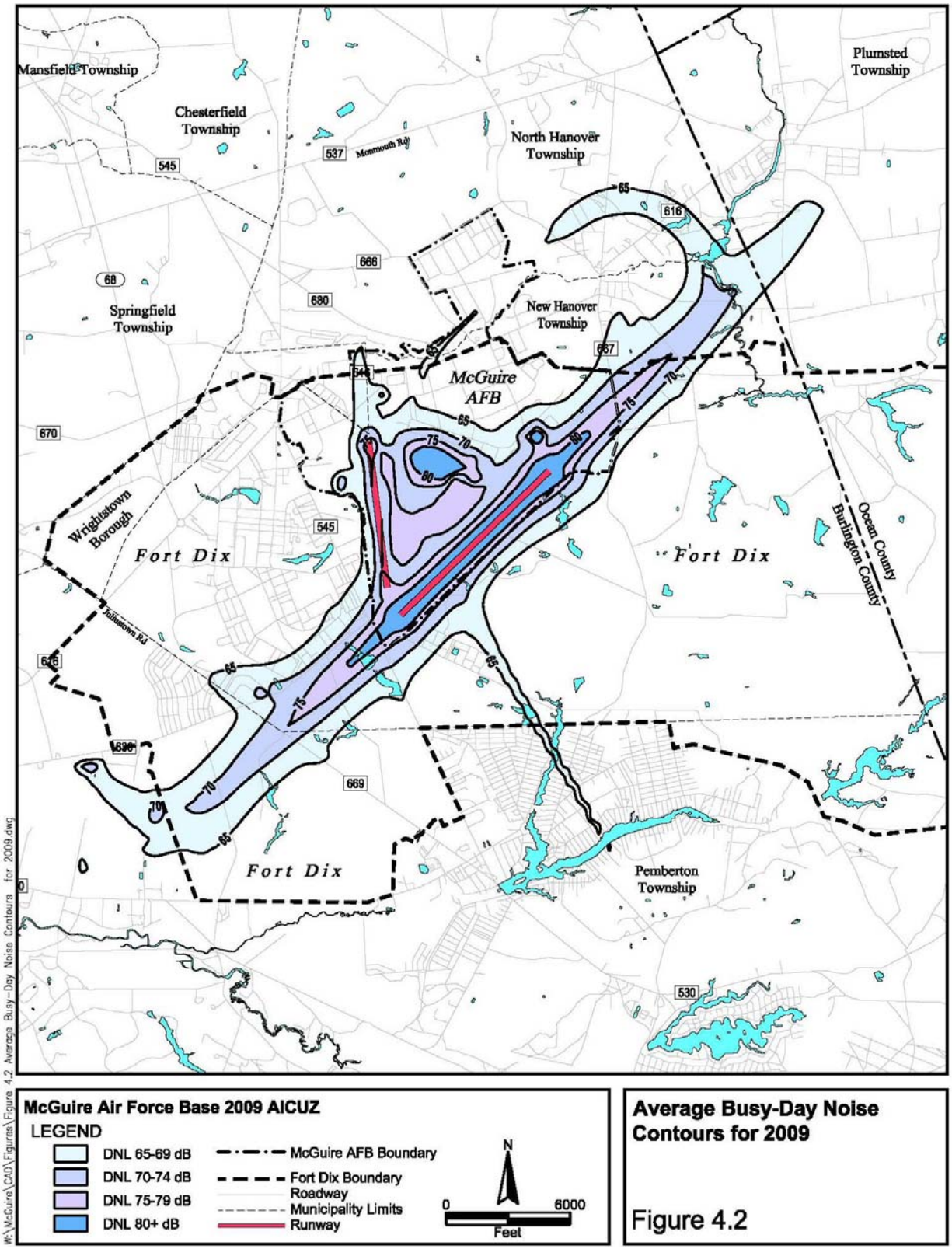
- Releases into the air of any substance that would impair visibility or otherwise interfere with the operation of aircraft (*e.g.*, steam, dust, or smoke);
- Light emissions, either direct or indirect (reflective), that would interfere with pilot vision;
- Electrical emissions that would interfere with aircraft communications systems or navigational equipment;
- Uses that would attract birds or waterfowl, including but not limited to, operation of sanitary landfills, waste transfer facilities, maintenance of feeding stations, sand and gravel dredging operations, storm water retention ponds, created wetland areas, or the growing of certain vegetation; and
- Structures within 10 feet of aircraft approach-departure and/or transitional surfaces.

4.4 Noise Exposure

NOISEMAP Version 7.32 was used to calculate and plot the DNL noise contours based on the average busy-day aircraft operations data collected in 2008 and described in Subsections 3.1 through 3.6. Figure 4.2 shows the DNL noise contours plotted in 5 dB increments, ranging from DNL 65 dB to DNL at or above 80 dB.

Different sounds have different frequency content. When describing sound and its effect on a human population, A-weighted (dB) sound levels are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the sound signal to emphasize frequencies in the middle of the audible spectrum and to de-emphasize low and high frequencies in a manner corresponding to the way the human ear perceives sound. This filtering network has been established by the American National Standards Institute. The A-weighted noise level has been found to correlate well with people's judgments of the noisiness of different sounds and has been in use for many years as a measure of community noise.

Table 4.1 shows the off-DoD property noise exposure within the DNL 65 dB and greater noise exposure area for aircraft operations at McGuire AFB in terms of acreage and estimated population. DNL is the measure of the total noise environment. The population data used in preparing this estimate were obtained from the United States Census Bureau 2000 census. To estimate affected population, it was assumed that population was equally distributed within a census tract area. Using this assumption, the total acreage and population in each census tract surrounding McGuire AFB was collected and assessed. Using the noise contour information, the number of acres of land in each noise zone (*i.e.*, DNL 65-69 dB, 70-74 dB, 75-79 dB, and 80 dB and greater) was divided by the number of acres of land in each census tract to determine what portion of the census tract was contained within each noise zone. The


Mansfield Township
Chesterfield Township
North Hanover Township
Plumsted Township
Springfield Township
New Hanover Township
McGuire AFB
Wrightstown Borough
Fort Dix
Fort Dix
Fort Dix
Ocean County
Burlington County
Pemberton Township
Monmouth Rd
Jobstown Rd
545
537
616
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68
680
667
670
669
530
65
70
75
80
McGuire Air Force Base 2009 AICUZ
LEGEND
DNL 65-69 dB
DNL 70-74 dB
DNL 75-79 dB
DNL 80+ dB
McGuire AFB Boundary
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
6000
Feet
Average Busy-Day Noise Contours for 2009
Figure 4.2
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population total in each block-group was then multiplied by this ratio to estimate population exposed to aircraft noise at and above DNL 65 dB.

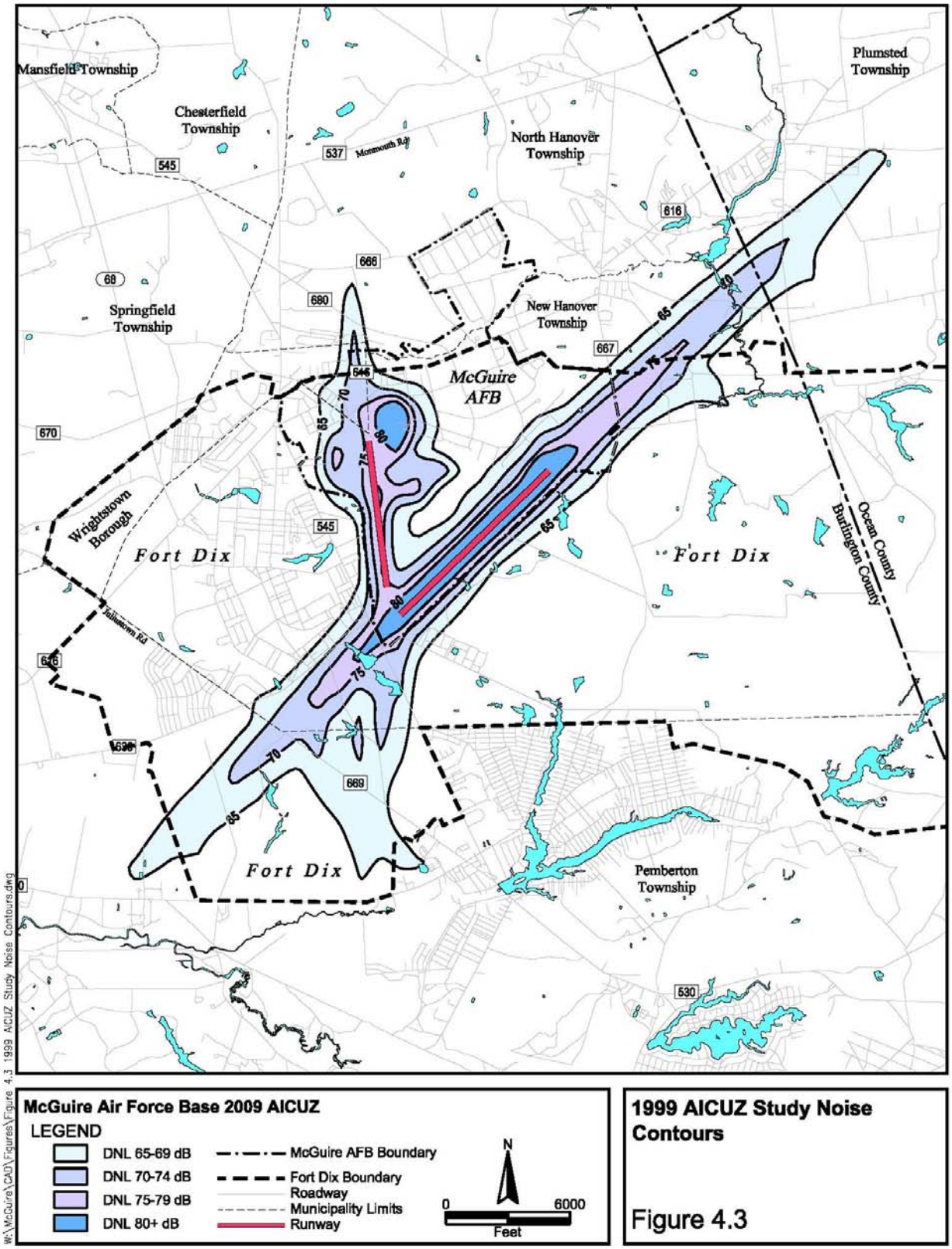
Table 4.1 Area and Population within DNL 65 dB and Greater Noise Exposure Area (off-DoD Property)

DNL Noise Zone	Acres	Population
65–69	1,004	431
70–74	194	130
75–79	1	6
80+	0	0
Total	**1,199**	**567**

From Table 4.1, a total of 1,199 acres and 567 persons are expected to be in the off-DoD property area within the DNL 65 dB and greater noise exposure area. The largest affected population is within the DNL 65–69 dB noise zone. This area is estimated to contain 1,004 acres in off-DoD property land area (73 percent of the total) and an estimated population of 431 persons (76 percent of the total) based on the calculated population densities for the area.

4.5 Comparison with 1999 AICUZ Study

The 2009 AICUZ Study noise contours are similar in both shape and extent of coverage when compared to the noise contours in the 1999 AICUZ Study. Figure 4.3 depicts the 1999 AICUZ Study contours and Figure 4.4 compares the 2009 and 1999 contours. The off-DoD property exposure for this AICUZ Study is approximately 158 more acres than the 1999 AICUZ Study. Table 4.2 lists the total noise exposure for the four noise zones in each study. The 2009 AICUZ Study noise contours when compared to the 1999 AICUZ Study noise contours show there are 248 acres more off-DoD property acres within the DNL 65-69 dB noise contour. However, the 2009 AICUZ Study noise contours contain 77 acres less off-base acres in the DNL 70-74 noise contour and 13 acres less in the 75-79 DNL noise contour when compared to the 1999 AICUZ Study noise contours. There was no change in the DNL 80+ noise contour. Differences in the contours occur to the south where the 2009 contour extends farther and to the northeast and southeast where the 1999 contour covers more land. Additional differences occur to the northeast, east, and southeast of the installation where area that was exposed to DNL 65-69 dB in the 1999 study is exposed to DNL 70-80+ dB in the 2009 study. The changes in the contours result from a greater number of operations being accomplished on Runway 06/24 when comparing the aircraft operations conditions for the 2009 and 1999 studies. The increase in operations on Runway 06/24 causes the slight eastward "shift" of the contours when comparing 2009 and 1999. Additionally, there are a greater number of closed pattern flight tracks on the east side of the airfield under the 2009 study and the operations on these tracks contribute to the increased noise exposure to the northeast, east, and southeast of the installation.


Mansfield Township
Chesterfield Township
Plumsted Township
North Hanover Township
New Hanover Township
Springfield Township
Wrightstown Borough
McGuire AFB
Fort Dix
Fort Dix
Fort Dix
Pemberton Township
Ocean County
Burlington County
Monmouth Rd
Tuckerton Rd
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537
616
668
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667
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669
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65
70
75
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W:\McGuire\CAD\Figures\Figure 4.3 1999 AICUZ Study Noise Contours.dwg
McGuire Air Force Base 2009 AICUZ
LEGEND
DNL 65-69 dB
DNL 70-74 dB
DNL 75-79 dB
DNL 80+ dB
McGuire AFB Boundary
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
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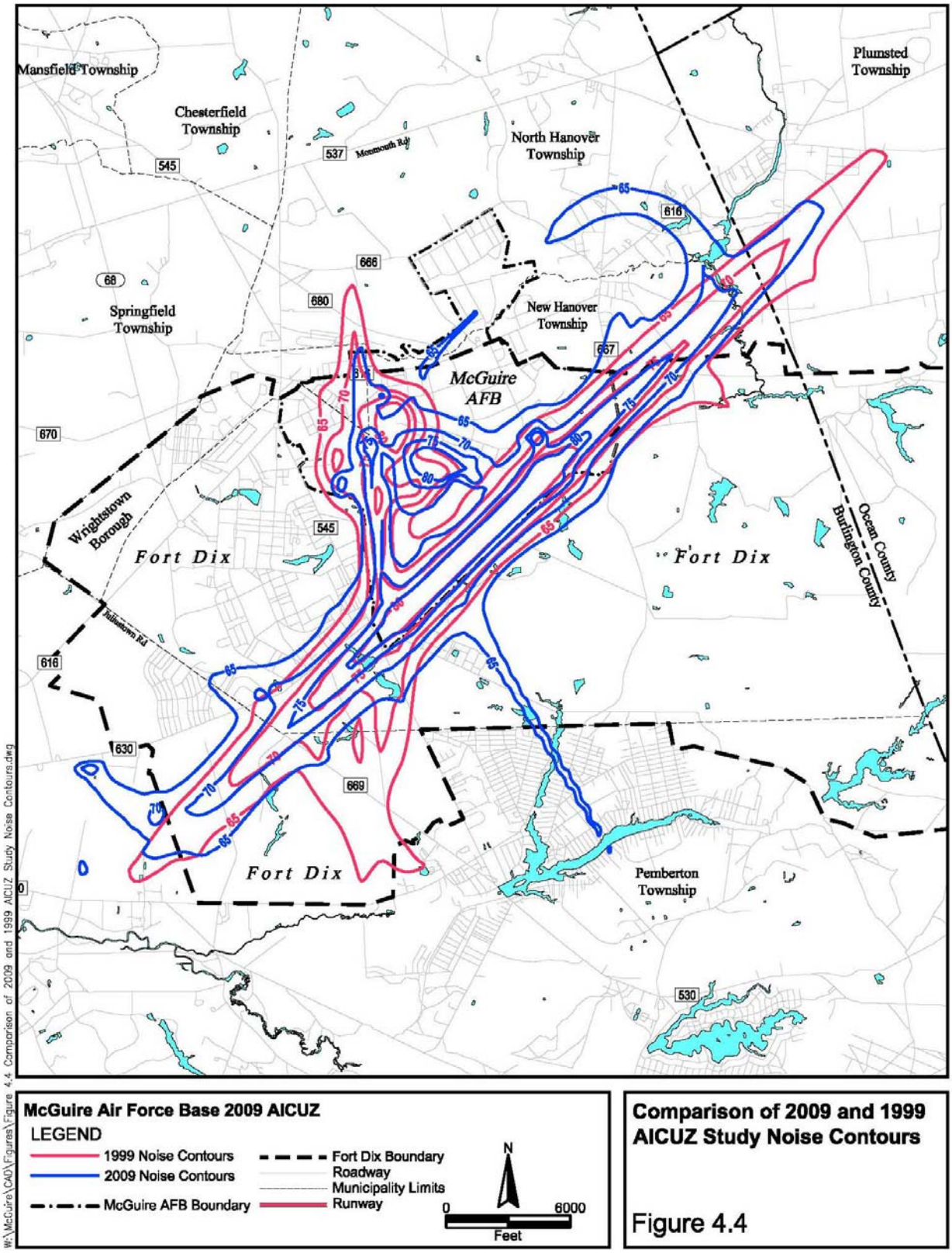
Feet
1999 AICUZ Study Noise Contours
Figure 4.3


Mansfield Township
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Springfield Township
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Fort Dix
Ocean County
Burlington County
Pemberton Township
Monmouth Rd
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McGuire Air Force Base 2009 AICUZ
LEGEND
1999 Noise Contours
2009 Noise Contours
McGuire AFB Boundary
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
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Feet
Comparison of 2009 and 1999 AICUZ Study Noise Contours
Figure 4.4

Table 4.2 Total Acres within the 2009 and 1999 AICUZ Study Noise Zones (off-DoD Property)

	Acres	
DNL Noise Zone	**2009 Study**	**1999 Study**
65–69	1,004	756
70–74	194	271
75–79	1	14
80+	0	0
Total	**1,199**	**1,041**

4.6 Clear Zones and Accident Potential Zones

The purpose of this section is to describe the basis for CZs and APZs and apply the zones to the McGuire AFB runways.

4.6.1 Basis for Clear Zones and Accident Potential Zones

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

The risk of people on the ground 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 Air Force does not attempt to base its safety standards on accident probabilities. Instead, it approaches this safety issue from a land use-planning perspective. Designation of safety zones around the airfield and restriction of incompatible land uses can reduce the public's exposure to safety hazards.

The AICUZ program includes three safety zones: the CZ, APZ I, and APZ II. These zones were developed from analysis of over 800 major Air Force accidents that occurred within 10 miles of an Air Force installation between 1968 and 1995. Figure B-3 in Appendix B summarizes the location of these accidents.

The CZ has the highest accident potential of the three zones, as 27 percent of accidents studied occurred in this area. Due to the relatively high accident potential, the Air Force adopted a policy of acquiring real estate interests in the CZ through purchase or easement when feasible.

APZ I is an area that possesses somewhat less accident potential than the CZ, with 10 percent of the accidents studied occurring in this zone. APZ II has less accident potential than APZ I, with 6 percent of the accidents studied occurring in this zone. While the potential for aircraft accidents in APZs I and II does not warrant land acquisition by the Air Force, land-use planning and controls are strongly encouraged in these areas for the protection of the public.

4.6.2 Clear Zones and Accident Potential Zones

Figure 4.5 depicts the CZs and APZs for Runways 06/24 and 18/36 at McGuire AFB. Each end of Runways 06/24 and 18/36 at McGuire AFB have a 3,000-foot by 3,000-foot CZ and two APZs (APZ I and APZ II). The clear zones and APZ's I at runway ends 24 and 36 overlap due to their proximity. Accident potential on or adjacent to the runway or within the CZ is so high that the necessary land use restrictions would prohibit reasonable economic use of land. It is Air Force policy to request that Congress authorize and appropriate funds to purchase the real property interests in this area to prevent incompatible land uses.

Accident potential in zone I is less critical than the CZ, but still possess 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.

Accident potential in zone II is less critical than APZ I, but still possesses potential for accidents. Accident potential zone II, also 3,000 feet wide, is 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable land uses include those of APZ I, as well as 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 multi-story buildings, places of assembly (*e.g.*, theaters, churches, schools, restaurants, *etc.*), and high-density office uses are not considered appropriate.

High people densities should be limited to the maximum extent possible in APZ II. The optimum density recommended for residential usage (where it does not conflict with noise criteria) in APZ II is one dwelling per acre.

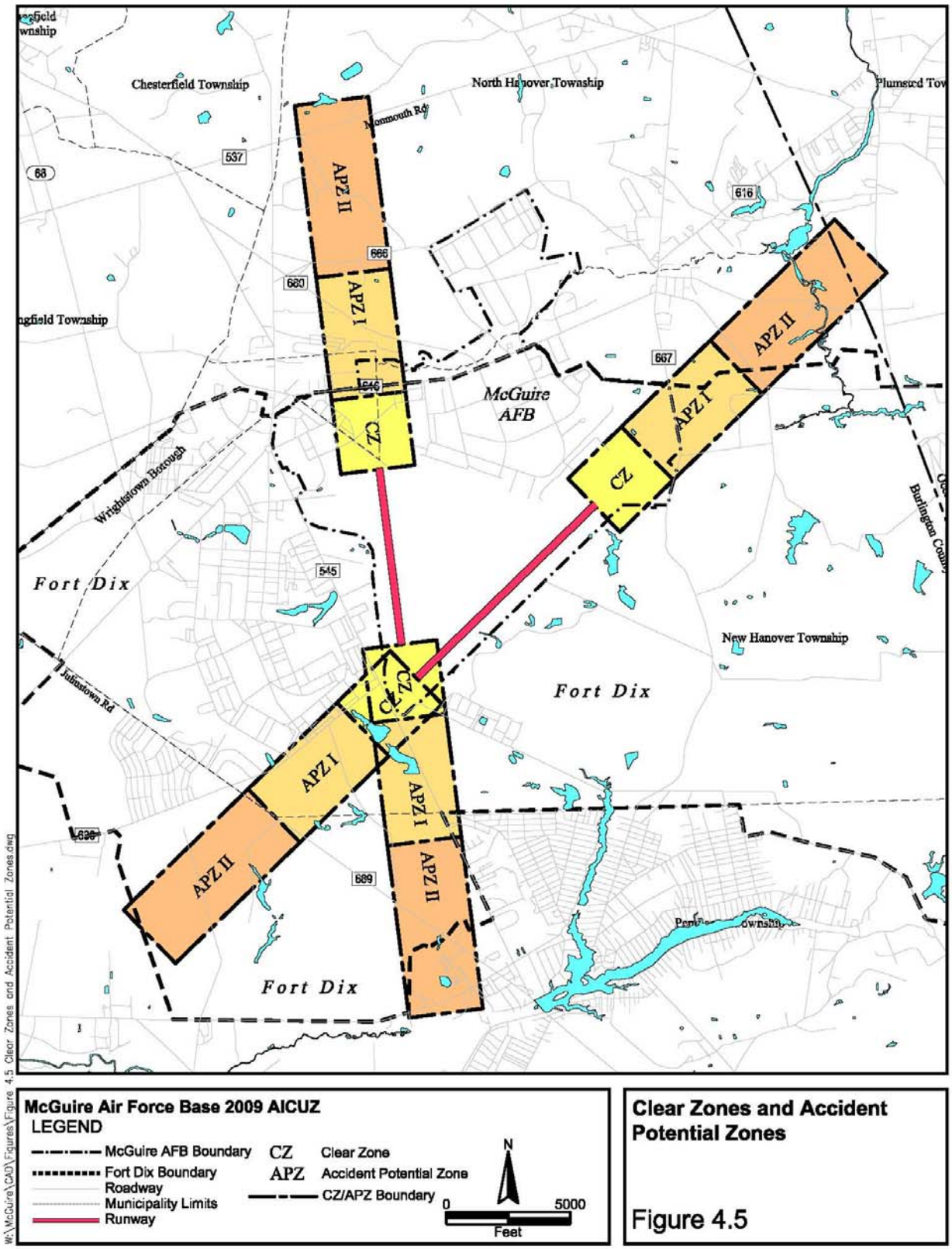
4.6.3 Land Use Compatibility Guidelines

Subsection 4.6.3.1 introduces the AICUZ concept and Subsection 4.6.3.2 presents the land use compatibility guidelines applicable to McGuire AFB.

4.6.3.1 Introduction

The DoD developed the AICUZ program for military airfields in 1972. Using this program at its installations, the DoD works to protect aircraft operational capabilities and to assist local government officials in protecting and promoting the public's 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.

AICUZ reports describe three basic types of constraints that affect, or result from, flight operations. The first constraint involves areas that the FAA and the DoD identified for height limitations (see Subsection 4.2).


Chesterfield Township
North Hanover Township
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APZ II
APZ I
CZ
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McGuire
AFB
Wrightstown Borough
Fort Dix
545
New Hanover Township
Johnstown Rd
636
689
Burlington County
W:\McGuire\CAD\Figures\Figure 4.5 Clear Zones and Accident Potential Zones.dwg
McGuire Air Force Base 2009 AICUZ
LEGEND
McGuire AFB Boundary
Fort Dix Boundary
Roadway
Municipality Limits
Runway
CZ Clear Zone
APZ Accident Potential Zone
CZ/APZ Boundary
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Feet
Clear Zones and Accident Potential Zones
Figure 4.5

The second constraint involves noise zones based on the DNL metric and the DoD NOISEMAP method. Using the NOISEMAP program, which is similar to FAA's INM, the Air Force produces noise contours showing the noise levels generated by aircraft operations. The AICUZ report contains noise contours plotted in 5 dB increments, ranging from DNL 65 dB to 80+ dB.

The third constraint involves CZs and APZs based on statistical analysis of past DoD aircraft accidents. DoD analysis has determined that areas immediately beyond the ends of runways and along the approach and departure flight paths have greater potential for aircraft accidents (see Appendix B).

4.6.3.2 Land Use Compatibility Guidelines

Each AICUZ Study contains land use guidelines. Table 4.3 identifies land uses and possible noise exposure and accident potential combinations for McGuire AFB. These noise guidelines are essentially the same as those published by the Federal Interagency Committee on Urban Noise in the June 1980 publication, *Guidelines for Considering Noise in Land-Use Planning and Control.* The U.S. Department of Transportation publication, *Standard Land Use Coding Manual (SLUCM),* has been used to identify and code land use activities. The designations are a combination of criteria listed in the Legend and Notes at the end of the table. For example, Y^1 means land use and related structures are compatible without restriction at a suggested maximum density of 1-2 dwelling units per acre, possibly increased under a Planned Unit Development where lot coverage is less than 20 percent.

4.7 Participation in the Planning Process

The Air Force provides the AICUZ Study to local communities to assist them in preparing their local land use plans. This section discusses how the Base participates in the community planning process. Subsection 6.3 addresses the role played by the local community in enhancing compatible land use.

Airspace obstructions, construction in the APZs, residential development, and the construction of other noise-sensitive uses near the Base are of great concern to McGuire AFB. The Air Force is very interested in minimizing increases in incompatible usage and in encouraging voluntary conversion of non-compatible usage to compatible usage. Applying the categories for compatible land use described in Table 4.3, the Base evaluates the impact aircraft operations have on surrounding properties and the effect new development or changes in land use might have on McGuire AFB operational capabilities.

The points of contact for AICUZ matters at McGuire AFB are the Public Affairs Office at 609-754-2104 and the Base Community Planner at 609-754-6520. In addition to working with local governing entities and planning professionals, the McGuire AFB Base Public Affairs Office works to address complaints and concerns expressed by off-airfield neighbors.

McGuire AFB conducts active outreach to the community by meeting with various community groups and speaking with individuals as needed. The McGuire AFB Base Civil

Engineer and Public Affairs Offices work together providing public meetings and informational workshops to disseminate information about base operations, forecasts, plans, and mitigation strategies.

Table 4.3 Land Use Compatibility Guidelines

Land Use		Accident Potential Zones			Noise Zones in DNL dB			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
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	**Manufacturing**							
21	Food & 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 & 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	Y	Y	Y[12]	Y[13]	Y[14]
30	**Manufacturing**							
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]

Table 4.3 Land Use Compatibility Guidelines (continued)

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
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]
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 & 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

Table 4.3 Land Use Compatibility Guidelines (continued)

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
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
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**							
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 recreation	N	Y[9]	Y[9]	Y*	Y*	N	N

Table 4.3 Land Use Compatibility Guidelines (continued)

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
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	Agricultural related activities	N	Y[5]	Y	Y[18]	Y[19]	N	N
83	Forestry activities and related services	N[5]	Y	Y	Y[18]	Y[19]	Y[20]	Y[20,21]
84	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

LEGEND

SLUCM - Standard Land Use Coding Manual, U.S. Department of Transportation.
Y - (Yes) - Land use and related structures are compatible without restriction.
N - (No) - Land use and related structures are not compatible and should be prohibited.
Y[x] - (yes with restrictions) - Land use and related structures generally compatible; see notes 1-21.
N[x] - (no with exceptions) - See notes 1-21.
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 (see Appendix C, section c.4).
A, B, or C - Land use and related structures generally compatible; measures to achieve NLR of A (DNL 25 dB), B (DNL 30 dB), or C (DNL 35 dB) 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 footnotes.
***** - The designation of these uses as "compatible" in this zone reflects individual federal agency and program consideration of general cost and feasibility factors, as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

NOTES

1. Suggested maximum density of 1-2 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 definition may be needed due to the variation of densities in people and structures. Shopping malls and shopping centers are considered incompatible in any accident potential zone (CZ, APZ I, or APZ II).
3. The placing of structures, buildings, or above ground utility lines in the clear zone is subject to severe restrictions. In a majority of the clear zones, these items are prohibited. See AFI 32-7063 and UFC 3-260-01 for specific guidance.
4. No passenger terminals and no major above ground 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, etc., 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.

11A. Although local conditions may require residential use, it is discouraged in DNL 65-69 dB and strongly discouraged in DNL 70-74 dB. 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, and there are no viable alternative locations.

11B. Where the community determines the residential uses must be allowed, measures to achieve outdoor to indoor NLR for DNL 65-69 dB and DNL 70-74 dB should be incorporated into building codes and considered in individual approvals.

11C. 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 in the DNL 65-69 dB range 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 in the DNL 70-74 dB range 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 in the DNL 75-79 dB range 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 required for facilities in the DNL 65-69 dB range.

19. Residential buildings require the same NLR required for facilities in the DNL 70-74 dB range.

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.

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SECTION 5

LAND USE ANALYSIS

5.1 Introduction

Land use planning and control is a dynamic, rather than a 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, as well as changing public concern. The planning process accommodates this fluidity in which decisions are normally not based on boundary lines, but rather on more generalized area designations.

McGuire AFB was originally established in a relatively undeveloped area in Burlington County, New Jersey. Development was affected with the drawdown of Fort Dix activities. Recently there has been increased residential development in the surrounding communities as the area is attracting metropolitan commuters with rural country living amenities.

Computer technology has enabled McGuire AFB to more precisely display its flight tracks, airspace control surfaces, noise contours, and accident potential areas for land use planning purposes. The computer technology has revealed the extent of the McGuire AFB region of impact into Burlington and Ocean Counties and their nearby cities and towns.

For the purpose of this Study, existing and future land uses on the figures in this section are generalized into one of the following six categories:

- Residential: This category includes all types of residential activity, such as single and multi-family residences and mobile homes, at a density greater than one dwelling unit per acre.
- Commercial: This category includes offices, retail, restaurants, and other types of commercial establishments.
- Industrial: This category includes manufacturing, warehousing, and other similar uses.
- Public/Quasi-Public: This category includes publicly owned lands and/or land to which the public has access, including military reservations and training grounds, public buildings, schools, churches, cemeteries, and hospitals.
- Recreational: This category includes land areas designated for recreational activity including parks, wilderness areas and reservations, conservation areas, and areas designated for trails, hikes, camping, *etc.*
- Open/Agricultural/Low Density: This category includes undeveloped land areas, agricultural areas, grazing lands, and areas with residential activity at densities less than or equal to one dwelling unit per acre.

5.2 Existing Land Use

As previously described, McGuire AFB is located in central Burlington County, adjacent to and southeast of Wrightstown Borough and within New Hanover Township. Since Fort Dix surrounds McGuire AFB on the east, south, and west, the impact of airfield activities on surrounding communities in these areas is limited. Primary impact is to the north (accident potential) and to the northeast (noise and accident potential).

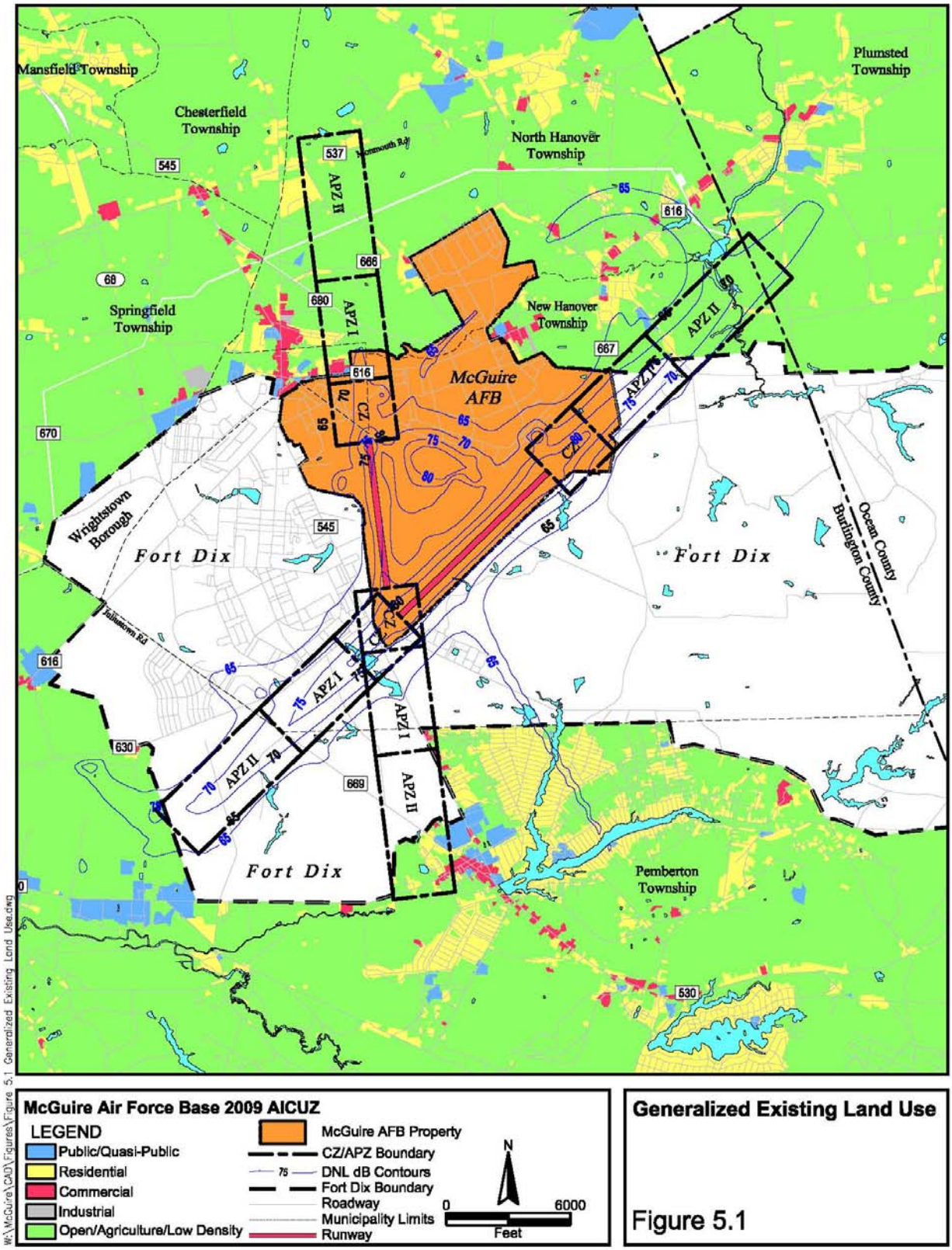
Existing land use within these portions of Burlington and Ocean Counties is largely low-density residential, with several open and agricultural areas adjacent to the installation. Figure 5.1 is an overlay of the 2009 noise contours onto a map displaying the APZs and the existing land use in the vicinity of McGuire AFB. An analysis was performed on the property lying inside the noise zones or accident potential zones but outside the McGuire AFB and Fort Dix Military Reservation boundaries. The acreage of existing land use of this property was calculated by land use type. Table 5.1 reveals the acreage by land use of the areas lying within the DNL 65 dB noise contours. Table 5.2 reflects the land use within the Clear Zones (CZs) and accident potential zones (CZs and APZs).

Table 5.1 Generalized Existing Land Use within DNL 65 dB and Greater Noise Exposure Area (off-DoD property outside CZs and APZs)

Category	Acreage Within Noise Zones, Not Included in CZs and APZs				Total
	65-69	70-74	75-79	80+	
Residential	44	0	0	0	**44**
Commercial	9	0	0	0	**9**
Industrial	0	0	0	0	**0**
Public/Quasi-public	6	0	0	0	**6**
Recreation/Open/ Agricultural/Low Density	447	1	0	0	**448**
Total	**506**	**1**	**0**	**0**	**507**

Table 5.2 Generalized Existing Land Use within the McGuire AFB Clear Zones and Accident Potential Zones (off-DoD property)

Category	Acreage within CZs and APZs			Total
	CLEAR ZONE	APZ I	APZ II	
Residential	0	25	150	**175**
Commercial	0	19	8	**27**
Industrial	0	0	8	**8**
Public/Quasi-public	0	1	8	**9**
Recreation/Open/ Agricultural/Low Density	0	346	959	**1,305**
Total	**0**	**391**	**1,133**	**1,524**


Mansfield Township
Chesterfield Township
North Hanover Township
Plumsted Township
Springfield Township
New Hanover Township
Wrightstown Borough
McGuire AFB
Fort Dix
Fort Dix
Fort Dix
Pemberton Township
Ocean County
Burlington County
APZ I
APZ II
CZ
537
545
616
666
680
667
670
630
669
530
68
Jamesburg Rd
Juliustown Rd
65
70
75
80
W:\McGuire\CAD\Figures\Figure 5.1 Generalized Existing Land Use.dwg
McGuire Air Force Base 2009 AICUZ
LEGEND
Public/Quasi-Public
Residential
Commercial
Industrial
Open/Agriculture/Low Density
McGuire AFB Property
CZ/APZ Boundary
DNL dB Contours
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
6000
Feet
Generalized Existing Land Use
Figure 5.1

5.3 Current Zoning

Figure 5.2 is an overlay of the 2009 noise contours and APZs onto a map displaying the current generalized zoning in the vicinity of McGuire AFB. The zoning classifications identified on Figure 5.2 are generalized for AICUZ planning purposes. As described in the above section on existing land use, the area of interest is primarily limited to areas north and northeast of the base. The zoning to the north is primarily residential, with the areas northwest and northeast of the Base having mixed zoning, but for this study is mostly agriculture. Burlington County zoning ordinances and zoning maps guide and control development. The county identifies low-density residential development being permitted in the northwest APZ I and APZ II. The southeast APZ II shows low density residential development and commercial land uses.

Ocean County local governments and planning agencies have developed a strong working relationship with McGuire AFB in matters of development planning. Ocean County has zoned land under the northeast APZ II as low density residential development, which is compatible with the AICUZ land use compatibility guidelines. Table 5.3 shows the number of acres by land use category within each noise contour. From this analysis, the zoning designations were categorized into residential, commercial, industrial, public/quasi-public, and recreational/open/agricultural/low density. Figure 5.2 shows the results of the compilation, and Table 5.3 provides a breakdown of the generalized zoning (areas outside McGuire AFB only, outside CZs and APZs) within the DNL 65 dB and greater noise area.

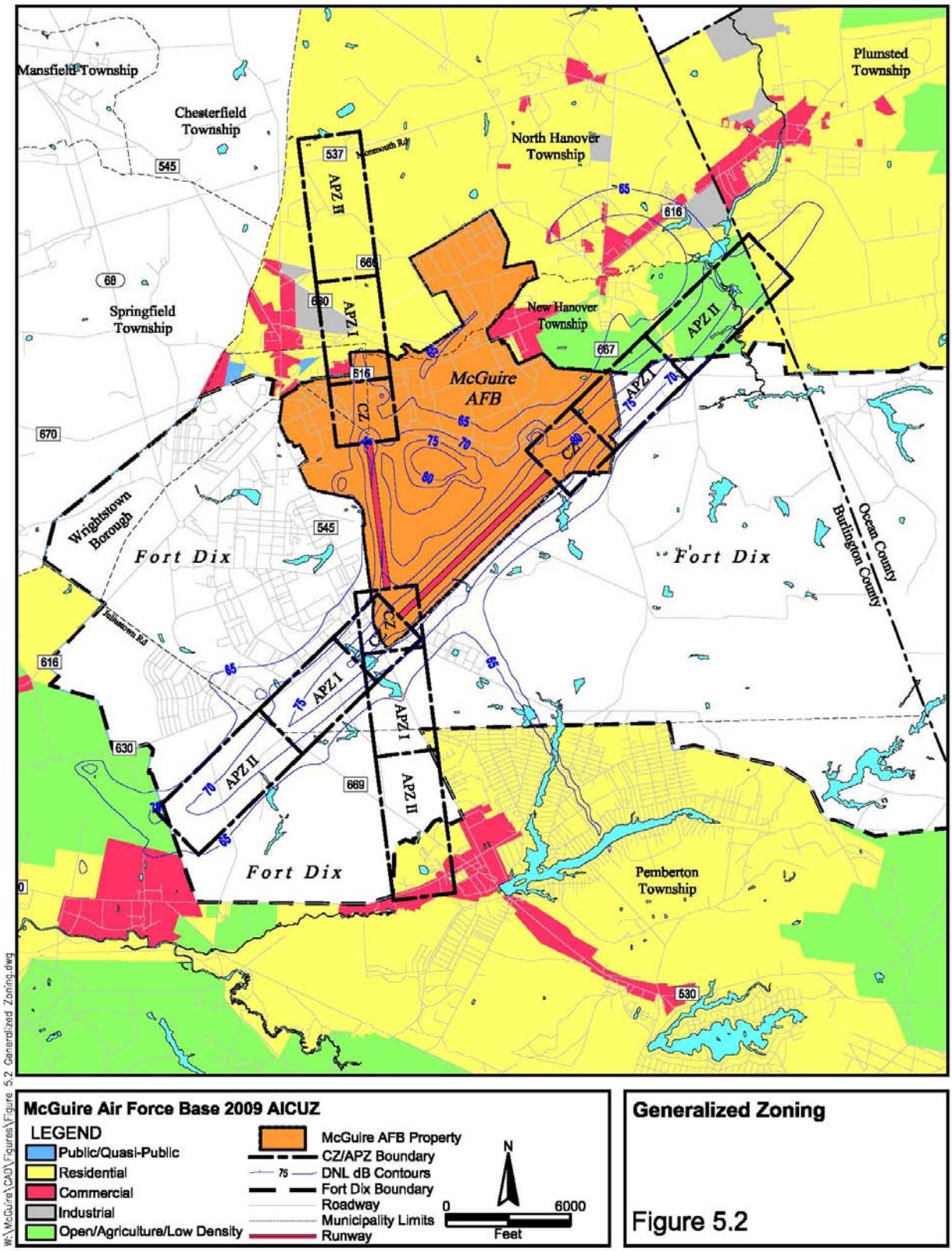
Table 5.3 Generalized Zoning within DNL 65 dB and Greater Noise Exposure Area (off-DoD property outside CZs and APZs)

Category	Acreage within Noise Zones, not Included in CZs and APZs				Total
	65-69	70-74	75-79	80+	
Residential	498	17	4	0	**519**
Commercial	28	0	0	0	**28**
Industrial	8	0	0	0	**8**
Public/Quasi-public	17	0	0	0	**17**
Recreation/Open/ Agricultural/Low Density	690	821	112	0	**1,623**
Total	**1,241**	**838**	**116**	**0**	**2,195**

A similar analysis was performed to determine the acreage of each generalized zoning category within the McGuire AFB CZs and APZs and is shown on Table 5.4.

Table 5.4 Generalized Zoning within the McGuire AFB Clear Zones and Accident Potential Zones (off-DoD property)

Category	Acreage within CZs and APZs			Total
	CLEAR ZONE	APZ I	APZ II	
Residential	0	273	843	**1,116**
Commercial	0	14	43	**57**
Industrial	0	38	0	**38**
Public/Quasi-public	0	33	0	**33**
Recreation/Open/ Agricultural/Low Density	0	69	419	**488**
Total	**0**	**427**	**1,305**	**1,732**


Mansfield Township
Chesterfield Township
Springfield Township
Wrightstown Borough
North Hanover Township
New Hanover Township
Plumsted Township
Pemberton Township
Fort Dix
McGuire AFB
Ocean County
Burlington County
APZ I
APZ II
CZ
537
545
616
666
667
669
670
630
530
68
Monmouth Rd
Jobstown Rd
65
70
75
80
McGuire Air Force Base 2009 AICUZ
LEGEND
Public/Quasi-Public
Residential
Commercial
Industrial
Open/Agriculture/Low Density
McGuire AFB Property
CZ/APZ Boundary
DNL dB Contours
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
6000
Feet
Generalized Zoning
Figure 5.2
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5.4 Future Land Use and Future Development

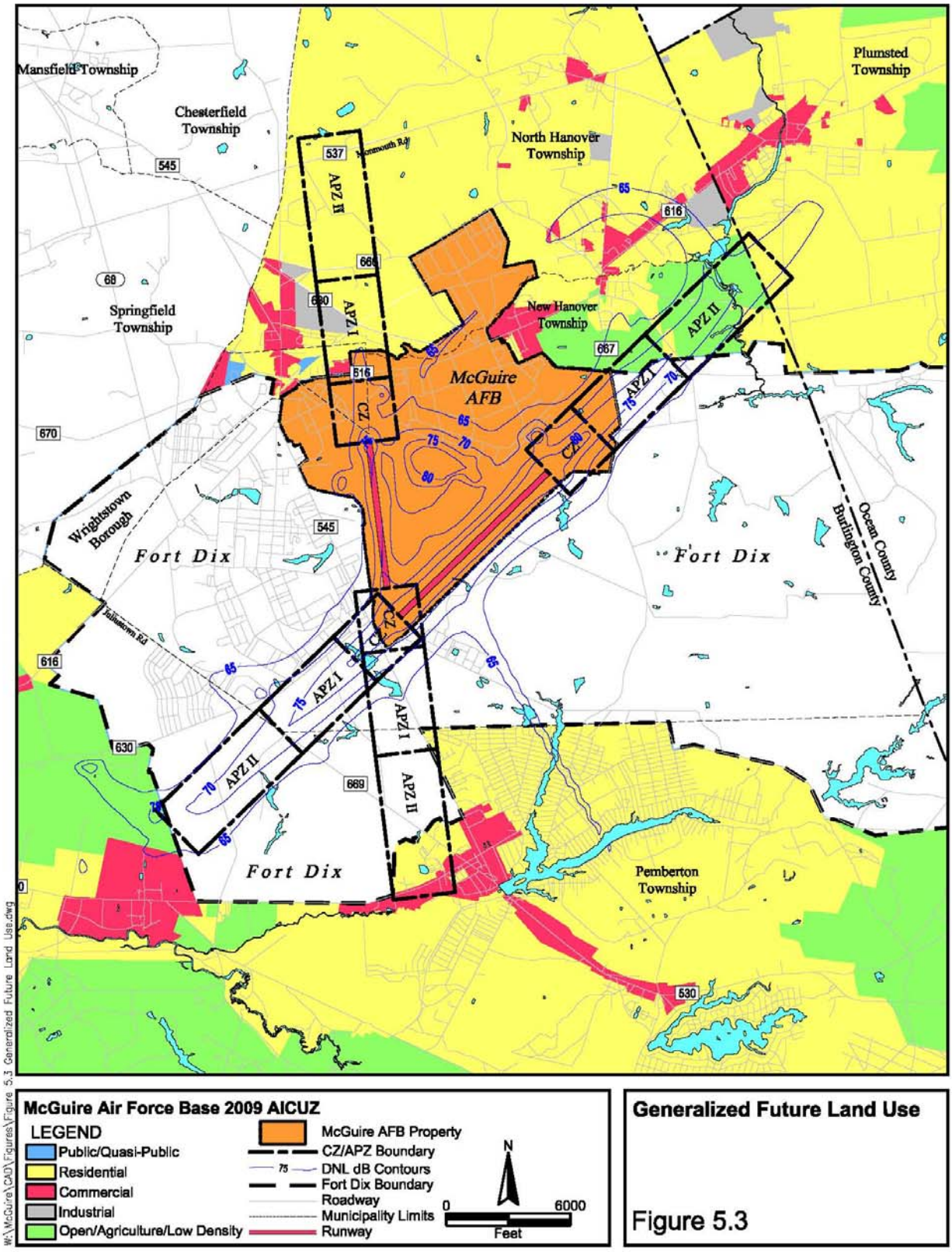
Figure 5.3 shows long-range generalized future land use predicted for the McGuire AFB environs based on local zoning maps, comprehensive plans, and local development proposals. The following paragraphs discuss these anticipated future land use patterns. This section examines the comprehensive land use plans adopted by local jurisdictions and assesses the potential conflicts with the McGuire AFB mission. Both the Burlington County and the Ocean County land use plans encourage planning for compatible land use. The future Joint Land Use Study (JLUS) will establish for the counties, townships, and communities protective land use recommendations that protects the Base from future encroachment.

Future land use shows proposed residential and industrial development being planned for the Runway 18 end APZ I and APZ II. The planned industrial development planned in APZ I is compatible. The AICUZ land use compatibility guidelines discourages residential development in APZ I. The majority of APZ I located off base is identified for residential development. For APZ II, the AICUZ recommends a maximum density of 1-2 dwelling units per acre possibly increased under a planned Unit Development where maximum coverage is less than 20 percent.

The Runway 24 end shows compatible development planned for APZ I. In APZ II, the majority of the planned uses are compatible. Residential development is planned in two areas. In APZ II, the majority of residential development in Burlington County currently exists and is compatible. In the Ocean County portion of APZ II, where residential development is planned, the AICUZ recommends a maximum density of 1-2 dwelling units per acre possibly increased under a planned Unit Development where maximum coverage is less than 20 percent.

The Runway 36 end shows the majority of APZ I and APZ II being located on Fort Dix property. A very small area of residential development is planned in APZ I. In APZ II, residential development is planned. The AICUZ recommends a maximum density of 1-2 dwelling units per acre possibly increased under a planned Unit Development where maximum coverage is less than 20 percent.

One noteworthy initiative taken by the partnership of the State of New Jersey, Burlington County, and municipalities is to acquire easements by acquiring development rights covering 11,890 acres of farmland within the Burlington County Two-Mile Military Buffer Zone. This initiative promotes retaining farmland and low-density development. This buffer surrounds McGuire AFB and Fort Dix, and abuts the Ocean County Two-Mile Military Buffer around NAES Lakehurst. This buffer encompasses McGuire AFB, Fort Dix, and NAES Lakehurst to prevent encroachment by preserving farmland and open space within the Two-Mile Military Buffer. Implementation of this initiative by the State of New Jersey, Burlington and Ocean Counties and municipalities endorses compatible development to provide encroachment protection for Joint Base McGuire-Dix-Lakehurst well into the future.


Mansfield Township
Chesterfield Township
Springfield Township
Wrightstown Borough
North Hanover Township
New Hanover Township
Plumsted Township
Pemberton Township
Fort Dix
Fort Dix
Fort Dix
McGuire AFB
Ocean County
Burlington County
APZ I
APZ II
CZ
537
545
68
666
630
516
670
616
667
669
530
Jobstown Rd
Monmouth Rd
65
70
75
80
McGuire Air Force Base 2009 AICUZ
LEGEND
Public/Quasi-Public
Residential
Commercial
Industrial
Open/Agriculture/Low Density
McGuire AFB Property
CZ/APZ Boundary
DNL dB Contours
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
6000
Feet
Generalized Future Land Use
Figure 5.3
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5.5 Incompatible Land Uses

Table 5.4 shows land use compatibility as it applies to generalized zoning within the APZs and noise contours DNL 65 dB and greater for McGuire AFB. For a land use area to be considered compatible, it must meet both noise and accident potential criteria shown in Table 4.3. The compatibility guidelines shown in Table 4.3 were combined with the existing land use plan shown in Figure 5.1 to determine land use incompatibility associated with aircraft operations at McGuire AFB. Results of this analysis are depicted numerically in Table 5.5 and illustrated in Figure 5.4.

Table 5.5 Incompatible Land Use for Runways 06/24 and 18/36 at McGuire AFB

Category	Acreage Within CZs and APZs			Acreage Within Noise Zones, Not Included in CZs and APZs				Total
	CLEAR ZONE	APZ I	APZ II	65-69	70-74	75-79	80+	
Residential	•	42	152	498	•	•	•	**692**
Commercial	•	21	11	28	•	•	•	**60**
Industrial	•	•	•	8	•	•	•	**8**
Public/Quasi-public	•	5	8	17	•	•	•	**30**
Recreation/Open/ Agricultural/Low Density	•	798	1,383	690	•	•	•	**2,871**
Total	•	**866**	**1,554**	**1,241**	•	•	•	**3,661**

**Represents compatible land use*

5.5.1 Runway 06/24 Clear Zones and Accident Potential Zones

5.5.1.1 Runway 06 Clear Zone and Accident Potential Zones I and II

All land within the CZ is located within the McGuire AFB and Fort Dix boundaries.

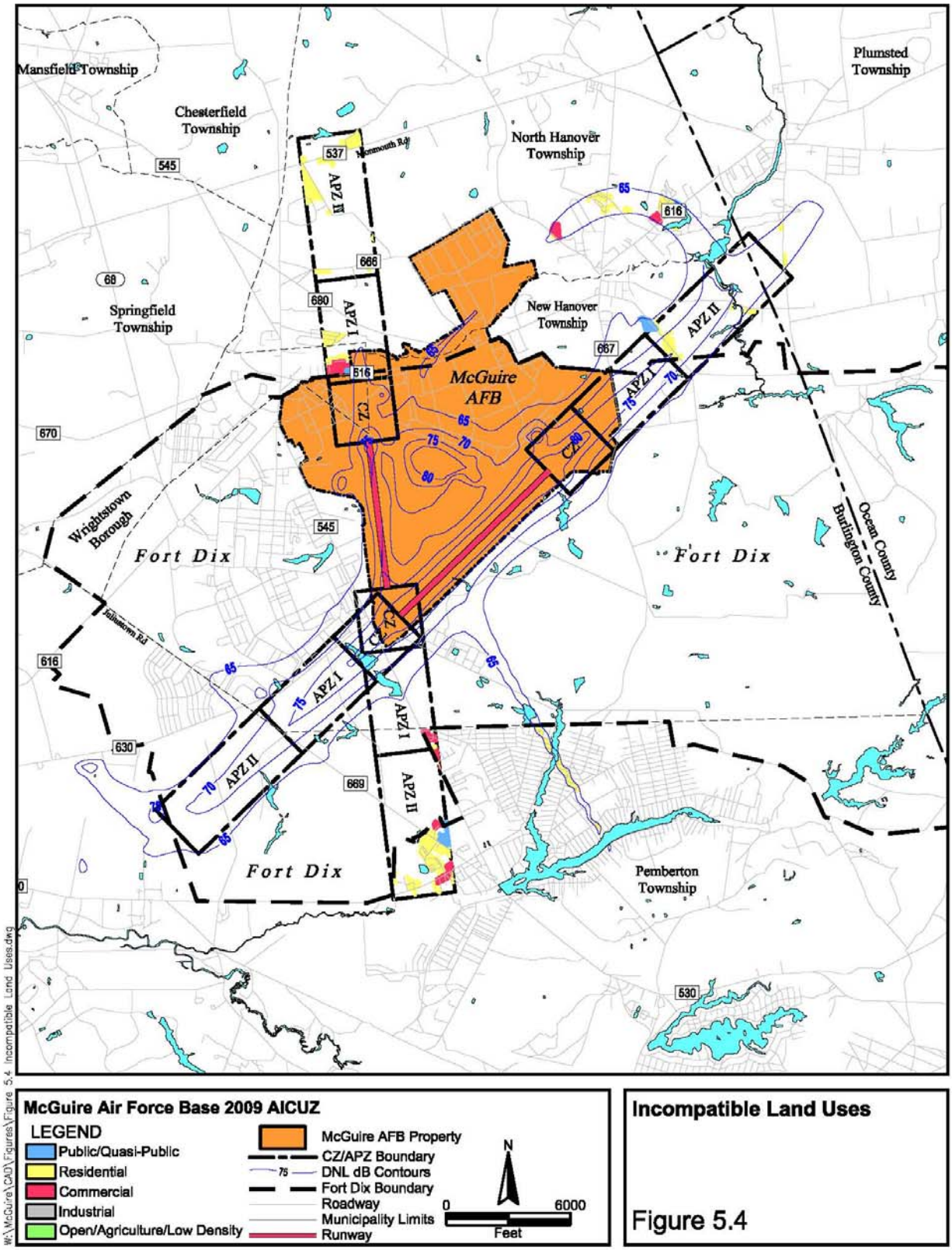
5.5.1.2 Runway 24 Clear Zone and Accident Potential Zones I and II

The CZ is located within the McGuire AFB and Fort Dix boundaries. The northeast portion of APZ I is located off base and consists of agricultural and open space land uses. The majority of land in APZ II is located outside the McGuire AFB and Fort Dix boundaries and consists of agricultural and open space land uses with three small low-density residential areas.

5.5.2 Runway 18 and 36 Clear Zones and Accident Potential Zones

5.5.2.1 Runway 18 Clear Zone and Accident Potential Zones I and II

All land within the CZ is located within the McGuire AFB boundary. The majority of APZ I and all of APZ II are located outside of McGuire AFB boundary. APZ I immediately adjacent to the base boundary contains commercial, low-density residential, and open space land uses. APZ II consists of small areas of low-density residential development with the majority of the land being agricultural and open space land uses.


Mansfield Township
Chesterfield Township
Springfield Township
Wrightstown Borough
North Hanover Township
New Hanover Township
Plumsted Township
Pemberton Township
Fort Dix
McGuire AFB
APZ I
APZ II
CZ
537
545
668
680
68
616
667
670
630
669
530
Ocean County
Burlington County
Jobstown Rd
Monmouth Rd
65
70
75
80
McGuire Air Force Base 2009 AICUZ
LEGEND
Public/Quasi-Public
Residential
Commercial
Industrial
Open/Agriculture/Low Density
McGuire AFB Property
CZ/APZ Boundary
DNL dB Contours
Fort Dix Boundary
Roadway
Municipality Limits
Runway
N
0
6000
Feet
Incompatible Land Uses
Figure 5.4
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5.5.2.2 Runway 36 Clear Zone and Accident Potential Zones I and II

The CZ is located within the McGuire AFB and Fort Dix boundaries. The far southeast corner of APZ I is located within Pemberton Township and contains a few commercial and low-density residential land uses. The southern third of the property in APZ II is within Pemberton Township and contains residential, commercial, and public land uses.

5.6 Noise Zones

At noise levels between DNL 65-69 dB, the only incompatible land use type is residential without noise level reduction (NLR) materials. Residential uses within the DNL 65-69 dB noise zone would be conditionally compatible upon incorporation of the appropriate amount of NLR. Based on the land use compatibility guidelines detailed in Table 4.3, residential use within the DNL 65-74 dB zone is discouraged unless there is a demonstrated community need and no viable alternate locations. The majority of the residential areas surrounding McGuire AFB appear to have been built prior to the implementation of sound attenuation and energy insulation requirements. The majority of incompatible residential land use occurs in Pemberton Township where the narrow DNL 65-69 dB noise contour overlays residential land uses. Additionally, there are incompatible commercial land uses in Pemberton Township in the general area where the incompatible residential land uses occur.

5.7 Air Installation Compatible Use Zone Study Updates

AICUZ noise contours describe the noise characteristics of a specific operational environment, and as such, will change if a significant operational change is made. An AICUZ Study should be evaluated for an update if the noise exposure map changes by DNL 2 dB or more in noise sensitive areas when compared to the noise contour map in the last publicly released AICUZ Study. With this in mind, this 2009 AICUZ Study updates the 1999 AICUZ Study and provides flight track, accident potential zone and noise zone information in this report, which reflects the most accurate picture of the installation's aircraft activities as of November 2008.

SECTION 6

IMPLEMENTATION

6.1 Introduction

Implementation of the AICUZ Study must be a joint effort between the Air Force and adjacent communities. The role of the Air Force is to minimize impact on the local communities by McGuire AFB aircraft operations. The role of the communities is to ensure that development in the surrounding area is compatible with accepted planning, zoning, and development principles and practices.

6.2 Air Force Responsibilities

In general, the Air Force perceives its AICUZ 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 ensure that aircraft accidents are avoided. Despite the best aircrew training and aircraft maintenance intentions, however, history clearly shows that accidents do occur. It is imperative 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 Air Force policy to periodically review existing traffic patterns, instrument approaches, weather minima, and operating practices, and evaluate these factors in relationship to populated areas and other local situations. This requirement is a direct result and expression of Air Force 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 both in the air and on the ground.

Preparation and presentation of this McGuire AFB AICUZ Study is one phase of continuing Air Force participation in the local planning process. It is recognized that as the local community updates its land use plans, the Air Force 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. McGuire AFB personnel are prepared to participate in the continuing discussion of zoning and other land use matters as they may affect, or may be affected by the Base. Base personnel also are available to provide information, criteria, and guidelines to state, regional, and local planning bodies, civic associations, and similar groups.

Participation in land use planning can take many forms. The simplest of these forms is straightforward, consistent two-way discussion and information sharing with both professionals and neighbors. Copies of the AICUZ Study, including maps, will be provided

to local communities and counties and regional planning departments and zoning administrators. Through this communication process, the Base reviews applications for development or changed use of properties within the noise impact and safety areas, as well as other nearby parcels. The Base coordinates closely with surrounding communities and counties on zoning and land use issues.

6.3 Local Community Responsibilities

Residents in the area neighboring McGuire AFB and Base personnel have a long history of working together for mutual benefit of the area around the airfields and installation. Local jurisdictions have taken a proactive approach in incorporating land use regulations into local plans and ordinances, which consider the McGuire AFB flying operations when considering development proposals. Adoption of the following recommendations will strengthen this relationship, increase the health and safety of the public, and help protect the integrity of the installation's flying mission:

- Incorporate AICUZ policies and guidelines into the comprehensive plans of Burlington and Ocean Counties, and local communities. Use overlay maps of the AICUZ noise contours and Air Force Land Use Compatibility Guidelines to evaluate existing and future land use proposals.
- Modify existing zoning ordinances and subdivision regulations to support the compatible land uses outlined in this study through implementation of a zoning overlay district based on noise contours and accident potential zones.
- Provide Real Estate disclosure of noise impact to all prospective property buyers of properties exposed to noise levels greater than DNL 65 dB.
- Implement height and obstruction ordinances to reflect current Air Force and FAR Part 77 requirements.
- Modify building codes to ensure new construction within the AICUZ area of influence has the recommended noise level reductions incorporated into design and construction codes.
- Support the future Joint Base McGuire-Dix-Lakehurst and Ocean and Burlington Counties JLUS to protect the joint base installation from encroachment. As a result of BRAC 2005, the three military installations will be formally joined in FY09 as Joint Base McGuire-Dix-Lakehurst. The JLUS objective is to avoid land use conflicts and to plan in a manner that supports both the military mission and the needs of the civilian population.
- Continue to inform McGuire AFB of planning and zoning actions that have the potential of affecting base operations. Develop a working group representing city planners, county planners, and base planners to meet at least quarterly to discuss AICUZ concerns and major development proposals that could affect airfield operations.

6.4 Burlington County Military Buffer Project

The Office of Secretary of Defense, the Air Force, Air Mobility Command, and the State of New Jersey, Burlington County, and municipalities have formed a partnership to acquire easements by acquiring development rights covering 11,890 acres of farmland within the Burlington County Two-Mile Military Buffer Zone. This buffer surrounds McGuire AFB and Fort Dix, and abuts the Ocean County Two-Mile Military Buffer. This buffer encompasses McGuire AFB, Fort Dix, and NAES Lakehurst to prevent encroachment by preserving farmland and open space within the Two-Mile Military Buffer. Purchase of easements in the Military Buffer Zone commenced in 2009. A list of properties where easements have been secured is available through 87 CES/CEAO or 87 ABW/JAV. Implementation of this initiative by The Office of Secretary of Defense, the Air Force, Air Mobility Command, and the State of New Jersey will provide encroachment protection for Joint Base McGuire-Dix-Lakehurst well into the future. The Office of Secretary of Defense, the Air Force, Air Mobility Command, the State of New Jersey and local governments, as well as Joint Base McGuire-Dix-Lakehurst, continue to support this program.

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SECTION 7

REFERENCES

McGuire AFB Economic Impact Report FY03.

McGuire AFB Fact Sheet, Personnel Facts, October 2005.

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APPENDIX A

THE AICUZ CONCEPT, PROGRAM, METHOD, AND POLICIES

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APPENDIX A

THE AICUZ CONCEPT, PROGRAM, METHOD, AND POLICIES

A.1 Concept

Federal legislation, national sentiment, and other external forces, which directly affect the Air Force mission, serve greatly to increase the role of the Air Force in environmental and planning issues. Problems of airfield encroachment from incompatible land uses surrounding installations, as well as air and water pollution and socioeconomic impact, require continued and intensified Air Force involvement. The nature of these problems dictates direct Air Force participation in comprehensive community and land use planning. Effective, coordinated planning that bridges the gap between the federal government and the community requires establishment of good working relationships with local citizens, local planning officials, and state and federal officials. This depends on creating an atmosphere of mutual trust and helpfulness. The AICUZ concept has been developed in an effort to:

- Protect local citizens from noise exposure and accident potential associated with flying activities; and
- Prevent degradation of the capability of the Air Force 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 McGuire AFB aviation environment.

A.2 Program

Installation commanders establish and maintain active programs to promote the maximum feasible land use compatibility between air installations and neighboring communities. The program requires that all appropriate government 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; and
- Ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing activities. These measures include such considerations as proper location of engine test facilities, provision of sound suppressors where necessary, and adjustment of flight patterns and/or techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

A.3 Method

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

- Accident Potential Zones (APZ) and Clear Zones (CZ) based on past Air Force aircraft accidents and installation operational data (see Appendix B);
- Noise zones (NZ) produced by the computerized DNL modeling of the noise created by aircraft flight and maintenance operations (see Section 3 of the Study); and
- The area designated by the FAA and the Air Force for purposes of height limitations in the approach and departure zones of the base (see Section 4 of the Study).

The APZ, CZ, and NZ are the basic building blocks for land use planning with AICUZ data. Compatible land uses are specified for these zones (see Table 4.3), and recommendations on building materials and standards to reduce interior noise levels inside structures are provided in Appendix C.4.

As part of the AICUZ Program, the only real property acquisition for which the Air Force has requested and received Congressional authorization, and for which the installation and major commands request appropriation, are the areas designated as the CZ. McGuire AFB either owns or holds restrictive easements on all property in the CZs. Compatible land use controls for the remaining airfield area of influence 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. McGuire AFB recommends the following policies be considered for incorporation into the comprehensive plans of agencies in the vicinity of the Base's area of influence:

A.4.1 Policy 1

To promote the public health, safety, peace, comfort, convenience, and general welfare of the inhabitants in the airfield area of influence, 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 destruction or impairment of the airfield and the public investment therein;
- Enhance the quality of living in the areas affected; and
- Protect the general economic welfare by restricting incompatible land use.

A.4.2 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 which 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; and
- Adopt appropriate ordinances to implement airfield area of influence land use plans.

A.4.3 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 which 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; and
- Uses that provide for structures within 10 feet of aircraft approach-departure and/or transitional surfaces.

A.4.4 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 (schools, churches, *etc*.); and
- Recreation buildings and structures.

A.4.5 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.

A.4.6 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 (Appendix D) for new construction should be implemented to permit certain uses where they would otherwise be prohibited.

A.4.7 Policy 7

Land use planning and zoning in the airfield area of influence 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 capabilities and constraints;
- Existing land use;
- Land ownership patterns and values;
- Economic and social demands;
- Cost and availability of public utilities, transportation, and community facilities; and
- Other noise sources.

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. These 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:

- 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 periods of aircraft operations and land use activities;
- Specific site analysis; and
- 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

Each end of Runways 06/24 and 18/36 at McGuire AFB have a 3,000-foot by 3,000-foot CZ and two APZs (APZ I and APZ II). The clear zones and APZ I's at runway ends 24 and 36 overlap. Accident potential on or adjacent to the runway or within a CZ is so high that the necessary land use restrictions would prohibit reasonable economic use of land. As stated previously, it is Air Force policy to request Congress to authorize and appropriate funds for the necessary real property interests in this area to prevent incompatible land uses.

Accident Potential Zone 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 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 are not acceptable.

Accident Potential Zone II is less critical than APZ I, but still possesses potential for accidents. Accident potential zone II, also 3,000 feet wide, is 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable uses include those of APZ I, as well as 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 (theaters, churches, schools, restaurants, *etc*.), and high-density office uses are not considered appropriate.

High-density populations 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.

Land use guidelines (see Subsection 4.6.3) for the Air Force Class B runway CZs and APZs (see Subsection 4.2.2) 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; and
- 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 so 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 above-ground explosives, fire, toxic, corrosive, or other hazardous characteristics;
- Promote population concentrations;
- Involve utilities and services required for area-wide population, where disruption would have an adverse impact (telephone, gas, *etc*.);
- Concentrate people who are unable to respond to emergency situations, such as children, elderly, handicapped, *etc*.; and
- 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 a demand for land development. To go beyond these guidelines, however, substantially increases risk by placing more people in areas where there may ultimately be an aircraft accident.

A.7 Noise

Nearly all studies analyzing aircraft noise and residential compatibility recommend no residential uses in noise zones above DNL 75 dB. Usually, no restrictions are recommended below noise zone DNL 65 dB. There is currently no consensus between DNL 65-74 dB. These areas may not qualify for federal mortgage insurance in residential categories according to United States Department of Housing and Urban Development (HUD) Regulation 24 CFR 51B. In many cases, HUD approval requires noise attenuation measures, the Regional Administrator's concurrence, and an Environmental Impact Statement. The United States Department of Veterans Affairs also has airfield noise and accident restrictions that apply to its home loan guarantee program. Whenever possible, residential land use should be located below DNL 65 dB according to Air Force land use recommendations. Residential buildings within the DNL 65-75 dB noise contours should contain noise level reduction in accordance with the Air Force land use compatibility guidelines in the AICUZ Study, Table 4.3.

Most industrial/manufacturing uses are compatible in the airfield area of influence. Exceptions are uses such as research or scientific activities that require lower noise levels. Noise attenuation measures are recommended for portions of buildings devoted to office use, receiving the public, or where the normal background noise level is low.

The transportation, communications, and utilities categories have a high 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. Where buildings are required for these uses, additional evaluation is warranted.

The commercial/retail trade and personal and business services categories are compatible without restriction up to DNL 70 dB; however, they are generally incompatible above DNL 80 dB. Between DNLs 70-79 dB, 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 below DNL 65 dB (an Air Force 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 DNL 75 dB, noise becomes a factor that limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (*e.g*., music shell, *etc*.), compatibility is limited. Buildings associated with golf courses and similar uses should be noise attenuated.

With the exception of forestry activities and livestock farming, uses in the resources production, extraction, and open space category are compatible almost without restrictions.

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APPENDIX B

CLEAR ZONES AND ACCIDENT POTENTIAL ZONES

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APPENDIX B

CLEAR ZONES AND ACCIDENT POTENTIAL ZONES

B.1 Guidelines for Accident Potential

Areas around airports are exposed to the possibility of aircraft accidents even with well-maintained aircraft and highly trained aircrews. Despite stringent maintenance requirements and countless hours of training, history makes it clear that accidents do happen.

When the AICUZ Program began, there were no current comprehensive studies on accident potential. To support the program, the Air Force completed a study of Air Force aircraft 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 (1,500 feet either side of the runway centerline) wide, extending from the runway threshold along the extended runway centerline for a distance of 15,000 feet. The Air Force updated these studies and this information is presented later in this section.

The CZ, APZ I, and APZ II were established based on crash patterns. 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 Air Force 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.

Research in accident potential conducted by the Air Force 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 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 Air Force does not attempt to base its safety standards on accident probabilities. Instead, the Air Force approaches this safety issue from a land use planning perspective.

B.2 Guidelines for Accident Potential

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 Air Force performed a service-wide 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 Air Force accidents during 1968-1972, and found that 61 percent of those accidents were related to landing operations, and 39 percent were takeoff related. It also found that 70 percent occurred in daylight, and that fighter and training aircraft accounted for 80 percent of the accidents.

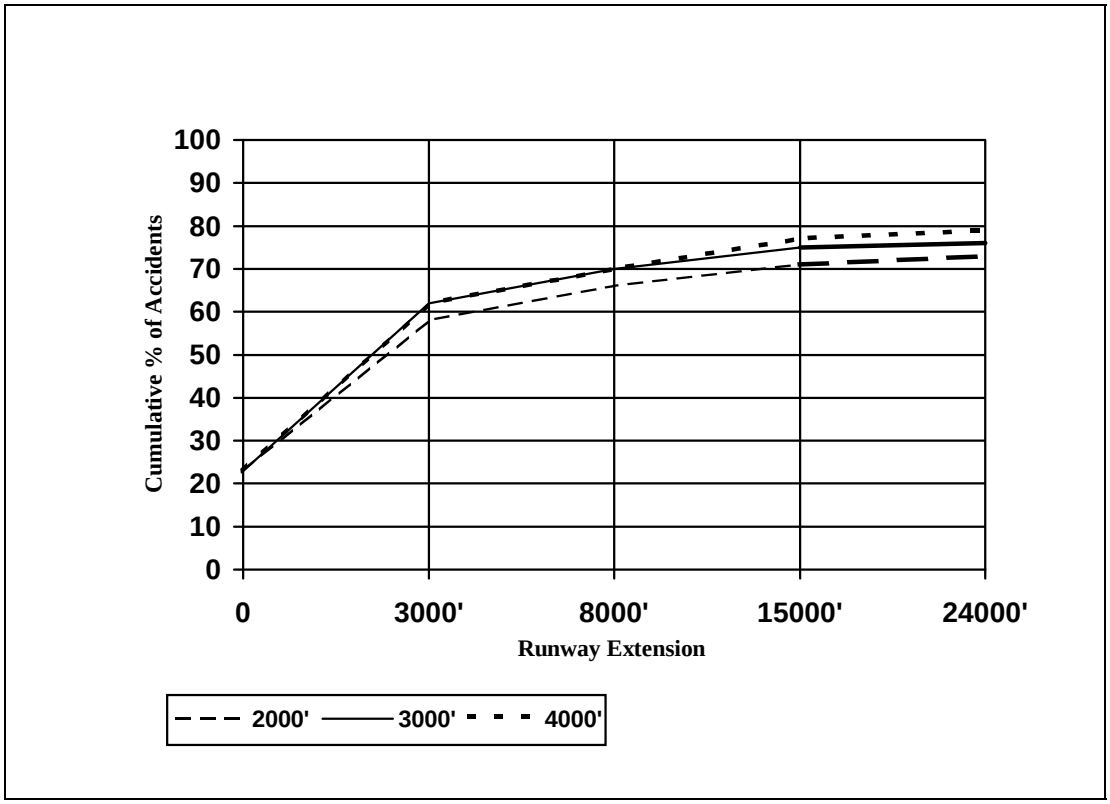
Because the purpose of the study was to identify accident hazards, the study plotted each of the 369 accidents in relation to the airfield. This plotting found that the accidents clustered along the runway and its extended centerline. To further refine this clustering, a tabulation was prepared that 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 total feet. Table B.1 reflects the location analysis.

Table B.1 Location Analysis

	Width of Runway Extension (feet)		
Length From Both Ends of Runway (feet)	**2000**	**3000**	**4000**
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

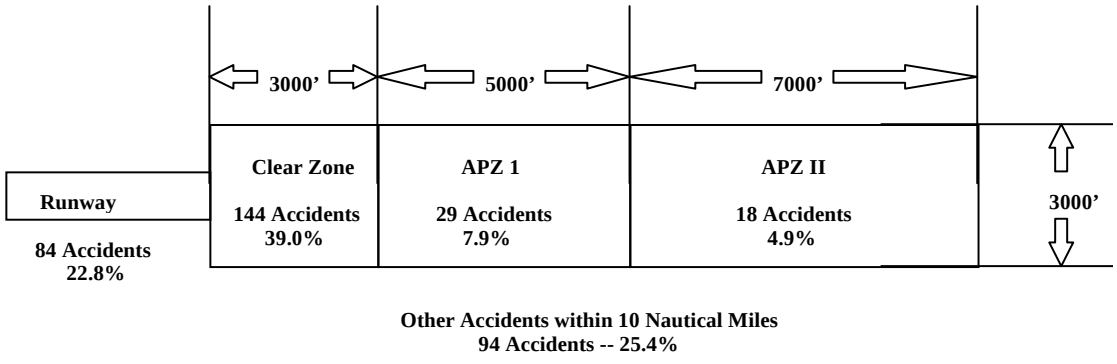
Figure B.1 indicates that the cumulative number of accidents rises rapidly from the end of the runway to 3,000 feet, rises more gradually to 8,000 feet, and then continues at about the same rate of increase to 15,000 feet, where it levels off rapidly. The location analysis also indicates 3,000 feet as the optimum runway extension width and the width which includes the maximum percentage of accidents in the smallest area.

Figure B.1 Distribution of Air Force Aircraft Accidents (369 Accidents - 1968 - 1972)



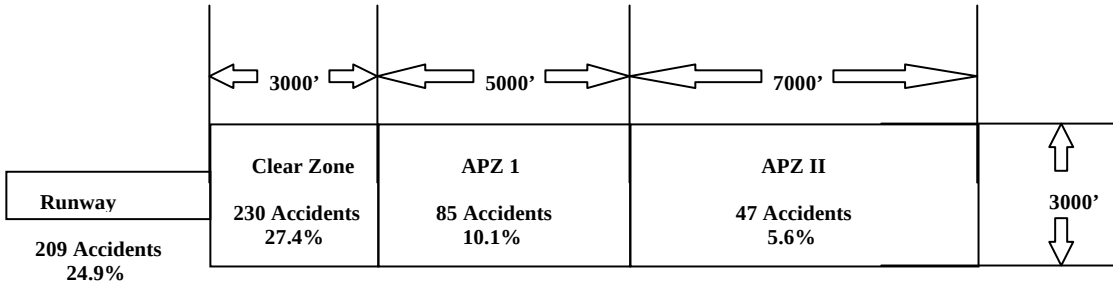
Using the optimum runway extension width, 3,000 feet, and the cumulative distribution of accidents from the end of the runway, zones were established that minimized the land area included and maximized the percentage of accidents included. The zone dimensions and accident statistics for the 1968-1972 study are shown in Figure B.2.

Figure B.2 Air Force Aircraft Accident Data (369 Accidents - 1968 - 1972)



The original study was updated to include accidents through September 1995. This updated study includes 838 accidents during the 1968-1995 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 Air Force Aircraft Accident Data
(838 Accidents - 1968 - 1995)



Other Accidents within 10 Nautical Miles
267 Accidents -- 31.9%

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 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 then APZ II. Table B.2 reflects this data.

Table B.2 Accident to Area Ratio
Ratio of Percentage of Accidents to Percentage of Area
(Air Force Accident Data 1968 - 1995)

	Area[1] (Acres)	Number[2] Accident	Accident Per Acre	Percent of Total Area	Percent of Total Accidents	Ratio:[3] % Accidents to % Area
Runway Area	487	209	1 Per 2.3 acres	0.183	24.9	136
Clear Zone	413	230	1 Per 1.8 acres	0.155	27.4	177
APZ I	689	85	1 Per 8.1 acres	0.258	10.1	39
APZ II	964	47	1 Per 20.5 acres	0.362	5.6	16
Other Area	264,053	267	1 Per 989 acres	99.042	31.9	0.3

[1] Area includes land within 10 nautical miles of runway.
[2] Total number of accidents is 838 (through 1995).
[3] Percent total accidents divided by percent total area.

Additional accident data for 1986 through July 1995 has been analyzed. Specific location data for some of the 1986-1995 accidents were not available and these were not included in the analysis. Table B.3 compares the 1968-1985 data with the data through July 1995:

Table B.3 Additional Accident Data

	1968-1985		1968-1995	
ZONE	**Accidents**	**% of Total**	**Accidents**	**% of Total**
On-Runway	197	27.1	209	24.9
Clear Zone	210	28.8	230	27.4
APZ I	57	7.8	85	10.1
APZ II	36	5.0	47	5.7
Other (Within 10 nautical miles)	228	31.3	267	31.9
Total	728	100.0	838	100.0

Analysis shows that the cumulative changes evident in accident location through July 1995 reconfirm the dimensions of the CZs and APZs.

B.3 Definable Debris Impact Areas

The Air Force 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 Air Force used weighted averages of impact areas, for accidents occurring only in the approach and departure phase, to determine the following average impact areas:

Average Impact Areas for Approach and Departure Accidents

Overall Average Impact Area 5.06 acres

Fighter, Trainer, and Misc. Aircraft 2.73 acres

Heavy Bomber and Tanker Aircraft 8.73 acres

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.

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

- 61% were related to landing operations.
- 39% were related to takeoff operations.
- 70% occurred in daylight.
- 80% were related to fighter and training aircraft operations.
- 25% occurred on the runway or within an area extending 1,000 feet out from each side of the runway.

- 27% 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% 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.

Air Force aircraft accident statistics found 75 percent of aircraft accidents resulted in definable impact areas. The size of the impact areas were:

- 5.06 acres overall average.
- 2.73 acres for fighters and trainers.
- 8.73 acres for heavy bombers and tankers.

APPENDIX C

NOISE

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APPENDIX C

NOISE

C.1 General

Noise, often defined as unwanted sound, is one of the most common environmental issues associated with aircraft operations. Of course, aircraft are not the only sources of noise in an urban or suburban surrounding, where noise from interstate and local roadway traffic, rail, industrial, and neighborhood sources also intrude on the everyday quality of life. Nevertheless, aircraft are readily identifiable to those affected by their noise and are typically singled out for special attention and criticism. Consequently, aircraft noise problems often dominate analyses of environmental impacts.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (*e.g.*, music) or unpleasant (*e.g.*, aircraft noise) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound. It is often true that one person's music is another person's noise.

The measurement and human perception of sound involves two basic physical characteristics - intensity and frequency. Intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The higher the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic is sound frequency, that is, the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.

The loudest sounds, which can be detected comfortably by the human ear, have intensities that are a trillion times larger than those of sounds that can be detected at the lower end of the spectrum. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes very unwieldy. As a result, a logarithmic unit known as the decibel (dB) is used to represent the intensity of a sound. Such a representation is called a sound level.

A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

Because of the logarithmic nature of the decibel unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically. However, some

simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

The total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels behaves differently than that of ordinary numbers, such an addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what is really happening when decibel values are added is each decibel value is first converted to its corresponding acoustic energy, then the energies are added using the normal rules of addition, and finally the total energy is converted to its decibel equivalent.

An important facet of decibel addition arises later when the concept of time-average sound levels is introduced to explain Day-Night Average A-Weighted Sound Level (DNL). Because of the logarithmic units, the louder levels that occur during the averaging period dominate the time-average sound levels. As a simple example, consider a sound level that is 100 dB and lasts for 30 seconds, followed by a sound level of 50 dB that also lasts for 30 seconds. The time-average sound level over the total 60-second period is 97 dB, not 75 dB.

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the preferred scientific unit for cps. The normal human ear can detect sounds that range in frequency from about 20 Hz to about 15,000 Hz. Not all sounds in this wide range of frequencies, however, are heard equally well by the human ear, which is most sensitive to frequencies in the 1000 to 4000 Hz range. In measuring community noise, this frequency dependence is taken into account by adjusting the sound levels of the very high and low frequencies to approximate the human ear's lower sensitivity to those frequencies. This is called "A-weighting" and is commonly used in measurements of community environmental noise.

Sound levels measured using A-weighting are most properly called A-weighted sound levels while sound levels measured without any frequency weighting are most properly called sound levels. However, since most environmental impact analysis documents deal only with A-weighted sound levels, the adjective "A-weighted" is often omitted, and A-weighted sound levels are referred to simply as sound levels. In some instances, it will be indicated that the sound levels have been A-weighted by using the abbreviation dBA or dB(A), rather than the abbreviation dB, for decibel. As long as the use of A-weighting is understood to be used, there is no difference implied by the terms "sound level" and "A-weighted sound level" or by the units dB, dBA, and dB(A).

In this document and most AICUZ documents, all sound levels are A-weighted sound levels and the adjective "A-weighted" has been omitted and dB is used for the decibel units.

Sound levels do not represent instantaneous measurements but rather averages over short periods of time. Two measurement time periods are most commonly used - one second and one-eighth of a second. Most environmental noise studies use slow response measurements, and the adjective "slow response" is usually omitted. It is easy to understand why the proper descriptor "slow response A-weighted sound level" is usually shortened to "sound level" in environmental impact analysis documents.

C.2 Noise Metrics

A "metric" is defined as something "of, involving, or used in measurement." In environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. Noise studies have typically involved a confusing proliferation of noise metrics as individual researchers have attempted to understand and represent the effects of noise. As a result, past literature describing environmental noise abatement has included many different metrics.

Various federal agencies involved in environmental noise mitigation agree on common metrics for environmental impact analysis documents, and both the Department of Defense (DoD) and the FAA specified those that should be used for federal aviation noise assessments. These metrics are as follows.

C.2.1 Maximum Sound Level

The highest A-weighted sound level measured during a single event in which the sound level changes value as time goes on (*e.g.*, an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level, for short. It is usually abbreviated by ALM, $L_{max,}$ or L_{Amax}.

C.2.2 Sound Exposure Level

Individual time-varying noise events have two main characteristics - a sound level which changes throughout the event and a period of time during which the event is heard. Although the maximum sound level, described above, provides some measure of the intrusiveness of the event, it alone does not completely describe the total event. The period of time during which the sound is heard is also significant. The Sound Exposure Level (abbreviated SEL or L_{AE}) combines both of these characteristics into a single metric.

Sound Exposure Level is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of the constant sound that would, in one second, generate the same acoustic energy as did the actual time-varying noise event. Since aircraft overflights usually last longer than 1 second, the SEL of an overflight is usually greater than the ALM of the overflight.

Note that sound exposure level is a composite metric that represents both the intensity of a sound level of the constant sound and its duration. It does not directly represent the sound level heard at any given time, but rather provides a measure of the net impact of the entire acoustic event. It has been well established in the scientific community that SEL measures this impact much more reliably than just the ALM.

Because the SEL and the ALM are both A-weighted sound levels expressed in decibels, there is sometimes confusion between the two, so the specific metric used should be clearly stated.

C.2.3 Day-Night Average Sound Level

Time-average sound levels are measurements of sound levels that are averaged over a specified length of time. These levels provide a measure of the average sound energy during the measurement period.

For the evaluation of community noise effects, and particularly aircraft noise effects, the DNL (mathematically represented as L_{dn}) is used. DNL averages aircraft sound levels at a location over a complete 24-hour period, with a 10-dB adjustment added to those noise events that take place between 10:00 p.m. and 7:00 a.m. (local time). This 10-dB "penalty" represents the added intrusiveness of sounds that occur during normal sleeping hours, both because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours.

As noted earlier for SEL, DNL does not represent the sound level heard at any particular time. DNL provides a single measure of overall noise impact, but does not provide specific information on the number of noise events or the individual sound levels that occur during the day. For example, a DNL of 65 dB could result from a very few noisy events, or a large number of quieter events.

Scientific studies and social surveys that have been conducted to evaluate community annoyance to all types of environmental noise have found the DNL to be the best measure to predict annoyance. Its use is endorsed by the scientific community (See References C.1 through C-5 at the end of this section).

There is, in fact, a remarkable consistency in the results of attitudinal surveys about aircraft noise conducted in different countries to find the percentages of groups of people who express various degrees of annoyance when exposed to different levels of DNL.

Reference C.6 was published in 1978. A more recent study has reaffirmed this relationship (Reference C.7). In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. Nevertheless, findings

substantiate that community annoyance to aircraft noise can be predicted quite reliably using DNL.

This relation between community annoyance and DNL has been confirmed, even for infrequent aircraft noise events. Reference C.8 reported the reactions of individuals in a community to daily helicopter overflights correlated quite well with the daily time-average sound levels over this range of numbers of daily noise events.

The use of DNL has been criticized as not accurately representing community annoyance and land use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the basis for the measurement or calculation of L_{dn}. One frequent criticism is based on the principle that people inherently react more to single noise events and not as much to "meaningless" time-average sound levels.

In fact, a time-average noise metric, such as DNL, takes into account both the noise levels of all individual events which occur during a 24-hour period and the number of times those events occur. As described briefly above, the logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs in daytime during a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The DNL for this 24-hour period is 65.5 dB. Assume, as a second example, that ten such 30-second overflights occur in daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The DNL for this 24-hour period is 75.4 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events. This is the basic concept of a time-average sound metric, and specifically the DNL.

C.3 Noise Effects

C.3.1 Hearing Loss

Noise-induced hearing loss is probably the best defined of the potential effects of human exposure to excessive noise. Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period, or 85 dB averaged over a 16-hour period. An outdoor DNL of 75 dBA is considered the threshold above which the risk of hearing loss should be evaluated. Following guidelines recommended by the Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council, the average change in the threshold of hearing for people exposed to DNL equal to or greater than 75 dBA was evaluated. Results indicated that an average of 1 dBA hearing loss could be expected for people exposed to DNL equal to or greater than 75 dBA. For the most sensitive 10 percent of the exposed population, the maximum anticipated hearing loss would be 4 dBA. These hearing loss projections must be considered conservative as the calculations are based on an average daily outdoor exposure of 16 hours (7:00 a.m. to 10:00 p.m.) over a 40-year period.

Since it is unlikely that airport neighbors will remain outside their homes 16 hours per day for extended periods of time, there is little possibility of hearing loss below a DNL of 75 dB, and this level is extremely conservative.

C.3.2 Nonauditory Health Effects

Nonauditory health effects of long-term noise exposure, where noise may act as a risk factor, have never been found to occur at levels below those protective against noise-induced hearing loss, described above. Most studies attempting to clarify such health effects have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. The best scientific summary of these findings is contained in the lead paper at the National Institute of Health Conference on Noise and Hearing Loss, held on 22-24 January 1990 in Washington, D.C.

> "The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an eight-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem but also any potential nonauditory health effects in the work place." (Reference C.9; parenthetical wording added for clarification.)

Although these findings were directed specifically at noise effects in the work place, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the nonauditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies which purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, in an often-quoted paper, two University of California at Los Angeles (UCLA) researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Reference C.10). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Reference C.11).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft DNL below 75 dB.

C.3.3 Annoyance

The primary effect of aircraft noise on exposed communities is one of annoyance. Noise annoyance is defined by the U.S. Environmental Protection Agency as any negative subjective reaction on the part of an individual or group (Reference C.3). As noted in the discussion of DNL above, community annoyance is best predicted by that metric.

It is often suggested that a lower DNL, such as 60 or 55 dB, be adopted as the threshold of community noise annoyance for airport environmental analysis documents. While there is no technical reason why a lower level cannot be measured or calculated for comparison purposes, a DNL of 65 dB:

- provides a valid basis for comparing and assessing community noise effects;
- represents a noise exposure level which is normally dominated by aircraft noise and not other community or nearby highway noise sources; and
- reflects the FAA's threshold for grant-in-aid funding of airport noise mitigation projects.
- United States Department of Housing and Urban Development also establishes a DNL standard of 65 dB for eligibility for federally guaranteed home loans.

C.3.4 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Research has shown that "whenever intrusive noise exceeds approximately 60 dB indoors, there will be interference with speech communication" (Reference C.5). A steady A-weighted background sound level of 60 dB will produce 93 percent intelligibility; that of 70 dB will produce 66 percent intelligibility; and that of 75 dB will produce 2 percent intelligibility (Figure D-1 in Reference C.3).

C.3.5 Sleep Interference

Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat louder noise level than does a change in sleep stage.

A recent analysis sponsored by the Air Force summarized 21 published studies concerning the effects of noise on sleep (Reference C.14). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies and the limited in-home studies, did not permit development of an acceptable accurate assessment procedure. The noise events used in the laboratory studies

and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced in the home. None of the laboratory studies was of sufficiently long duration to determine any effects of habituation, such as those which would occur under normal community conditions.

Nevertheless, some guidance is available in judging sleep interference. The U.S. Environmental Protection Agency (USEPA) identified an indoor DNL of 45 dB as necessary to protect against sleep interference (Reference C.3). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor DNL of 65 dB as minimizing sleep interference.

The Federal Interagency Committee on Noise (Reference C.5) reviewed the sleep disturbance issue and presented an Air Force-developed sleep disturbance dose-response prediction curve, which is based on data from Reference C.14, as an interim tool for analysis of potential sleep disturbance. This interim curve shows that for an indoor SEL of 65 dB, approximately 15 percent or less of those exposed should be awakened.

C.3.6 Noise Effects on Domestic Animals and Wildlife

Animal species differ greatly in their responses to noise. Each species has adapted, physically and behaviorally, to fill its ecological role in nature, and its hearing ability usually reflects that role. Animals rely on their hearing to avoid predators, obtain food, and communicate with and attract other members of their species. Aircraft noise may mask or interfere with these functions. Secondary effects may include nonauditory effects similar to those exhibited by humans - stress, hypertension, and other nervous disorders. Tertiary effects may include interference with mating and resultant population declines.

Many scientific studies are available regarding the effects of noise on wildlife and some anecdotal reports of wildlife "flight due to noise." Few of these studies or reports include any reliable measures of the actual noise levels involved.

In the absence of definitive data on the effect of noise on animals, the Committee on Hearing, Bioacoustics, and Biomechanics proposed that protective noise criteria for animals be taken to be the same as for humans (Reference C.16).

C.3.7 Effects of Noise-Induced Vibration on Structures and Humans

The sound from an aircraft overflight travels from the exterior to the interior of the house in one of two ways: through the solid structural elements and directly through the air. The sound transmission starts with noise impinging on the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which in turn sets the interior finish surface vibrating, with some of the energy lost in the airspace. This surface then radiates sound into the dwelling interior. Vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressure impinging on the structure is normally sufficient to determine the possibility of damage. In general, at sound levels above 130 dB, there is the possibility of structural damage. While certain frequencies (such as 30 Hz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than 1 second above a sound level of 130 dB are potentially damaging to structural components (Reference C.17).

In terms of average acceleration of wall or ceiling vibration, the thresholds for structural damage (C.18) are:

- 0.5 meters/sec/sec—threshold of risk of damage to sensitive structures (e.g., ancient monuments); and
- 1.0 meters/sec/sec—threshold of risk of damage to normal dwellings (e.g., houses with plaster ceilings and walls).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or "rattle," of objects within the dwelling - hanging pictures, dishes, plaques, and bric-a-brac. Loose windowpanes may also vibrate noticeably when exposed to high levels of aircraft noise, causing homeowners to fear breakage. In general, such noise-induced vibrations occur at sound levels above those considered normally compatible with residential land use. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

In the assessment of vibrations on humans, the following factors determine if a person will perceive and possibly react to building vibrations:

- Type of excitation: steady state, intermittent, or impulsive vibration;
- Frequency of the excitation. ISO 2631-2 (Reference C.18) recommends a frequency range of 1 to 80 Hz for the assessment of vibration on humans;
- Orientation of the body with respect to the vibration;
- The use of the occupied space; and
- Time of day.

C.3.8 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow structures, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects will result from routine, subsonic aircraft operations.

C.3.9 Noise Effects on Historical and Archaeological Sites

Because of the potential for increased fragility of structural components of historical buildings and other historical sites, aircraft noise may affect such sites more severely than newer, modern structures. Again, there are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed scheduled operation of the supersonic Concorde airplane at Dulles (Reference C.19). There was a special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

As noted above for the noise effects of noise-induced vibrations of normal structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

C.4 Noise Level Reduction Guidelines

Wylie Labs in April 2005 completed a study for the Naval Facilities Engineering Command titled, "Guidelines for Sound Insulation of Residences Exposed to Aircraft Operations". The study provides an in-depth, state-of-the-art noise level reduction guidelines.

Copies of this study are available for review, upon request, from the 87th Civil Engineering Squadron at McGuire AFB or on-line at: http://afcee.af.mil/shared/media/document/AFD-070914-039.pdf

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APPENDIX D

NOISE LEVEL REDUCTION GUIDELINES

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