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Air Installations Compatible Use Zones Study

for NAS Meridian and NOLF Joe Williams

Prepared by:

United States Department of the Navy,
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AIR INSTALLATIONS COMPATIBLE USE ZONES STUDY FOR NAVAL AIR STATION MERIDIAN AND NAVY OUTLYING FIELD JOE WILLIAMS

FINAL - NOVEMBER 2012

Prepared by

UNITED STATES DEPARTMENT OF THE NAVY
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Acronyms and Abbreviations

- A -

AETC	Air Education and Training Command
AFB	Air Force Base
AGL	above ground level
AICUZ	Air Installations Compatible Use Zones
ANG	Air National Guard
ANSI	American National Standards Institute
AOD	Air Operations Department
APZ	accident potential zone
ARW	Air Refueling Wing
ATC	Air Traffic Control

- B -

BASH	bird/animal strike hazard
BRAC	Base Realignment and Closure

- C -

CEDS	Comprehensive Economic Development Strategy
CNATRA	Chief of Naval Air Training
CNEL	Community Noise Exposure Level
CNO	Chief of Naval Operations
CO	Commanding Officer
CPLO	Community Planning and Liaison Officer
CY	Calendar Year

- D -

dB	decibel
dBA	A-weighted decibel
DNL	day-night average sound level
DOD	United States Department of Defense

- E -

EA	Environmental Assessment
ECPDD	East Central Planning and Development District
EIS	Environmental Impact Statement
EMBDC	East Mississippi Business Development Corporation
EMI	electromagnetic interference
EPA	U.S. Environmental Protection Agency

- F -

FAA	Federal Aviation Administration
FCLP	Field Carrier Landing Practice
FICON	Federal Interagency Committee on Noise
FICUN	Federal Interagency Committee on Urban Noise

- G -

GCA	Ground Control Approach
GIS	Geographic Information System

- I -

IFR	Instrument Flight Rules

- J -

JLUS	Joint Land Use Studies

- M -

MAPDD	Mississippi Association of Planning and Development Departments
MATSS	Marine Aviation Training Support Squadron
MDA	Mississippi Development Authority
MLS	Multiple Listing Service
MMCC	Mississippi Military Communities Council
MOA	Military Operating Area
MSL	mean sea level

- N -

NAAS	Naval Auxiliary Air Station
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NATOPS	Naval Air Training Operations Procedures Standardization
NATRACOM	Naval Air Training Command
NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NEPA	National Environmental Policy Act
NM	nautical mile
NOLF	Navy Outlying Landing Field
NOSC	Naval Operational Support Center
NTTC	Naval Technical Training Command

- O -

OLF	Outlying Landing Field
OPNAVINST	Chief of Naval Operations Instruction

- P -

PPEL	Practice Precautionary Emergency Landing

- R -

RCTA	Regional Counterdrug Training Academy

- S -

SNA	Student Naval Aviator
STOVL	short-takeoff, vertical landing
SUA	Special Use Airspace

- T -

TACAN	Tactical Air Navigation
TDR	transfer of development rights
TRAWING	Training Air Wing
TS	Total System

- U -

USAF	United States Air Force
USCB	U.S. Census Bureau
USGS	United States Geological Survey
USMC	United States Marine Corps

- V -

VFR	visual flight rules
VA	U.S. Department of Veterans Affairs

- X -

XO	Executive Officer

EXECUTIVE SUMMARY

This Air Installations Compatible Use Zones (AICUZ) Study has been prepared in accordance with federal regulations and guidelines and United States Department of the Navy (Navy) instructions to protect the public's health, safety, and welfare and to prevent incompatible development from degrading the operational capability of Naval Air Station (NAS) Meridian and Navy Outlying Landing Field (NOLF) Joe Williams, both located in the east-central portion of the state of Mississippi. Analysis and findings presented in this AICUZ Study focus on the noise impact areas generated from air operations and the safety zones surrounding both airfields' runways. The Navy and NAS Meridian encourage compatible development within the noise and safety zones and are committed to working with the surrounding communities to ensure a mutually safe environment to live and work, while continuing to meet the mission of the installation.

This Executive Summary provides a preview of the AICUZ Study's outline and a brief overview of what is discussed and presented in each chapter.

ES.1 PURPOSE OF AN AICUZ STUDY

The core of the AICUZ Program is the development of a land use plan that promotes compatible uses by communities in the vicinity of a military installation. In the early 1970s, the United States Department of Defense (DOD) established the AICUZ Program to balance the need for aircraft operations and community concerns over aircraft noise and accident potential. The AICUZ Program was developed in response to growing incompatible urban development around military airfields. Today, the AICUZ Program is considered a vital tool that is used by all branches of the military to communicate with neighboring

The purpose of this AICUZ Study is to achieve land use compatibility between NAS Meridian and NOLF Joe Williams and the neighboring communities.

counties, communities, municipalities, and individuals to educate, inform, and present areas of incompatible land use surrounding military airfields. When implemented, AICUZ studies help protect the health and increase the safety and well-being of the public, while protecting the military's flying mission.

This AICUZ Study provides background information on NAS Meridian and NOLF Joe Williams, presents the 2012 AICUZ noise contours and zones associated with aircraft operations, establishes 2012 AICUZ accident potential zones (APZs) for aircraft, identifies areas of incompatible land uses and proposed development within these zones, and recommends actions to encourage compatible land use.

ES.2 NAS Meridian

- **Home to TRAWING One**
- **Advanced Pilot Training for T-45C Aircraft**
- **Training Commands for Navy**
- **Training for Local Law Enforcement**
- **Services for Active Duty, Reservists, Retired Military, and Civil Service Employees**

Located in Kemper and Lauderdale Counties in east-central Mississippi, NAS Meridian and NOLF Joe Williams provide an outstanding location for the training of Navy and United States Marine Corps (USMC) student pilots. Situated north of the city of Meridian, NAS Meridian is the largest employer in the region. NAS Meridian is home to one of the Chief of Naval Air Training's (CNATRA's) jet strike pilot training wings, Training Air Wing (TRAWING) One, and provides advanced pilot training to student naval aviators (SNAs) in T-45C jet aircraft.

NAS Meridian is also home to other training commands for the Navy and for local law enforcement and provides all typical installation services to active duty military, reservists, retired military, and civil service employees.

Located northwest of NAS Meridian, NOLF Joe Williams is utilized by SNAs to conduct practice landings.

ES.3 AIRCRAFT OPERATIONS

The T-45C is the only aircraft on station at NAS Meridian and is utilized for all aircraft operations performed at the installation. Typical operations include arrivals, departures, pattern operations (including touch-and-go's and field carrier landing practice [FCLP]), and low approaches. In addition, to practice landings at NOLF Joe Williams, SNAs train in designated Special Use Airspace (SUA) over Mississippi and Alabama, called Military Operating Areas, or MOAs.

Aircraft generally follow designated flight tracks, which are specific routes an aircraft must follow while conducting an operation at the airfield. Flight tracks provide safety, consistency, and control of an airfield and are graphically represented on paper as single lines, but flights vary due to aircraft performance, pilot technique, weather conditions, and Air Traffic Control (ATC) variables, such that the actual flight track is a band, often one-half to several miles wide.

This AICUZ Study has developed noise contours and APZs based on projected operations for CY 2020.

To develop noise contours and areas of accident potential, aircraft operations data have been collected and analyzed as part of this AICUZ Study. AICUZ studies project operations, typically five to ten years in the future, for planning purposes. Therefore, this AICUZ Study has projected operations for Calendar Year (CY) 2020. This projected year is the basis for the modeled noise contours and APZs.

ES.4 AIRCRAFT NOISE

Air Installation Noise Sources

- Aircraft Operations
- Engine Run-Ups

The chief sources of noise at an air installation are aircraft operations and maintenance engine run-ups. This AICUZ Study has incorporated both sources of noise to develop installation-specific noise contours for both NAS Meridian and NOLF Joe Williams.

Noise exposure is assessed using the day-night average sound level (DNL) noise metric. The DNL is depicted graphically as a noise contour that connects equal points of value. The DOD approved noise model, NOISEMAP, was utilized in this study and incorporated data collected from NAS Meridian and the Navy.

The AICUZ Program divides noise exposure into three categories known as noise zones. Noise zones 1 through 3 are developed based on the DNL and provide associated land use control recommendations for each of the zones. These noise zones provide the basis for identifying incompatible land use around an airfield. This AICUZ Study presents the 2012 AICUZ noise contours, and noise zones have been identified for NAS Meridian and NOLF Joe Williams.

ES.5 AIRFIELD SAFETY

The Navy recommends that land uses with a high concentration of people (apartments, churches, schools) be located outside APZs.

While the likelihood of an aircraft mishap occurring is remote, the Navy identifies areas of accident potential to assist in land use planning based on historical data from aircraft mishaps. The Navy recommends certain land uses that concentrate large numbers of people—apartments, churches, and schools—to be constructed outside APZs.

The closer an area is located to a runway, the more likely it is that a mishap will occur. APZs are developed, in part, based on the number of operations conducted on a runway per flight track. The three standard APZs, in order of accident potential, are Clear Zone, APZ I, and APZ II. Thus, an accident is more likely to occur in the Clear Zone than in APZ I or II, and is more likely to occur in APZ I than APZ II. The 2012 AICUZ APZs were developed for NAS Meridian and NOLF Joe Williams based on the CY 2020 projected operations.

ES.6 LAND USE COMPATIBILITY ANALYSIS

The 2012 AICUZ map defines the minimum area needed to protect the health, safety, and welfare of populations near NAS Meridian and NOLF Joe Williams.

A composite noise contour and APZ map has been developed and overlaid on an aerial photograph to show the 2012 AICUZ footprint for both NAS Meridian and NOLF Joe Williams. The footprint shows the minimum recommended acceptable area within which land use controls are needed to protect the health, safety, and welfare of those living or working nearby and to preserve the flying mission.

The Navy has developed land use compatibility recommendations for noise zones and APZs. These recommendations are found in the AICUZ guidance document, Chief of Naval Operations Instruction (OPNAVINST) 11010.36C, and also provide guidelines for the placement of APZs and noise zones. Noise sensitive land uses (e.g., houses, churches, schools) should be placed outside high noise zones, and people intensive uses (e.g., apartments, theaters, churches, shopping centers) should not be placed in APZs. This AICUZ Study incorporates county and state land use and zoning regulations and documents as the basis for identifying existing land use and zoning as well as future land use and zoning. Where land use or zoning data are not readily available or not required under the current regulations, site surveys, interviews, and desktop surveys have been conducted to accurately capture local development.

ES.7 Land Use Tools and Recommendations

Implementation of the AICUZ Study

- Federal Government
- State/Regional Governments
- Local Governments
- Businesses
- Real Estate Developers
- Private Citizens
- Navy

The federal government, state and regional governments, local governments, businesses, real estate developers, and private citizens, along with the Navy, all play an important role in implementing this AICUZ Study. The Navy recommends that the AICUZ footprint be incorporated into Kemper and Lauderdale Counties' existing AICUZ ordinances to best guide compatible development around the installation.

ES.8 Appendices

ES.8.1 Appendix A: Discussion of Noise and its Effect on the Environment

Appendix A provides a detailed discussion of the basics of sound, sound measurements, and noise effects on humans and wildlife.

ES.8.2 Appendix B: Land Use Compatibility Recommendations

Appendix B presents the comprehensive Navy Land Use Recommendations Tables within noise zones and APZs as provided in OPNAVINST 11010.36C, "Air Installations Compatible Use Zones Program."

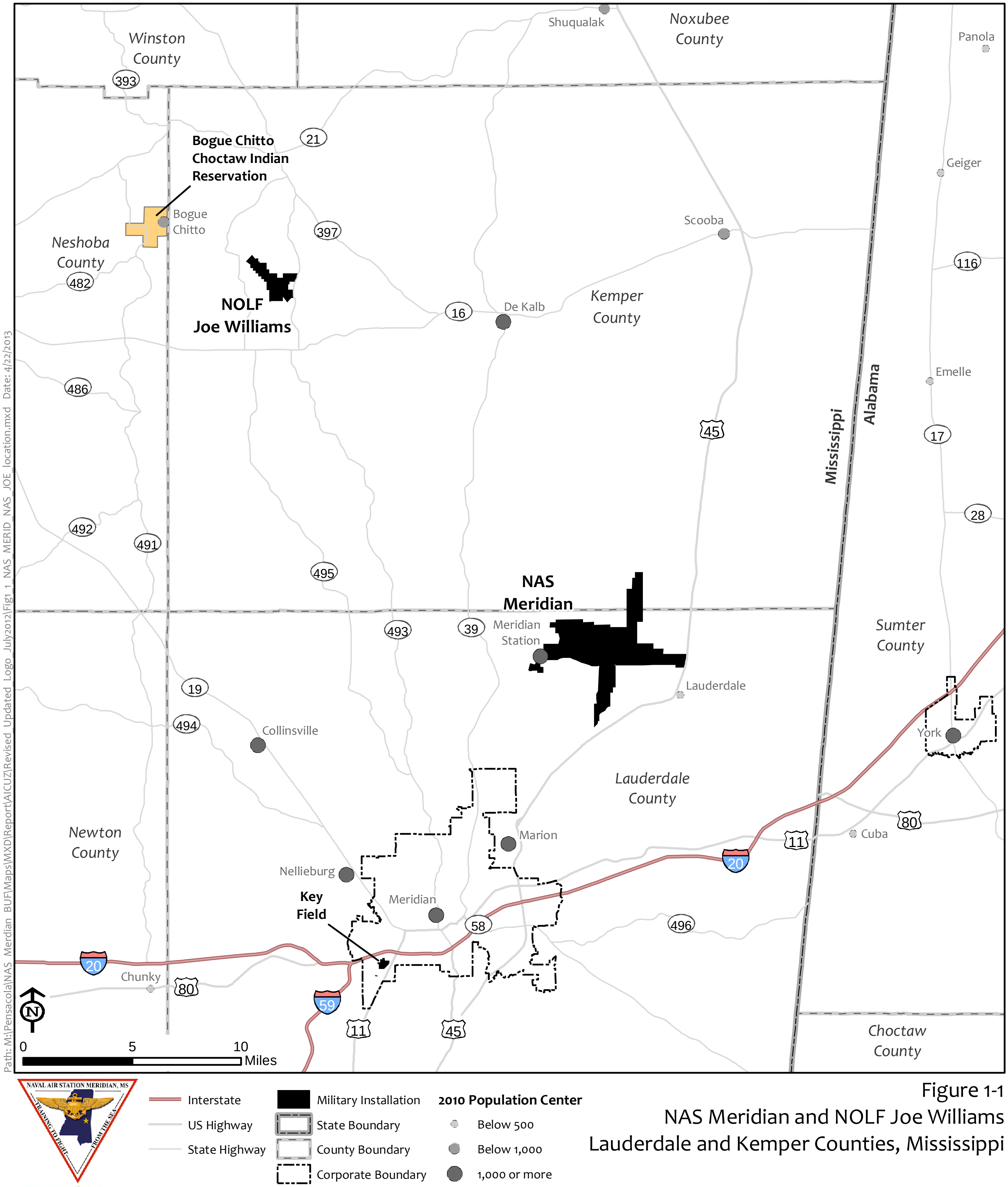
1 INTRODUCTION

Many areas throughout the United States have experienced associated population growth and increased development in close proximity to a military installation. New homes are often constructed in close proximity to military installations, in many instances to allow military and civilian personnel who work at a base to live near their employer. Similarly, businesses are established in the vicinity of these homes and military installations to support the installations and personnel. Because of the proximity to the installations, some of this development may be incompatible with aircraft and other military operations that occur at the base and, over time, can result in nearby residents or businesses being adversely impacted. This incompatible development can also result in the degradation of the installation's mission.

In keeping with this national trend, this type of growth pattern has occurred, on a limited basis, within the region surrounding Naval Air Station (NAS) Meridian, located in Meridian, Mississippi (Figure 1-1). Some areas in the region have experienced population growth and increased development. This Air Installations Compatible Use Zones (AICUZ) Study identifies where this development has occurred and is projected to occur.

The United States Department of Defense (DOD) initiated the AICUZ Program in 1973 to help governments and communities identify and plan for compatible land use and development near military installations. The goal of this program is to protect the health, safety, and welfare of the public, while also protecting the operational capabilities of the military. This goal is accomplished by achieving compatible land use patterns around an air installation.

NAS Meridian and NOLF Joe Williams



Path: M:\Pensacola\NAS Meridian BUF\Maps\MXD\Report\AICUZ\Revised Updated Logo July2012\Fig1 1 NAS MERID NAS JOE location.mxd Date: 4/22/2013

Figure 1-1
NAS Meridian and NOLF Joe Williams
Lauderdale and Kemper Counties, Mississippi

Source: ESRI 2010, U.S. Navy 2011

> **The goal of the AICUZ Program is to protect military operational capabilities while also protecting the health, safety, and welfare of the public.**
>
> **This goal is accomplished by achieving compatible land use patterns and activities in the vicinity of a military installation.**

The AICUZ Program recommends that noise contours, accident potential zones (APZs), height obstruction criteria, and land use recommendations be incorporated into local community planning to minimize impacts to the mission and the residents in the surrounding community. Mutual cooperation between the installation and neighboring communities is key to the AICUZ Program's success. As the communities that surround an airfield grow and develop, the United States Department of the Navy (Navy) has the responsibility to communicate and collaborate with local governments on land use planning, zoning, and mission impacts.

This 2012 NAS Meridian AICUZ Study has been prepared as an update to the 2004 AICUZ Study. The Study has been prepared in consideration of past and expected changes in mission and aircraft, and projected operational levels through 2020.

Compatible use zones, as described in this AICUZ Study, focus on the land use within the immediate vicinity of the airfield and the aircraft operations at the airfield, itself. Although aircraft stationed at NAS Meridian also utilize Key Field and designated Military Operating Areas (MOAs), this AICUZ Study only takes into account aircraft operations at NAS Meridian and Navy Outlying Field (NOLF) Joe Williams, including arrivals, departures, and pattern work in the vicinity of the airfields.

This chapter of the NAS Meridian AICUZ Study provides background on the AICUZ Program, historical data from the 2004 AICUZ Study, and changes that require an AICUZ update. Chapter 2 describes the location and features of NAS Meridian, including air space and operational areas. Aircraft type, operations, flight tracks, and inter-facility operations are discussed in Chapter 3. Chapter 4 presents the updated 2012 AICUZ noise contours, the development methodology, notable changes, and projections, as well as what the Navy has implemented to mitigate community noise concerns. Aircraft safety and the 2012 AICUZ APZs are discussed in Chapter 5. Chapter 6 evaluates the compatibility of both current and proposed land uses, as provided by local governments. Chapter 7 provides recommendations for promoting land use compatibility, and Chapter 8 presents a list of references used in this AICUZ Study.

1.1 AICUZ PROGRAM

In the early 1970s, DOD established the AICUZ Program to balance the need for aircraft operations with community concerns over aircraft noise and accident potential. The AICUZ Program was developed in response to growing incompatible urban development around military airfields. The objectives of the AICUZ Program, according to the Chief of Naval Operations Instruction (OPNAVINST) 11010.36C, are as follows:

- To protect the health, safety, and welfare of civilians and military personnel by encouraging land use that is compatible with aircraft operations;
- To reduce noise impacts caused by aircraft operations while meeting operational, training, and flight safety requirements, both on and in the vicinity of air installations;
- To inform the public and seek cooperative efforts to minimize noise and aircraft accident potential impacts by promoting compatible development; and
- To protect Navy and United States Marine Corps (USMC) installation investments by safeguarding the installations' operational capabilities.

Development/Land Uses that could Endanger Aircraft and Pilots

- Lighting that impairs pilot vision
- Towers, tall structures, and vegetation that penetrate airspace
- Development that generates smoke, steam, or dust
- Uses that attract birds
- EMI sources

The Federal Aviation Administration (FAA) and DOD have developed specific instructions and guidance to encourage local communities to restrict development or land uses that could endanger aircraft, including lighting (direct or reflected) that would impair pilot vision; towers, tall structures, and vegetation that penetrate navigable airspace or are constructed near the airfield; uses that generate smoke, steam, or dust; uses that attract birds, especially waterfowl; and electromagnetic interference (EMI) sources that may adversely affect aircraft communication, navigation, or other electrical systems. This is discussed in more detail in Chapter 5.1, Flight Safety.

Noise zones and APZs, which are described in detail in Chapters 4 and 5, respectively, are areas of concern for the air installation and local planning departments. Since noise zones and APZs often extend beyond the "fence line" of the installation, presenting the most current noise zones and APZs to local planners is essential in fostering mutually beneficial land uses and development. It is a goal of the AICUZ Program to have noise zones and APZs adopted by the local planning departments in order to incorporate development criteria in areas around the base.

1.2 PURPOSE, SCOPE, AND AUTHORITY

The purpose of the AICUZ Program is to achieve compatibility between air installations and neighboring communities. To satisfy this purpose, the Navy works with the local community to discourage incompatible development of lands adjacent to an installation. The scope of the AICUZ Study includes an analysis of:

- Aircraft noise zones for future-year forecasts;
- Aircraft APZs for future-year forecasts;
- Land use compatibility;
- Historic, current, and future aircraft operations;
- Noise reduction strategies; and
- Possible solutions to existing and potential incompatible land use problems.

As development encroaches upon an airfield, more people are potentially exposed to noise and accident potential associated with aircraft operations. The AICUZ Study uses an analysis of community development trends, land use tools, and mission requirements to recommend strategies for communities to prevent incompatible land development. Implementation requires cooperation between the air installation Commanding Officer (CO) and the local government.

The overall goal of the AICUZ Program is to simultaneously protect and promote the public's health, safety, and welfare, while protecting the installation's mission. In order to expand NAS Meridian's community outreach and to educate the surrounding communities, businesses, and the public about the AICUZ Program, a suite of public relation tools such as a brochure, trifold and informational video has been developed in association with this AICUZ Study.

Key documents, some of which are used in this analysis, that outline the authority for the establishment and implementation of the AICUZ Program, as well as guidance on facility requirements, are derived from:

- DOD Instruction 4165.57, "Air Installations Compatible Use Zones," dated May 2, 2011;
- OPNAVINST 11010.36C, "Air Installations Compatible Use Zones Program," dated October 9, 2008;
- Unified Facilities Criteria 3-260-01, "Airfield and Heliport Planning and Design," dated November 17, 2008;
- Naval Facilities Engineering Command P-80.3, "Facility Planning Factor Criteria for Navy and USMC Shore Installations: Airfield Safety Clearances," dated January 1982; and
- United States Department of Transportation, FAA Regulations, Code of Federal Regulations, Title 14, Part 77, "Objects Affecting Navigable Airspace."

1.3 Responsibility for Compatible Land Use

Military installations can make recommendations or advise local governments and agencies on land use near an installation, but it is the local government and agencies that have the planning and zoning authority to preserve land use compatibility near the military installation.

Ensuring land use compatibility within the area that makes up the AICUZ is a cooperative effort of many organizations including the DOD, Navy, local naval air installation command, local government, planning and zoning agencies, real estate agencies, residents, and developers. Military installations can advise the local government and agencies on land use near an installation, but it is the local government and agencies that have authority to preserve land use compatibility outside the fence line. Cooperative action by all parties is essential in preventing land use incompatibility and hazards. Table 1-1 identifies key responsibilities for various community stakeholders with respect to AICUZ and land use compatibility.

Table 1-1. Responsibility for Compatible Land Uses

Navy	▪ Examine air mission for operational changes that could reduce impacts. ▪ Conduct noise and APZ studies. ▪ Develop AICUZ maps. ▪ Examine local land uses and growth trends. ▪ Make land use recommendations. ▪ Release an AICUZ Study. ▪ Work with local governments and private citizens. ▪ Monitor operations and noise complaints. ▪ Update AICUZ studies, as required.
Local Government	▪ Incorporate AICUZ guidelines into a comprehensive development plan and zoning ordinance. ▪ Regulate height and obstruction concerns through an airport ordinance. ▪ Regulate acoustical treatment in new construction. ▪ Require fair disclosure in real estate for all buyers, renters, lessees, and developers.
Builders/Developers	▪ Develop properties in a manner that appropriately protects the health, safety, and welfare of the civilian population by constructing facilities that are compatible with aircraft operations (e.g., sound attenuation features, densities, and compatible businesses).
Real Estate Professionals	▪ Ensure potential buyers and lessees receive and understand AICUZ information on affected properties. ▪ When working with builders/developers, ensure an understanding and evaluation of the AICUZ Program.
Private Citizens	▪ Seek information and self-education on the established zones and what impacts they may cause for an individual. ▪ Identify AICUZ considerations in all property transactions. ▪ Understand AICUZ effects before buying, renting, leasing, or developing property.

1.4 PREVIOUS AICUZ EFFORTS

The original, complete AICUZ for NAS Meridian and affiliated NOLFs was approved by the Chief of Naval Operations (CNO) and published in 1978. Since then, the AICUZ footprint and study has been revised based on additional noise studies and surveys and AICUZ updates. It also has been used as a

Previous AICUZ Efforts

- **1978** AICUZ Study for NAS Meridian, OLF Alpha, and OLF Bravo
- **1987** NAS Meridian Master Plan
- **2004** AICUZ Study Update for NAS Meridian and NOLF Joe Williams

reference source in installation planning documents and environmental assessments (EAs). These historical studies reflected changes in aircraft, changes in flight tracks, and changes in the Navy AICUZ instruction. The following list highlights significant documents that present noise contours for NAS Meridian and NOLF Joe Williams (previously named Outlying Field [OLF] Bravo). A timeline with a brief summary and the relevance of each document is provided.

1978 – AICUZ Study for NAS Meridian, OLF Alpha, and OLF Bravo

The original AICUZ Study was approved for implementation by the CNO in February 1978. It established the AICUZ footprint for the main station and OLFs Alpha and Bravo, and provided strategies for compatible land use. This AICUZ Study modeled operations and noise from the T-2 aircraft. [OLF Bravo was renamed Joe Williams Field in 1987; OLF Alpha was transferred to Columbus Air Force Base (AFB) in 1990.]

1987 – NAS Meridian Master Plan

The 1987 Master Plan presented an approved AICUZ update for McCain Field and OLF Bravo (NOLF Joe Williams) and served as the official AICUZ Study until the 2004 update. This AICUZ Update modeled operations and noise from the T-2 aircraft. As a result of this AICUZ update, Kemper and Lauderdale Counties used the 1987 AICUZ Update as the basis for the AICUZ ordinances in 1992 and 1995.

2004 – AICUZ Study Update for NAS Meridian and NOLF Joe Williams

This document was the first complete update to the original 1978 AICUZ Study. Noise contours were based on the 2002 Noise Study and modeled the T-45 aircraft. The 2004 AICUZ Study is used for the baseline conditions comparison in this 2012 AICUZ Study.

1.5 CHANGES THAT REQUIRE AN AICUZ UPDATE

AICUZ studies should be updated when an installation has:

- Changes in the type of aircraft stationed at the installation
- Significant changes in aircraft operations
- Changes in flight paths or procedures

AICUZ studies should be updated when an air installation has a change in the type of aircraft at the installation, a significant change in operations (i.e., the number of takeoffs and landings or significant increases in nighttime [10:00 p.m. to 7:00 a.m. hours] flying activities), or changes in flight paths or procedures.

In accordance with OPNAVINST 11010.36C, this AICUZ Study has been prepared to reflect flight tracks, APZs, and operations projected for Calendar Year (CY) 2020. Since publication of the 2004 AICUZ Study, changes have occurred with runway usage and published flight tracks, thus affecting APZs. Navy AICUZ Instruction has been updated since the 2004 AICUZ Study and provides guidance and instruction that was not considered in that study. In addition, land use changes and increased development have occurred around the installation.

1.5.1 Changes in Aircraft Mix

No significant changes in aircraft mix have occurred at NAS Meridian since publication of the 2004 AICUZ Study. The 2004 AICUZ Study presents projected CY 2005 operations, with only the T-45C as the primary aircraft. The Navy does not anticipate any changes in aircraft operating at the installation through CY 2020. Therefore, in this AICUZ Study, it is assumed that the T-45C will remain the primary aircraft operating from NAS Meridian. No aircraft are permanently stationed at NOLF Joe Williams, as that location is primarily utilized by aircraft from NAS Meridian. Table 1-2 provides a list of aircraft types operating at NAS Meridian from CY 2000 through CY 2010, and projected aircraft for CY 2020.

T-45 Aircraft

Table 1-2. Aircraft Types at NAS Meridian

2000	2005	2010	2020*
Permanent	**Permanent**	**Permanent**	**Permanent**
T-2	T-45	T-45	T-45
T-45	HH-1	--	--
HH-1	--	--	--
Transient	**Transient**	**Transient**	**Transient**
F-18	F-18	F-18	F-18
T-38	T-38	AV-8B	F-35
F-5	F-5	T-38	T-38
C-12	C-12	F-5	F-5
C-9	C-9	C-26	C-26
--	--	C-12	C-12
--	--	C-9	T-6
--	--	--	EA-18G
--	--	--	E-2
--	--	--	C-2

Source: Navy 2004; NAS Meridian 2011a
Note:
* = All foreseeable projections out to CY 2020.

1.5.2 Changes in Operations Level

Operational levels at NAS Meridian have decreased over the past decade. Likewise, operations at NOLF Joe Williams display a decreasing trend, with the peak year being 2001. Operations in the 2004 AICUZ Study projected 134,919 total operations for NAS Meridian and 68,906 for NOLF Joe Williams. The 2020 projected operations at NAS Meridian are 191,272 annual operations. The change in projections is due, in part, to the F/A-18 training syllabus sorties that will be conducted on station in the T-45C as part of training requirements. Training that is being conducted at other locations in the F/A-18 is projected to be conducted at NAS Meridian in the T-45C to improve efficiency and reduce cost. There is an overall increase in departures, arrivals, and pattern work, and actual operations from 2005 to 2010 were higher than projected in 2004, resulting in a higher five-year average. In addition, intra-facility operations (departing one runway and arriving at another) have expanded as a component of annual operations on station.

The projected operational level at NOLF Joe Williams has been reduced to 34,188 annual operations in CY 2020, an almost 50 percent decrease since the 2004 AICUZ Study. The decrease in operations is due, in part, to a significant decrease in pattern operations. While the aircraft utilize NOLF Joe Williams more than the 2004 AICUZ, they conduct less operations (pattern work) while there than presented in the previous study.

Tables 1-3 and 1-4 provide the annual military and civilian aircraft operations from CY 2001 through CY 2010, and projected aircraft operations for CY 2020, for NAS Meridian and NOLF Joe Williams, respectively. Chapter 3 presents a more detailed look into the operational level at each airfield.

Table 1-3. Annual Military and Civilian Operations by Year at NAS Meridian

Calendar Year	Annual Operations				
	Military		Civilian		Total
	Navy	Other	Air Carrier	General Aviation	
2020*	191,272	300	0	103	191,675
2010	162,248	91	0	26	162,365
2009	187,616	226	0	92	187,934
2008	170,896	81	0	188	171,165
2007	194,282	709	0	144	195,135
2006	205,324	394	0	67	205,785
2005	205,302	302	0	106	205,765
2004	235,191	0	0	91	235,282
2003	260,815	323	0	45	261,183
2002	247,783	169	0	38	247,990
2001	302,700	216	0	19	302,935

Sources: Navy 2004; Wyle Laboratories 2003, 2012

Note:

* = Projected operations. The 2020 projection is a five-year average of annual operations plus 15% for added sorties projected in the *Draft Environmental Assessment Addressing the Establishment of the Meridian 2 Military Operations Area at Naval Air Station Meridian, Mississippi, August 2011.*

Table 1-4. Annual Military and Civilian Operations by Year at NOLF Joe Williams

Calendar Year	Annual Operations				
	Military		Civilian		Total
	Navy	Other	Air Carrier	General Aviation	
2020*	34,188	3	0	44	34,234
2010	20,703	10	0	0	20,713
2009	29,010	0	0	177	29,187
2008	40,468	3	0	20	40,491
2007	46,377	0	0	23	46,400
2006	34,379	0	0	0	34,379
2005	27,447	0	0	0	27,447
2004	33,890	0	0	0	33,890
2003	32,185	0	0	0	32,185
2002	40,222	0	0	0	40,222
2001	54,671	0	0	0	54,671

Sources: Navy 2004; Wyle Laboratories 2003, 2012

Note:

* = Projected operations. The 2020 projection is a five-year average of annual operations.

1.5.3 Changes in Flight Tracks and Procedures

Flight tracks established by NAS Meridian are dependent on aircraft mix, operational level, runway usage, and control measures. As summarized in Tables 1-3 and 1-4, operational levels have changed over time which, in turn, have influenced changes in flight tracks and procedures. Flight tracks at both airfields have slightly shifted since the previous AICUZ Study to reflect current operations. The basic tracks remain, along with the same patterns, but with a slight shift in location, extent, and locations of turns or breaks. In addition, Air Traffic Control (ATC) reported approximately 30 new flight tracks at NAS Meridian, some of which replaced previous tracks. Flight tracks at NOLF Joe Williams have also slightly shifted since the 2004 AICUZ Study; however, no notable changes have occurred. Chapter 3 presents a more detailed look into the flight tracks at each airfield.

2

NAVAL AIR STATION MERIDIAN

2.1 LOCATION AND HISTORY

NAS Meridian is located 15 miles northeast of downtown Meridian, Mississippi, and is just 10 miles west of the Mississippi-Alabama state line. Situated in the North Central Hills region of the state, the main base of NAS Meridian occupies 8,061 acres, with an additional 1,255 acres at NOLF Joe Williams Field and 654 acres at Target Range SEARAY. NAS Meridian is located in the northeastern portion of Lauderdale County and southeastern Kemper County; however, NOLF Joe Williams is 18 miles northwest in northwestern Kemper County, and Target Range SEARAY is located further north in Noxubee County (Figure 2-1). Centrally located in the southeastern United States, Meridian, Mississippi is 155 miles southwest of Birmingham, Alabama; 90 miles east of Jackson, Mississippi; 247 miles northeast of New Orleans, Louisiana; and 180 miles north of Pensacola, Florida.

NAS Meridian, Late 1960s

NAS Meridian Regional Location Map

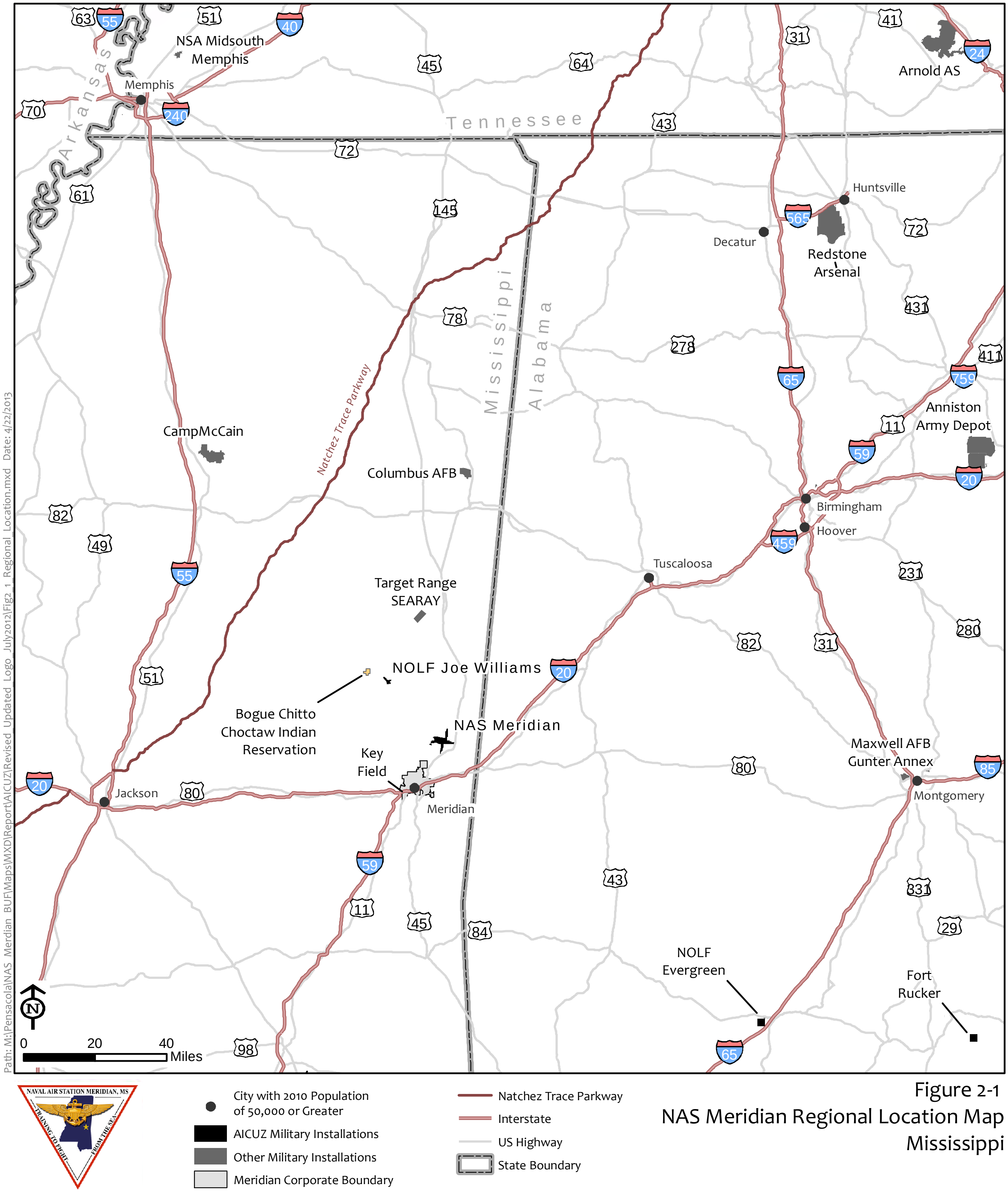
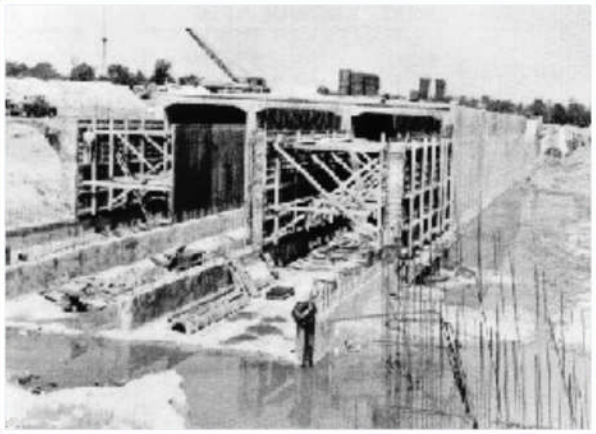


Figure 2-1
NAS Meridian Regional Location Map
Mississippi

Source: ESRI 2010



NAAS Construction, Ponta Creek, Circa 1960

Construction of NAS Meridian began in July 1957 and was first commissioned by the Navy on July 14, 1961 as a Naval Auxiliary Air Station (NAAS). The airfield was named McCain Field in honor of Admiral John S. McCain, Sr. In July of 1961, Training Squadron Seven (VT-7) was relocated to the installation and became the first squadron to arrive at NAAS Meridian. The VT-7 squadron then divided in December 1965 to form its sister squadron, Training Squadron Nine (VT-9). By July 1968, the station had become a full Naval Air Station. Aircraft flown out of NAS Meridian include T-2s (1961-2004), TA-4Js ("Skyhawks") (1971-1999), and T-45s (1997 to present).

The significance and operational importance of NAS Meridian steadily increased due to demand for pilots during the Vietnam War. The commissioning of Training Air Wing (TRAWING) One, the establishment of Training Squadron Nineteen (VT-19), the arrival of new advanced jet trainers (TA-4J), all in 1971, and the opening of the Naval Technical Training Command (NTTC) in 1973 (NAS Meridian 2010) and the Marine Aviation Training Support Group in 1979 also increased NAS Meridian's importance. The additions brought an increase in development and family housing units to the base and the surrounding area. In July 1968, then NAAS Meridian became a Naval Air Station (NAS); in October 1982, the station was upgraded to a Major Shore Command; and in 1984, NAS Meridian was one of 15 installations chosen for the DOD Model Installation Program.

The closure of NAS Chase Field and TRAWING THREE in 1993 resulted in the realignment of jet strike training to NAS Meridian and NAS Kingsville. Thirty-five T-2s shifted to NAS Meridian, and training peaked with over 300,000 annual operations in 2000, as NAS Kingsville converted to T-45As.

The Regional Counterdrug Training Academy (RCTA) was established in 1992 at NAS Meridian with the mission to provide no-cost, "street level," case-making, counterdrug skills to civilian law enforcement officers (RCTA

2010). Operated by the Mississippi National Guard, the RTCA provides training to law enforcement officers from Louisiana, Mississippi, Alabama, Tennessee, and Georgia.

Naval Reserve Center Meridian was established on station following the closure of Naval Reserve Center Jackson in 2000.

TRACOM Wings (TRAWING)

ONE – NAS Meridian
TWO – NAS Kingsville
FOUR – NAS Corpus Christi
FIVE – NAS Whiting Field
SIX– NAS Pensacola

Today, NAS Meridian is one of Chief of Naval Air Training's (CNATRA's) two jet strike pilot training bases, the other being NAS Kingsville, Texas. Headquartered on board NAS Corpus Christi, Texas, CNATRA oversees the Naval Air Training Command (NATRACOM) and is composed of five Wings located on Naval Air Stations in Florida, Mississippi, and Texas. The Wings are home to 17 training squadrons. NAS Meridian is home to TRAWING ONE, composed of squadrons VT-7 and VT-9 instructing Student Naval Aviators (SNAs) in the Boeing T-45C "Goshawk," the Navy's most advanced strike jet trainer (CNATRA 2010). Figure 2-2 provides a general overview of the student pilot pipeline.

Student Naval Aviators Training Pipeline

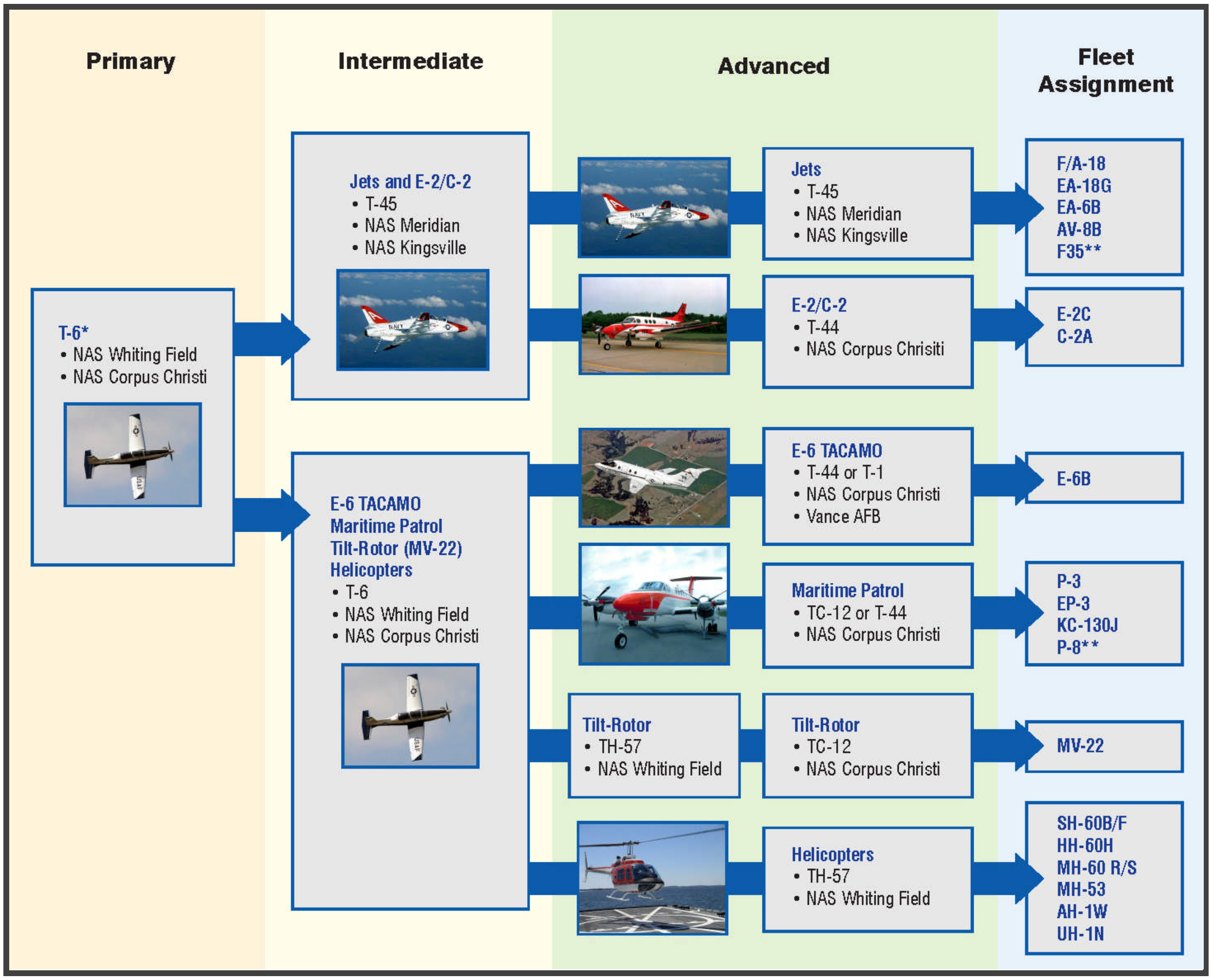
Prior to achieving the coveted *Wings of Gold*, SNAs (also referred to as student pilots or students) must go through primary, intermediate, and advanced training. All SNAs complete primary training in the T-6 aircraft at either NAS Whiting Field or NAS Corpus Christi. Following primary training, SNAs are selected for Maritime (multi-engine prop), E 2/C-2, Rotary (helos), Strike (jets), or the E-6 TACAMO aircraft.

↓

An SNA's intermediate training location is determined by the type of aircraft the student has been selected to fly. Intermediate training locations include NAS Meridian, NAS Kingsville, NAS Corpus Christi, and NAS Whiting Field.

↓

Student pilots who enter the Strike (jet) pipeline complete their training at either NAS Meridian in the T-45C or NAS Kingsville in the T-45A/C. During Strike training, pilots learn strike tactics, weapons delivery, air combat maneuvering, and receive their carrier landing qualification.



* The T-34 is currently being phased out of the inventory and replaced by the T-6.
** New aircraft coming into inventory.

Figure 2-2. Student Naval Aviators Training Pipeline

2.2 MISSION

NAS Meridian's mission is to support Navy and USMC war fighters. The station "*supports aviation and technical training and other tenant activities by providing timely, quality services and facilities in an environmentally safe, secure community*." With the guiding principle of innovation, NAS Meridian strives to improve quality of service and maximize efficiency, and communicate to promote integration, understanding, and teamwork.

The installation is responsible for providing basic facility services, business and support functions, housing and accommodations, and quality of life services, all in support of the installation's mission. NAS Meridian is led by a CO who is responsible for all installation activities. TRAWING ONE (commonly referred to as "the Wing") is known locally, regionally, and Navy-wide for its premier pilot training services. Both installation and TRAWING ONE activities are summarized below.

Like TRAWING ONE, NATRACOM's mission is focused on the student aviators. The Mission of NATRACOM is "*to train the world's finest combat quality aviation professionals, delivering them at the right time, in the right numbers, and at the right cost to the Joint Forces for tasking in the Global War on Terrorism*" (NATRACOM 2010).

2.3 Installation Activities

TRAWING ONE is the most notable tenant at NAS Meridian; however, there are other major tenant activities on station, including other training commands. A brief description of tenant activities is provided below.

2.3.1 Training Air Wing One

The primary mission of TRAWING ONE is to provide newly designated aviators to the fleet for further training in operational combat aircraft.

For TRAWING ONE, the Commodore's (or Wing Commander's) specific mission is to supervise, coordinate, and administer the student pilot academic and flight training program. The instructor pilot cadre at TRAWING ONE includes men and women from almost every Navy and USMC aviation community as well as several international military exchange pilots, bringing an enormous array of fleet experience to the training command. TRAWING ONE is comprised of two training squadrons that conduct Total System (TS) Strike Flight Training in the T-45C for Navy and USMC aviators and international military aviators. The two training squadrons include:

- **Training Squadron Seven (VT-7) "Eagles."** VT-7's mission is the training of advanced strike SNAs to provide the fleet with the finest naval aviators in the world.

- **Training Squadron Nine (VT-9) "Tigers."** VT-9's mission is to safely train SNAs in the air strike mission for the United States and other international naval forces. The squadron has trained international students from Spain, France, Brazil, Italy, and other allied nations.

There is a continuous pool of approximately 90 students in each squadron at any one time. Students are on board VT-7 and VT-9 for approximately nine to twelve months before earning their *Wings of Gold*.

The TS Strike Flight Training program was established to streamline the Navy's strike pilot training program. In the TS program, after completing primary training, SNAs go directly to the T-45, eliminating the intermediate stage. The TS program combines all of the elements of intermediate and advanced programs, without the need to transition to another aircraft. The TS program is currently composed of 123 flights and 70 flights in the simulator. The TS program takes approximately 12 months to complete, as compared to the 14 months it took students to transition from the T-2s to the TA-4s.

Initial flights and simulators are devoted to instrument flight rules (IFR), culminating in an instrument rating. In phase one, the Familiarization stage, students learn basic aircraft maneuvering, aerobatics, and the fundamentals of landing on a carrier during sixteen day and four night flights. Twenty-three formation flights provide students the skills to fly in two- and four-plane formations. The second phase, Weaponry, exposes students to manual air-to-ground bombing, tactical formation, air combat maneuvering, and operational navigation at low altitude. Four night formation flights are followed by ten flights focused on the basics of air combat maneuvering. Finally, students perform field carrier landing practice (FCLP) in preparation for their carrier qualifications, which consist of four touch-and-go landings and ten carrier-arrested landings aboard a carrier at sea. Completing this, the students become "tailhookers" and earn their *Wings of Gold*. Upon graduation, Strike pilots report to an F/A-18 or EA-6B Fleet Replacement Squadron, and eventually report to their first Fleet Squadron.

2.3.2 Other Training Commands

Four additional training organizations at NAS Meridian provide training to active duty Navy and USMC personnel, civilian law enforcement officers, and Navy reservists:

- **Naval Technical Training Center (NTTC).** The mission of NTTC is to support fleet operational readiness through training. NTTC is the Navy's primary training facility for enlisted administrative and supply class "A" schools.
- **Marine Aviation Training Support Squadron One (MATSS-1).** MATSS-1 provides administrative support for permanent personnel and USMC student personnel assigned to attend school at NTTC Meridian and TRAWING ONE.
- **Regional Counterdrug Training Academy (RCTA).** RCTA's mission is to provide no-cost, "street level," case-making, counterdrug skills to civilian law enforcement officers. RCTA offers 38 courses to its students, such as basic narcotics investigations, undercover investigations, gang school, and interview and interrogation.
- **Naval Operational Support Center (NOSC).** The NOSC trains and mobilizes nine reserve units (250 reservists) to augment active forces in U.S. campaigns. A Naval Reserve Recruiting Office is also located at the NOSC and is responsible for all naval reserve recruiting in eastern Mississippi.

2.3.3 Other Activities

NAS Meridian operates much like a small town and provides a variety of services required to operate and maintain a fully functioning installation. Installation and Personnel Support Services (Support Services) serves military and civilian personnel and maintains infrastructure on station. The Air Operations Department (AOD or Air Ops) is the hub of all airfield activity at NAS Meridian and is the key to supporting the flying mission. Both functions are briefly described below.

Installation and Personnel Support Services

Support Services is the overarching name given to activities such as public works, supply, customer service, human resources, and financial management, all of which provide support to TRAWING ONE and the tenant commands. Support Services aboard NAS Meridian also includes legal, public affairs, health clinic, environmental, religious, and retiree services. Other services include the commissary, Navy exchange, gas stations, credit union, sports complex, golf course, auto/hobby shop, restaurants, and library.

Air Operations Department

Air Ops is an integral component to operations at NAS Meridian and this AICUZ Study because historic knowledge, current operations and statistics, and future projections all fall under the responsibility of this department.

Air Operations is the largest department under NAS Meridian and is directly involved in supporting TRAWING ONE. Air Ops is the overarching term to describe aircraft operations, the coordination of flights, the availability of airspace and airfields, the maintenance of facilities and services, and the safety of aviators and the public, and is often the liaison department between the installation and the surrounding community. Air Ops' primary mission is to support TRAWING ONE. The AOD on board NAS Meridian provides air traffic controllers, ground electronics personnel, and field support personnel, and coordinates with weapons personnel and fire department personnel. The AOD is also responsible for the daily coordination and safety of all aircraft and operations for McCain Field and NOLF Joe Williams. Pursuant to the Naval Air Training Operations Procedures Standardization (NATOPS) Program and the Navy Aircraft Firefighting and Rescue Manual (NAVAIR 00-80R-14) (NATOPS 2003), the AOD ensures that a safety and "crash crew" (i.e., specialized fire and rescue personnel) and equipment are deployed when any aircraft touches down on a runway.

The majority of responsibility for historic knowledge, current operations and statistics, and future projections falls on the AOD and, thus, the department is an indispensable resource to this AICUZ Study.

2.4 Operational Areas

NAS Meridian has been a naval aviation training facility since it was commissioned in July 1961 and, as such, is an ideal location for pilot training due to established operational areas. NAS Meridian is comprised of three runways and one outlying landing field (NOLF Joe Williams) which has one runway and airspace designated for military training. Section 2.4.1 presents general airfield operations and area specifics including location, runway configurations, and dimensions for NAS Meridian and NOLF Joe Williams. Section 2.4.2 describes the designated airspace used by TRAWING ONE for pilot training purposes.

2.4.1 Airfields

All runways at NAS Meridian and NOLF Joe Williams are Class B runways.

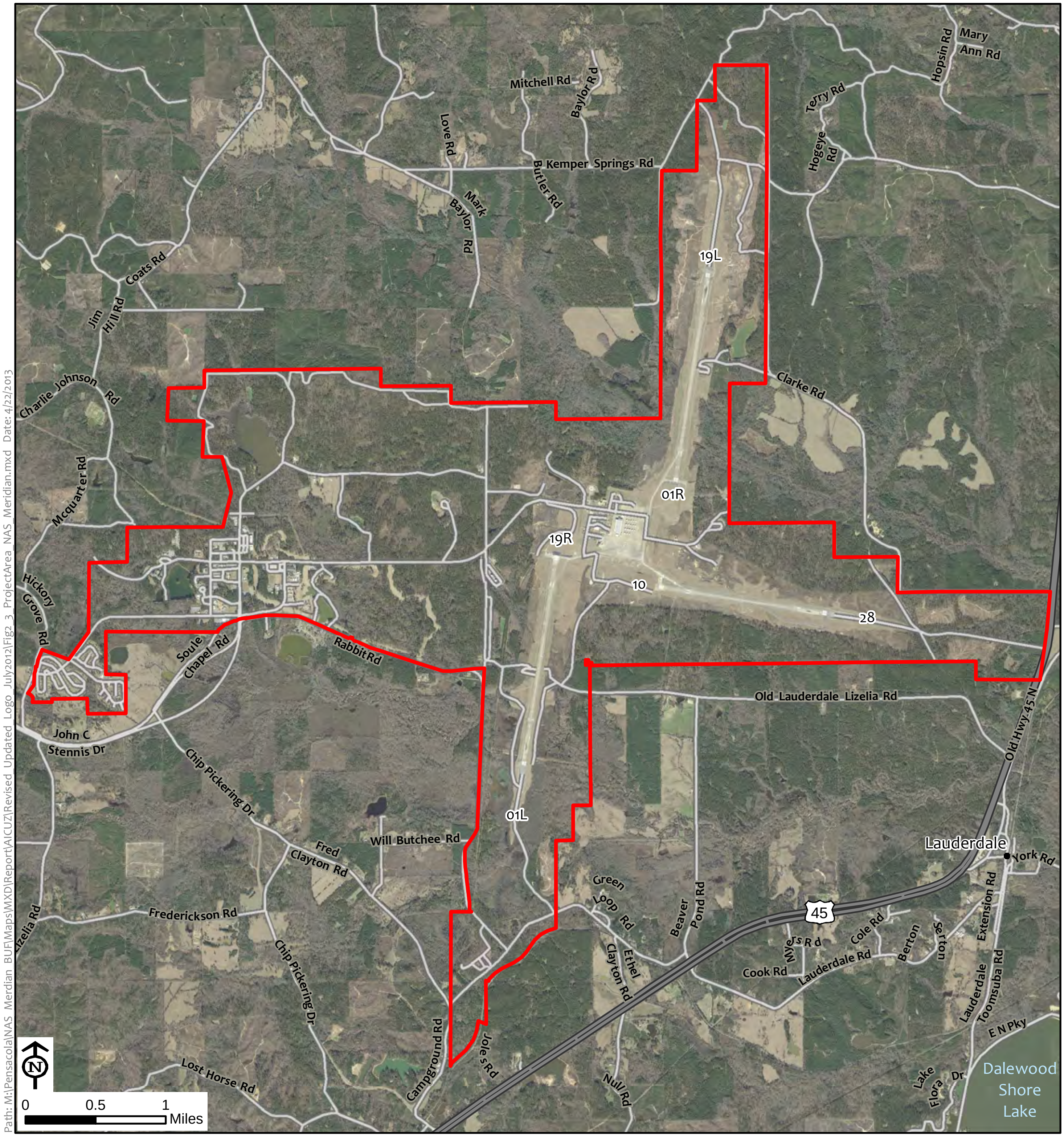
DOD fixed-wing runways are separated into two classes, Class A and Class B, for the purpose of AICUZ analysis and APZs. Class A runways are primarily used by light aircraft and do not have the potential for intensive use by heavy or high performance aircraft. Class B runways are used for all other fixed-wing aircraft. All runways at NAS Meridian and NOLF Joe Williams are categorized as Class B. A discussion of each airfield is provided below.

McCain Field at NAS Meridian

Located at NAS Meridian, McCain Field's elevation is 316 feet mean sea level (MSL). McCain Field is composed of two parallel offset runways, 1L/19R (South runway) and 1R/19L (North runway), and one cross-wind runway, 10/28 (East runway) (Figure 2-3).

Runways are numbered according to their magnetic heading for aircraft on approach or departure. For example, on Runway 10/28, the numbers 10 and 28 signify that this runway is most closely aligned with a compass heading of 100 and 280 degrees, respectively. For parallel runways, each runway is designated "L" for left and "R" for right to distinguish between the runways. Table 2-1 provides detailed information about the length and width of each runway.

NAS Meridian



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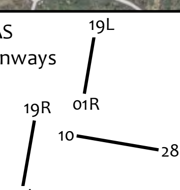
NAS Runways



US Highway
Secondary/Local Road
Installation Boundary

Figure 2-3
NAS Meridian
McCain Field
Lauderdale County, Mississippi

Source: U.S. Navy 2011

Table 2-1. NAS Meridian Runways

Runway	Length (feet)	Width (feet)
1L/19R	8,003	200
1R/19L	7,999	200
10/28	6,401	200

Source: NAS Meridian 2010

The airfield is open Monday through Thursday, from 7:00 a.m. to 11:00 p.m., Friday from 7:00 a.m. to 5:00 p.m., and is closed on Saturdays and federal holidays. The field is typically open during a four-hour recovery window for returning cross-country trips based on Wing requirements. Some Sundays are surge days with concentrated FCLPs. During certain periods of daylight savings, the hours change to 8:00 a.m. to 12:00 a.m. to ensure enough hours of night flying. Extenuating circumstances can result in extended operation hours, open days, or temporarily suspend operations.

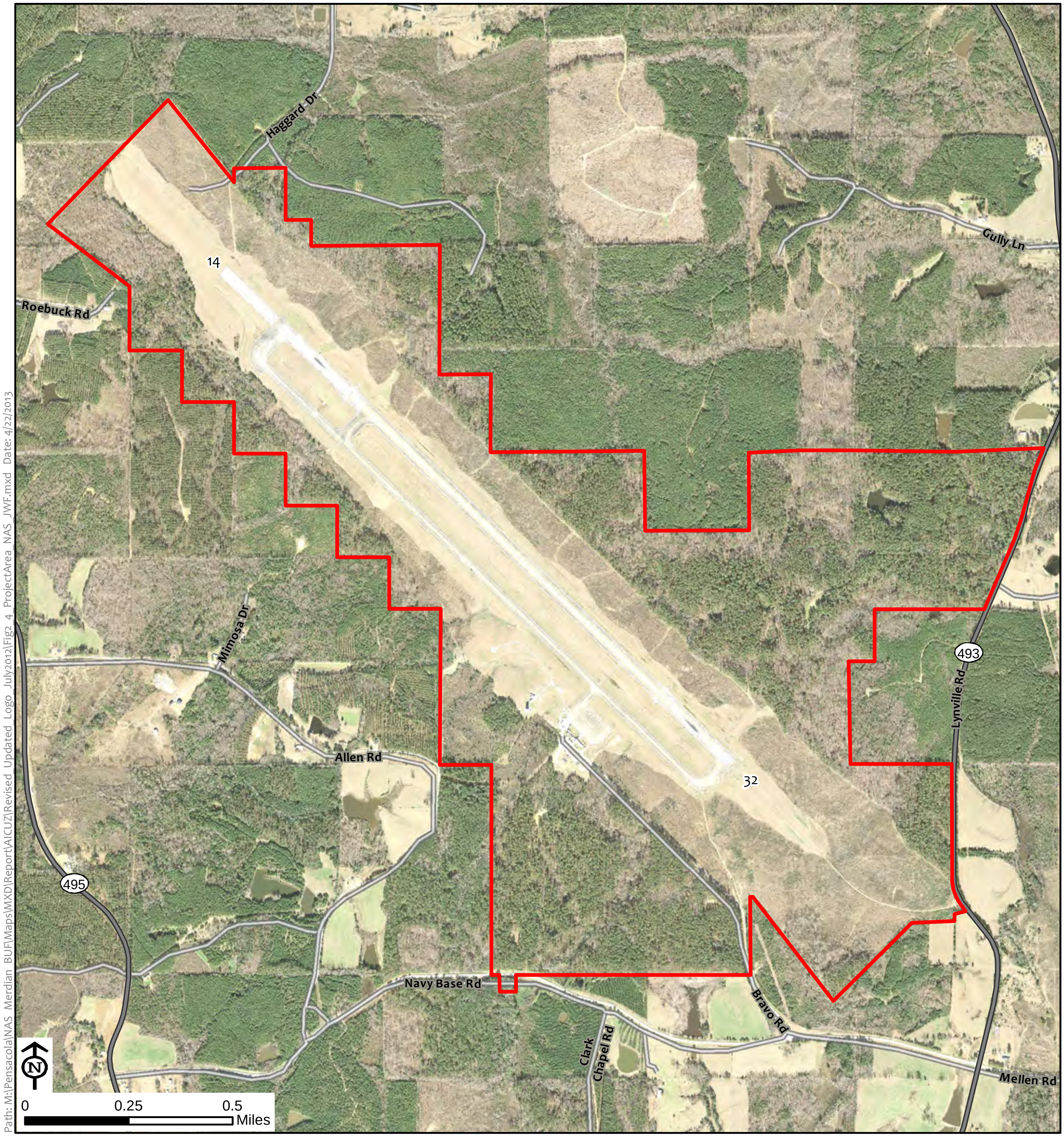
NOLF Joe Williams

NOLFs are typically used for training, practice, or other routine operations. Aircraft are not stationed, parked overnight, or maintained at NOLFs.

NOLFs are airfields, runways, or landing areas that are located within the region of an affiliated active Naval Air Station. NOLFs are used for training, practice, or other routine operations. NOLF Joe Williams is usually used for FCLP patterns, but also hosts touch-and-go’s, low approaches, or other operations. It provides a low-traffic location for flight training, without the risks and distractions common to McCain Field. Aircraft are not stationed and are not typically parked overnight at NOLF Joe Williams, and routine maintenance activities are not conducted at this NOLF.

NOLF Joe Williams airfield’s elevation is 539 feet MSL and facilities include a control tower, maintenance and safety buildings, and a fuel storage area. NOLF Joe Williams has one runway, 14/32 (Figure 2-4), and a full-length parallel taxiway.

NOLF Joe Williams



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NOLF Runways: 14 – 32

State Highway

Secondary/Local Road

Installation Boundary

Figure 2-4
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011

Table 2-2 provides detailed information about the length and width of the runway.

Table 2-2. NOLF Joe Williams Runway

Runway	Length (feet)	Width (feet)
14/32	8,000	150

Source: NAS Meridian 2010

Airfield hours of operation are published weekly by TRAWING ONE, but typically follow those for NAS Meridian.

In addition to NAS Meridian and NOLF Joe Williams, TRAWING ONE also utilizes Key Field Airport in the City of Meridian. The 186th Air Refueling Wing (ARW), an Air National Guard (ANG), unit is based at Key Field Airport. Key Field Airport is a public use airport; however, flights are primarily conducted by military aircraft, followed by general aviation and commercial aircraft.

2.4.2 Airspace

NAS Meridian and NOLF Joe Williams are located within Class D airspace.

Class E airspace encompasses both airfields.

The use and control of U.S. airspace is dictated by the FAA National Airspace System and seeks to ensure the safe, orderly, and efficient flow of commercial, private, and military aircraft. NAS Meridian (McCain Field) is located in Class D airspace and assigned to the Memphis Air Route Traffic Control Center by the FAA. The Atlanta Air Route Traffic Control Center controls operations in Alabama at the Birmingham and Pine Hill MOAs. All visual flight rules (VFR) and IFR departures must have clearance to depart. VFR and IFR arrivals must contact Meridian Approach prior to entering the Class D airspace for radar services.

There are two categories of airspace: regulatory and non-regulatory. Within these two categories there are four types of airspace: controlled, uncontrolled, special use, and other airspace. Controlled airspace, designated Class A through Class E, covers the airspace within which ATC clearance is required. Uncontrolled airspace is the portion of the airspace not designated as

Class A through Class E within which ATC has no authority or responsibility to control air traffic (FAA 2008) (see Figure 2-5).

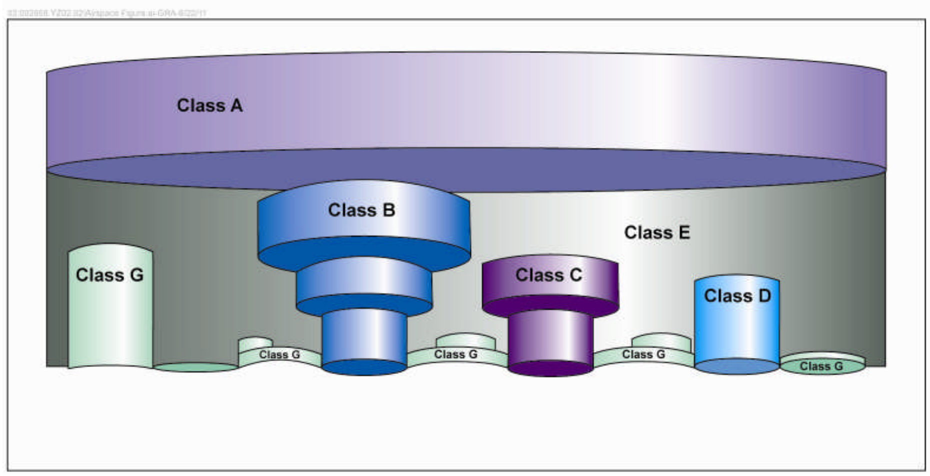


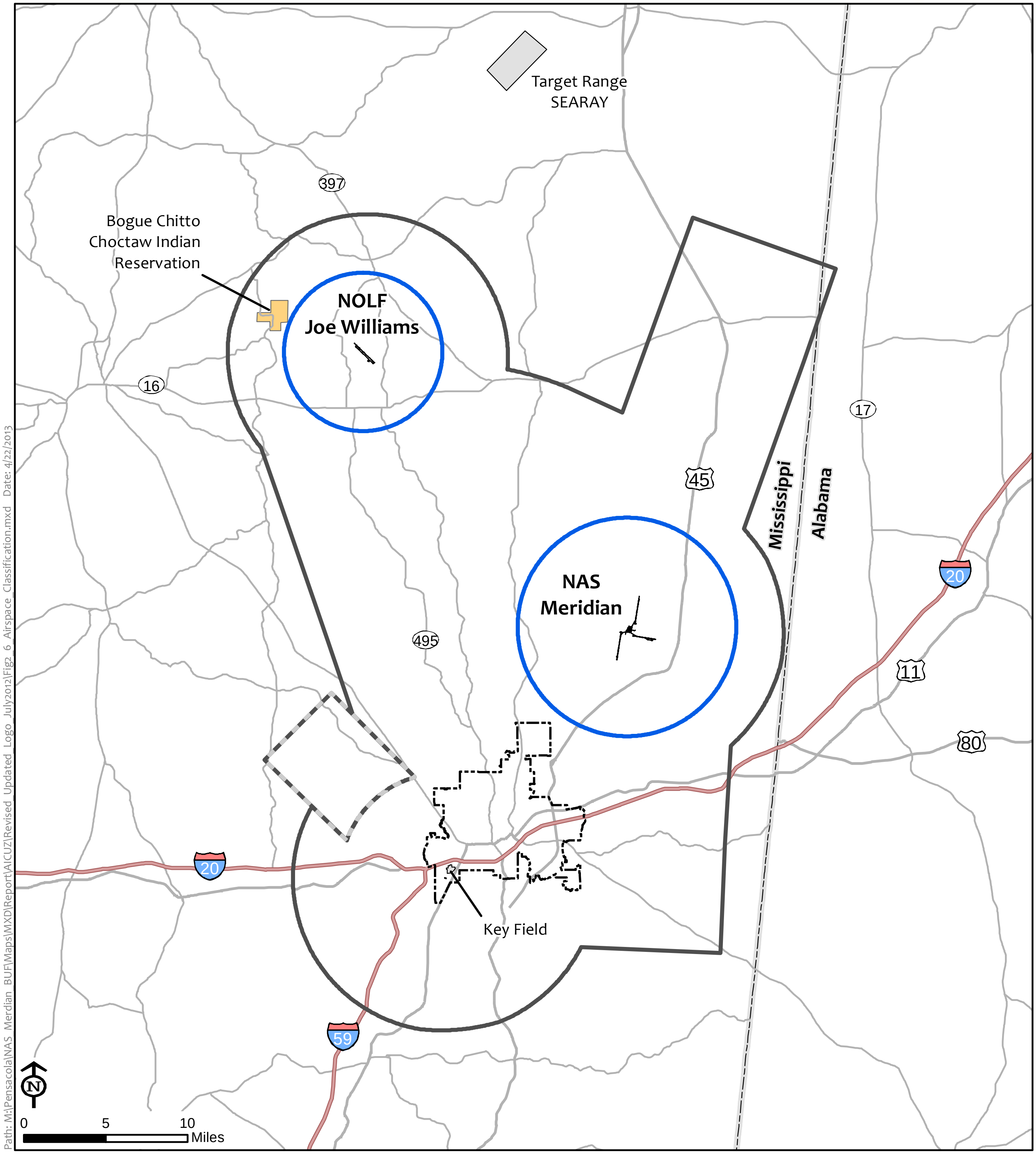
Figure 2-5. General Airspace Classifications

McCain Field and NOLF Joe Williams are surrounded by Class D airspace; the airspace encompassing the two airfields is Class E airspace. Applicable airspace classifications are described below and depicted on Figure 2-6.

Class D Airspace

Class D airspace generally extends from the surface to 2,500 feet above the airport elevation (MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of IFR operations or passenger enplanements. Each aircraft must establish two-way radio communications with the ATC prior to entering the airspace and, thereafter, maintain those communications while within the airspace. Since NAS Meridian is a tower controlled field, ATC at NAS Meridian controls the Class D airspace surrounding NAS Meridian.

Airspace Classification
NAS Meridian and NOLF Joe Williams



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Interstate
US Highway
State Highway
State Boundary
Airfield
Meridian Corporate Boundary

Airspace Classification

Class E - 700 ft to 18,000 ft MSL
Class E - Surface to 18,000 ft MSL
Class D - NAS Meridian: Surface to 2,800 ft MSL
NOLF Joe Williams: Surface to 3,000 ft MSL

Figure 2-6
Airspace Classification
NAS Meridian and NOLF Joe Williams
Mississippi

Source: ESRI 2010, FAA 2011, NAIP 2010

Class E Airspace

Class E airspace is the FAA controlled airspace that is not classified as A through D, and extends upward from either the surface or a designated altitude to the overlying or adjacent airspace. Unless designated at a lower altitude, Class E airspace begins at 14,500 feet MSL and up to, but not including, 18,000 feet MSL. Class E airspace surrounding NAS Meridian and NOLF Joe Williams has a designated floor of 700 feet above surface and a ceiling up to 18,000 feet MSL. VFR communication is not required within Class E airspace; however, by definition, IFR communication is required.

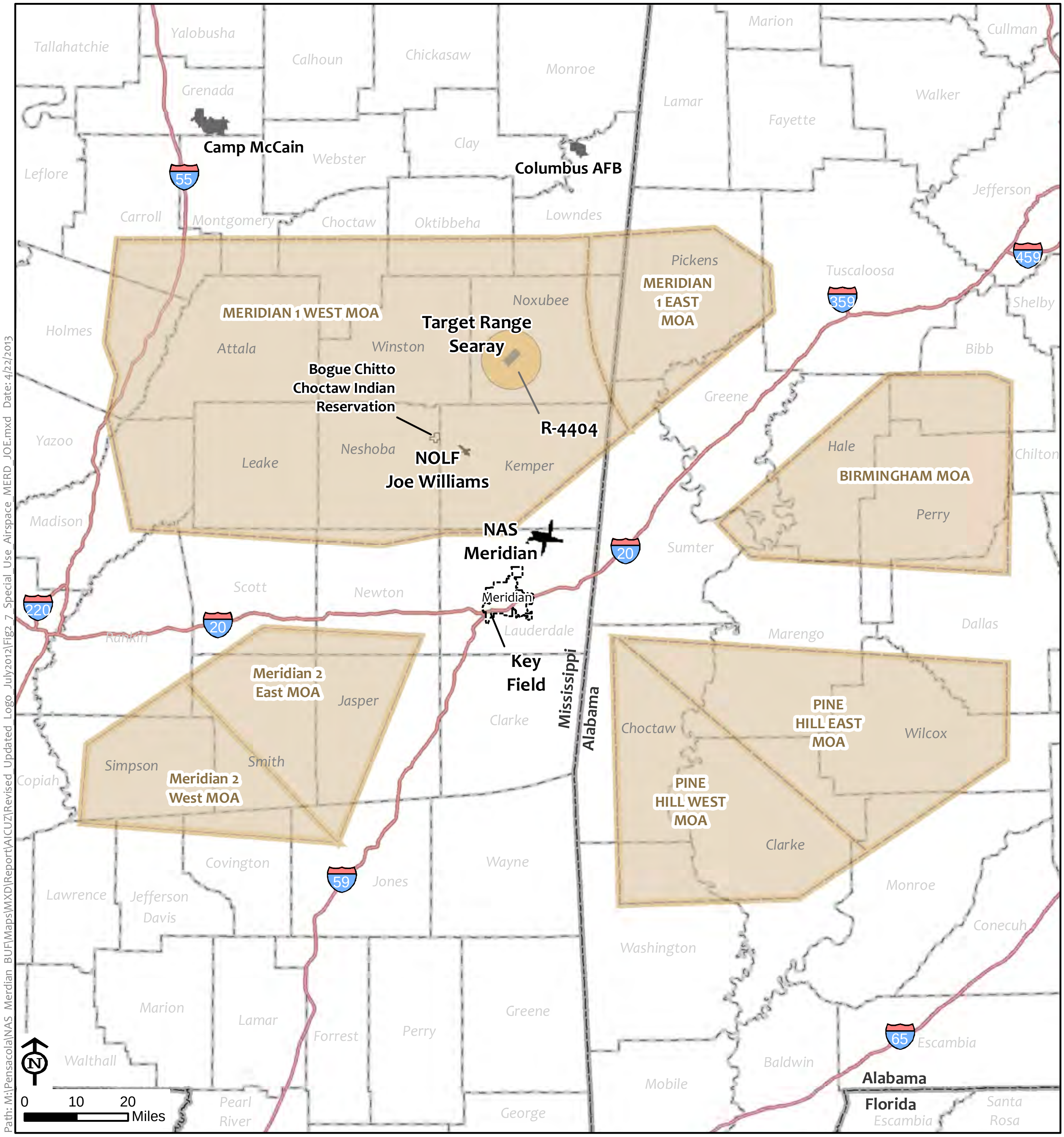
Special Use Airspace

Special Use Airspace (SUA) is the designation of airspace which confines or provides a boundary where certain operations or activities can take place or where restrictions are imposed on other aircraft that are not part of those operations. SUAs range in restrictiveness, from areas where flight is always prohibited except to authorized aircraft, to areas that are used by the military for potentially hazardous operations.

There are six major types of SUAs: prohibited areas, restricted areas, warning areas, MOAs, alert areas, and controlled firing areas. Aircraft operations within these SUAs were not included in the noise analysis for this AICUZ Study due to their proximity to the airfields and their altitudes.

TRAWING ONE uses both restricted areas and MOAs for training student pilots. NAS Meridian's MOAs are depicted on Figure 2-7, and brief descriptions of the MOAs are provided below.

Special Use Airspace
NAS Meridian and NOLF Joe Williams



Interstate
R-4404
AICUZ Military Installation
Other Military Installation
Military Operation Area (MOA)
County Boundary
State Boundary

Figure 2-7
Special Use Airspace
NAS Meridian and NOLF Joe Williams
Mississippi

Source: ESRI 2010; Navy 2010

For training student pilots, TRAWING ONE uses both restricted areas and MOA airspace.

- **Restricted Areas:** Areas where operations are hazardous to nonparticipating aircraft and contain airspace within which the flight of aircraft, while not wholly prohibited, is subject to restrictions.
  - R-4404 A/B/C: Located north of NAS Meridian in Noxubee County, over Target Range SEARAY, this restricted area is used for air-to-ground (practice bombing) missions and out-of-control flight training. Altitudes for R-4404 A, B, and C are up to 11,500 feet MSL, 1,200 feet above ground level (AGL) to 11,500 feet MSL, and 11,500 feet MSL to 14,500 feet MSL, respectively.
- **Military Operating Area (MOA):** Airspace with defined vertical and lateral limits established for the purpose of separating certain military training activities from IFR traffic.
  - Meridian 1 West MOA: Located north of NAS Meridian, this MOA is primarily used by VT-7 and VT-9 for basic instrument flight, familiarizations, formations, and air-to-air gunnery. Altitude for this MOA is 8,000 feet MSL to 17,999 feet MSL.
  - Meridian 1 East MOA: Located northeast of NAS Meridian in Mississippi and Alabama, this MOA is primarily used by Air Force student pilots from nearby Columbus AFB. This MOA is rarely used by TRAWING ONE. Altitude for this MOA is 8,000 feet MSL to 17,999 feet MSL.
  - Birmingham MOA: Located east of NAS Meridian in Alabama, this MOA is used for formation, night familiarization flights, and gunnery flights. Altitude for this MOA is 10,000 feet MSL to 17,999 feet MSL.
  - Pine Hill East/West MOA: Located southeast of NAS Meridian in Alabama, this MOA is used for air combat training when sufficient space is not available at the Meridian 1 West MOA. Altitudes for these two MOAs are 10,000 feet MSL to 17,999 feet MSL.
  - Meridian 2 MOA: The Meridian 2 MOA is located southwest of NAS Meridian in Mississippi. This MOA would be used by VT-

7 and VT-9 for air combat maneuvers (the primary MOA activity), instrument flights, familiarizations, formations, ground controlled intercepts, night vision goggle training, and to practice in-flight refueling (no fuel exchanged). Airspace for this MOA extends from 8,000 to 17,999 feet MSL.

2.5 Local Economic Impacts and Population Growth

The military creates a stable and consistent source of revenue for the areas in which its installations are located and is not as heavily influenced by fluctuations in the economy as can be experienced by the private sector. The 2,900 military personnel, civilians, and dependents that work and/or live at NAS Meridian and the associated spending have a $300 million contribution to the local and regional economies, making it the largest employer in eastern Mississippi (NAS Meridian 2011b).

According to NAS Meridian officials, the total military expenditures in Lauderdale and Kemper Counties in 2010 totaled over $120 million (NAS Meridian 2012). This includes active and inactive duty military pay, military retirement and disability payments, civilian pay, and procurements. Other key economic sectors around NAS Meridian include healthcare, education, agriculture, and manufacturing.

NAS Meridian is approximately 15 miles northeast of downtown Meridian. The city of Meridian is the sixth largest city in Mississippi, and the principal city of the Meridian Metropolitan Statistical Area, which includes Clarke, Kemper, and Lauderdale Counties. In the 2000 Census, there were 106,569 residents in the Meridian area. In 2010, the population of the Meridian Metropolitan Statistical Area was reported by the U.S. Census Bureau (USCB) at 107,449 residents, showing a slight population increase. Population data and growth projections for the city of Meridian, Lauderdale and Kemper Counties, and the State of Mississippi are summarized in Table 2-3.

Table 2-3. Population Data for Counties and Municipalities in the Vicinity of NAS Meridian

Population Area	1990	2000	2010	2020	% Growth 2000-2010	% Growth 2000-2020
City of Meridian	41,036	39,968	41,148	53,925[a]	+2.95	< +3.0[c]
Lauderdale County	75,555	78,161	80,261	77,755[b]	+2.68	-0.52
Kemper County	10,356	10,453	10,456	9,775[b]	0.00	-6.48
State of Mississippi	2,573,216	2,844,658	2,967,297	3,160,850[b]	+4.31	+11.11

Sources: NAS Meridian 2012, USCB 2010 (USCB 2020 Projections; and Census 2010, 2000,1990)

Notes:

a City of Meridian 2009. *Comprehensive Plan of the City of Meridian*. Dated 2004, revised 2009.

b Center for Policy Research and Planning, Mississippi Institutions of Higher Learning, September 2008.

c NAS Meridian 2012.

Key:

- Indicates a negative growth rate.

+ Indicates a positive growth rate.

The city of Meridian, as well as Lauderdale County as a whole, grew modestly between 2000 and 2010. In Lauderdale County, growth has been focused more to the west toward the community of Collinsville. The growth outside the city and within Lauderdale County boundaries suggests the outward spread of the population into unincorporated areas. This growth may indicate a shift of population away from the city core and into outlying areas and areas closer to NAS Meridian.

Meridian's recent growth pattern is to the north along Highway 39 and US-45. While the total population of Meridian has fluctuated over the past two decades, the city is projected to grow in the coming decades; however, this may be due to the city's recent annexation of unincorporated county areas south of the base which could accelerate the northward spread of growth. While not probable due to existing voting districts, the annexation of more land outside existing corporate limits is possible, especially with Meridian beginning to surround the town of Marion, thereby creating an opportunity for continued northward annexation.

Downtown Meridian, Mississippi

Overall, Mississippi has experienced steady population growth over the past two decades, which reflects the broader growth trends of the "Sunbelt" that are projected to continue. This local and regional level growth has begun to impact and may continue to impact NAS Meridian in terms of new developments around the installation that are incompatible with aircraft operations. A discussion of local and regional compatibility issues is provided in Chapter 6 of this AICUZ Study.

3

AIRCRAFT OPERATIONS

This chapter discusses aircraft types, the number of operations (including projected operations for CY 2020), and runway and flight tracks for NAS Meridian. NAS Meridian and NOLF Joe Williams are utilized by TRAWING ONE for pilot training for the Navy, USMC, and several allied nations. NAS Meridian serves as a pilot training installation and has two training squadrons.

3.1 AIRCRAFT TYPES

There are two basic types of aircraft: fixed-wing and rotary wing. Fixed-wing aircraft are aircraft whose lift is generated not by wing motion relative to the aircraft, but by forward motion through the air. The term is used to distinguish this type of aircraft from rotary-wing aircraft, commonly called helicopters, whose lift is generated by wing motion relative to the aircraft. Only fixed-wing aircraft are permanently stationed at NAS Meridian.

As a training installation, the primary aircraft stationed at NAS Meridian are designated by a “T” to assign them as training aircraft. Additional nomenclature often serves as a designator for different model years or ‘variants’ of the aircraft.

3.1.1 Fixed-Wing Aircraft

T-45C Goshawks

The T-45 is a single-engine, two-seat, advanced training aircraft. The T-45 replaced the T-2 Buckeye trainer and the TA-4 trainer with an integrated training system that includes the T-45C Goshawk aircraft, operations and instrument fighter simulators, and academics.

T-45C “Goshawk”

There are two versions of T-45 aircraft currently in operational use at this time: the T-45A and T-45C. The T-45A, which became operational in 1991, contains an analog design cockpit, while the new T-45C (which began delivery in December 1997) is built around a digital "glass cockpit" design. Only the T-45C is flown at NAS Meridian; the T-45A is flown at NAS Kingsville; however these aircraft are currently transitioning to the T-45C. The 9,400-pound aircraft is powered by a Rolls Royce F405-RR-401 turbofan engine that generates 5,257 pounds thrust. With a wingspan of 30 feet and a length of 39 feet, this aircraft can reach speeds of 640 miles per hour at altitudes of 42,500 feet and has a range of 700 nautical miles (NM). This aircraft is not capable of generating sonic booms due to its limited maximum airspeed.

3.1.2 Transient Aircraft

The term “transient aircraft” refers to all other aircraft not permanently stationed at NAS Meridian that conduct training or other mission-related operations at the station’s airfields. A wide range of military aircraft use the runways on NAS Meridian on a transient basis to accomplish specific missions or to stop over while on a cross-county flight. The principal transient aircraft include the F/A-18, AV-8, T-38, F-5, C-26, C-12, T-39 and T-1; however, due to the infrequent use of most transient aircraft, the F/A-18, T-38, and the AV-8B are discussed below, along with the projected transient aircraft, the F-35.

F/A-18 Hornet

The F/A-18 Hornet is an all-weather supersonic aircraft, used as an attack aircraft as well as a fighter. In its fighter mode, the F/A-18 is primarily used as a fighter escort, for reconnaissance, and for fleet air defense; in its attack mode, it is used for force protection, interdiction, and close and deep air support.

Designed by McDonnell Douglas and Northrop, the F/A-18 Hornet is 56 feet long with a 40-foot wing span and a height of 15.3 feet. The aircraft is powered by two General Electric F404-GE-402 engines that deliver 17,750 pounds-force each. The range of the aircraft is 500+ NM, with a maximum airspeed of Mach 1.8.

F/A-18 "Hornet"

The majority of F/A-18s use NAS Meridian as a stop-over when flying cross-country missions to/from the west and east coasts. With the upcoming deployment of the Joint Strike Fighter aircraft, the F-35, it is anticipated that the F/A-18 will be replaced by the F-35C variant of the aircraft. Therefore, there is potential for the F-35C to utilize NAS Meridian as a transient aircraft.

AV-8B Harrier II

The Boeing AV-8B Harrier II is a subsonic, short-takeoff, vertical landing (STOVL), tactical strike aircraft. The AV-8B is primarily used for light attack or multi-role tasks and is typically operated from small aircraft carriers, large amphibious assault ships, and simple forward operating bases. There is a dedicated two-seat trainer version known as the TAV-8B.

AV-8B "Harrier II"

The aircraft is powered by a single Rolls-Royce F402-RR-408 Pegasus engine that delivers a total of 23,500 pounds-force. The AV-8B has a maximum gross take-off weight of 32,000 pounds, with a maximum airspeed of Mach 1.0. As a redesign of the original AV-8A (Harrier I), the AV-8B has a larger-area carbon-fiber supercritical wing, a completely revised and raised cockpit, and advanced aerodynamic devices that enhance lift capabilities over the AV-8A.

The AV-8B is used by the USMC and, similar to the transient F/A-18s, these USMC aircraft utilize NAS Meridian as a stop-over when flying cross-county missions. With the upcoming deployment of the F-35 Joint Strike Fighter (JSF) aircraft, it is anticipated that the AV-8B will be replaced by the F-35B variant of the aircraft.

T-38 Talon

Developed by the Northrop Grumman Corporation, the Talon is a tandem-seat, twin-engine, high-altitude, supersonic, jet trainer primarily used for joint undergraduate pilot and pilot instructor training. Student pilots fly the T-38A to learn supersonic techniques, aerobatics, formation, night and instrument flying, and cross-country navigation. Advanced training for the bomber-fighter track is accomplished using the T-38 Talon and prepares pilots for the transition to fighter and bomber aircraft.

The T-38 is 46 feet long with a 25-foot wing span and a height of 12.8 feet. The aircraft is powered by two General Electric J85-GE-5 turbojet engines with afterburners rated at 2,680 pounds dry thrust and 3,850 pounds with afterburners each. The range of the aircraft is 1,093 NM, with a maximum airspeed of 812 miles per hour.

The Talon is predominantly utilized by the United States Air Force (USAF) Air Education and Training Command (AETC). However, the Air Combat Command, Air Mobility Command, U.S. Naval Test Pilot School, and the National Aeronautics and Space Administration (NASA) also use the T-38 in various roles. Due to the proximity of Columbus AFB to NAS Meridian, USAF student pilots often utilize the airfield and, thus, the T-38 is a common transient aircraft.

T-38 "Talon"

Projected Transient Aircraft: F-35 A/B/C Joint Strike Fighter, Lightning II

Lockheed Martin's F-35 has three different variants. The Air Force F-35A is the conventional takeoff and landing variant. The Marine F-35B is a STOVL variant which is similar in size to the Air Force F-35A, but trades fuel volume for vertical flight systems. The Navy F-35C is a carrier-based variant with a larger, folding wing and larger control surfaces for improved low-speed control, and stronger landing gear for the stresses of carrier landings.

F-35C (Carrier-Based Variant)

3.2 AIRCRAFT OPERATIONS

The two major sources of aircraft noise are engine maintenance "run-up" operations and flight operations.

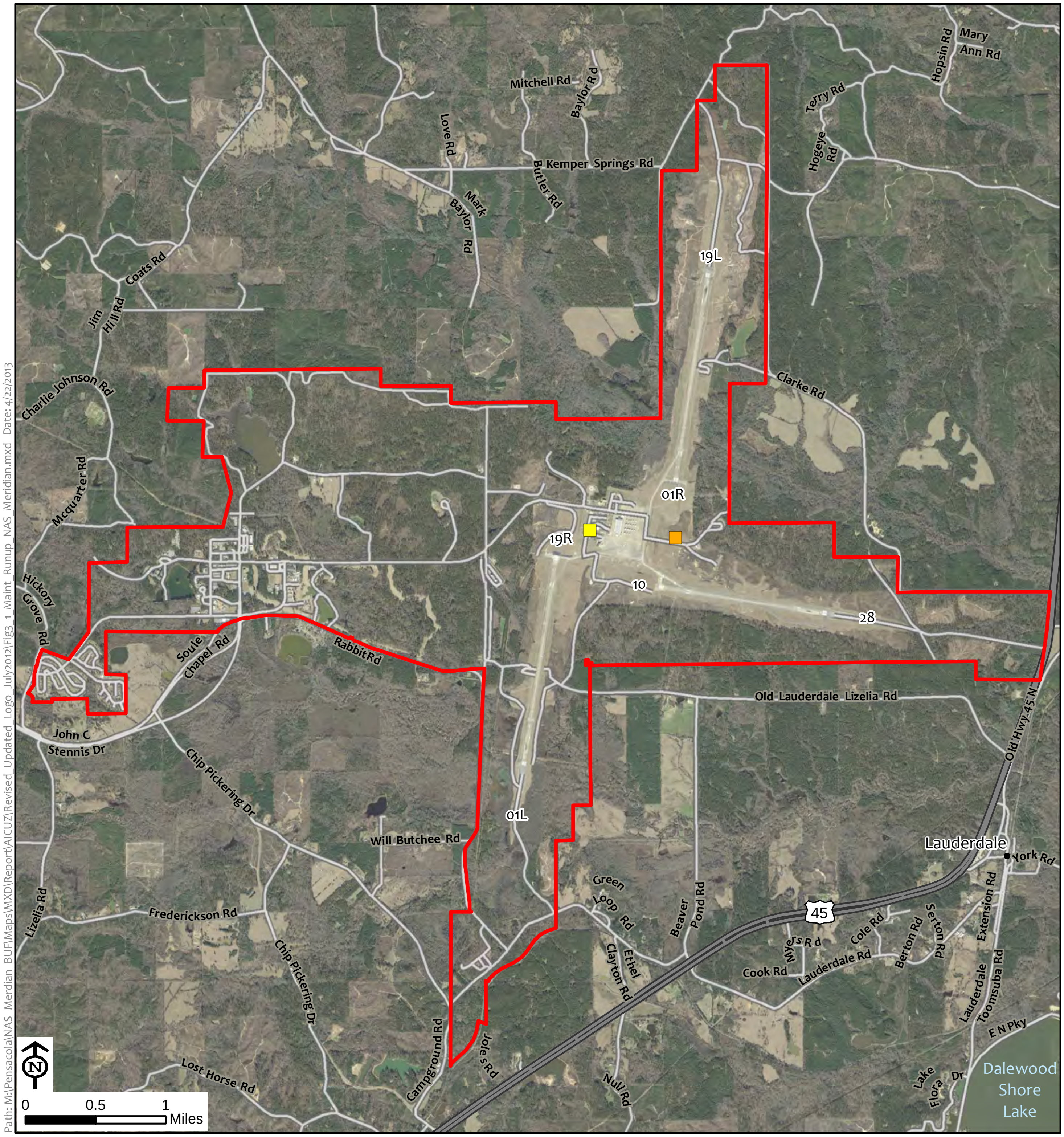
"Aircraft operations" is a common term used to describe the pre-flight and flying activities of an aircraft, and these activities make up the two primary sources of aircraft noise at NAS Meridian: ground engine maintenance "run-up" operations and flight operations. Both of these sources have been incorporated into the noise analysis and modeling inputs associated with this AICUZ Study.

The level of noise exposure is related to the aircraft type, engine power setting, altitudes flown, direction of the aircraft, durations of run-ups, flight tracks, temperature, relative humidity, frequency, and time of operations. These variables, as they relate to NAS Meridian, are discussed in detail below and throughout this AICUZ Study.

3.2.1 Maintenance Run-Up Operations

Aircraft engine maintenance, also called "run-up" operations, are conducted east of the flight line, commonly referred to as the high-power turn area (Figure 3-1). These activities include engine rinses and washes, maintenance turns, and high-power turns. Noise associated with these operations is included in the noise analysis and modeled to be incorporated into the noise contours for NAS Meridian.

NAS Meridian



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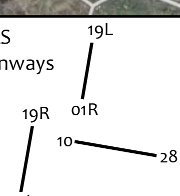
NAS Runways



- Engine Run-Up Location
- Hush-House
- US Highway
- Secondary/Local Road
- Installation Boundary

Figure 3-1
Aircraft Engine Maintenance Locations
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011

A test cell is a building specially designed to test aircraft engines out of frame.

A hush house is an enclosed and acoustically controlled facility for running and testing aircraft engines.

In addition to the run-up locations, an aircraft engine "test cell" is used at the installation to test engines outside the frame of the aircraft. There is one hush house located on NAS Meridian where aircraft engines are tested in frame in a muffled environment; this facility is expected to be operational by the end of CY 2012.

NOLF Joe Williams does not have any ground engine maintenance run-up locations, as all maintenance is done at NAS Meridian.

3.2.2 Flight Operations

Operations at NAS Meridian and NOLF Joe Williams are tracked by ATC, AOD, and TRAWING ONE and have been utilized for developing noise contours and APZs for this AICUZ Study.

As described above, a flight operation refers to any occurrence of an aircraft crossing over the runway threshold at an airfield. A takeoff and landing may be part of a training maneuver (or pattern) associated with touch down on the runway or simulated touch down, or may be associated with a departure or arrival of an aircraft to or from a defense-related SUA. Certain flight operations are conducted as patterns (e.g., touch-and-go). Departures and arrivals each count as one operation and touch-and-gos and low approaches count as two.

Operations at NAS Meridian and NOLF Joe Williams are tracked by ATC, AOD, and TRAWING ONE. These personnel have been interviewed and the information they maintain has been gathered to develop noise contours and APZs for this AICUZ Study.

Operations conducted at NAS Meridian follow the curriculum set forth by CNATRA for TRAWING ONE student aviators. Since there are no fleet squadrons stationed at NAS Meridian, all flight operations are conducted for the purpose of training student pilots. Each series of flight operations is repeated as new students join the program and begin training. All basic flight maneuvers are flown at NAS Meridian and NOLF Joe Williams, as well as intermediate and advanced operations.

Flight Training at NAS Meridian

Typical flight operations conducted by student aviators at NAS Meridian and NOLF Joe Williams are described below:

- **Departure.** An aircraft taking off to a training area or as part of a training maneuver (e.g., touch-and-go).
- **Straight-In/Full-Stop Arrival.** An aircraft lines up on the runway centerline, descends gradually, lands, comes to a full stop, and then taxis off the runway.
- **Overhead Break Arrival.** An expeditious arrival using VFR. An aircraft approaches the runway 500 feet above the altitude of the landing pattern. Approximately halfway down the runway, the aircraft performs a 180-degree turn to enter the landing pattern. Once established in the pattern, the aircraft lowers landing gear and flaps and performs a 180-degree descending turn to land on the runway.
- **Pattern Work.** Pattern work refers to traffic pattern training where the pilot performs takeoffs and landings in quick succession by taking off, flying the pattern, and then making a touch-and-go landing. Traffic pattern training is demanding and utilizes all the basic flying maneuvers a pilot learns: takeoffs, climbs, turns,

Touch-and-Go Flight Operation

climbing turns, descents, descending turns, and straight and level landings. Most patterns are left-handed (counter clockwise, as viewed from above) which mimics how they fly on a carrier.

1. **Touch-and-Go.** An aircraft lands and takes off on a runway without coming to a full stop. After touching down, the pilot immediately goes to full power and takes off again. The touch-and-go is counted as two operations—the landing is counted as one operation, and the takeoff is counted as another.
2. **Field Carrier Landing Practice (FCLP).** An FCLP is a training procedure that simulates landing an aircraft on the flight deck of a carrier.
3. **Ground Control Approach (GCA).** A GCA is a radar or "talk down" approach directed from the ground by ATC personnel. ATC personnel provide pilots with verbal course and glide slope information, allowing them to make an instrument approach during inclement weather. The Box Pattern is normally flown to practice GCA approaches. The Box Pattern utilizes a "box-shaped" flight pattern with four 90-degree turns done at a set altitude.

- **Practice Precautionary Emergency Landing (PPEL).** The PPEL is a procedure taught to student pilots to ensure that a safe landing at a paved field can be made if indications of an impending engine failure should occur. It is used any time engine reliability is questionable or there are indications of impending engine failure.
- **Low Approach.** A low approach is a runway approach when the pilot does not make contact with the runway but rather increases altitude and departs the airfield's airspace.
- **Radar Approach.** A radar instrument approach is provided with active assistance from ATC. ATC personnel direct the aircraft to align itself with the runway centerline, continuing until the pilot can

complete the approach and landing by sight. A radar approach may be given to any aircraft upon request and may be offered to pilots of aircraft in distress or to expedite traffic.

- **Formation Flights.** Formation flight operations are conducted with multiple aircraft flying in close proximity.
- **Sortie.** A sortie is a flight conducted by one aircraft. A sortie begins when the aircraft begins to move forward on takeoff from rest at any point and ends after airborne flight when the aircraft returns to the surface and the engines are stopped, or the aircraft has been on the ground for five minutes, whichever comes first.

As briefly discussed in Chapter 2, a pilot can operate an aircraft by VFR or IFR. As part of the TRAWING ONE curriculum, both rules are taught and flown at NAS Meridian.

When pilots can see the ground and other aircraft they can usually operate visually (Visual Flight Rules, VFR). When they cannot, pilots rely on instruments (Instrument Flight Rules, IFR).

VFR is a standard set of rules that govern the procedures for conducting flight under visual conditions (i.e., pilots remain clear of clouds, avoid other aircraft, and usually fly unassisted by ATC). IFR is a standard set of rules governing the procedures for conducting flights under instrument conditions or when weather becomes degraded. Pilots flying IFR do so with the assistance of ATC and aircraft instruments. At NAS Meridian, IFR is required to fly to a MOA. Although not required, VFR is often used to fly to NOLF Joe Williams or Key Field.. At NAS Meridian and NOLF Joe Williams, VFR rules are predominantly used while conducting landing pattern practice.

In addition to daytime flying, students are also instructed on nighttime flying. Historic and projected aircraft operations for NAS Meridian and NOLF Joe Williams were presented in Table 1-3 (Chapter 1), and Tables 3-1 and 3-2 provide a detailed list of the projected operations (CY 2020) that will be conducted at NAS Meridian and NOLF Joe Williams, respectively.

Table 3-1. Projected Annual Air Operations for NAS Meridian

Category	Operation Type	Day 0700-2200	Night 2200-0700	Total
T-45C	Departure	63,010	2,823	65,833
	Arrival[a]	62,986	2,847	65,833
	Pattern[b]	57,308	2,298	59,606
	Total	**170,580**	**7,968**	**191,272**
Transient Aircraft	Departure	150	0	150
	Arrival	150	0	150
	Pattern	0	0	0
	Total	**300**	**0**	**300**
Grand Total	Departure	63,160	2,823	65,983
	Arrival	63,136	2,847	65,983
	Pattern	57,308	2,298	59,602
	Total	**183,604**	**7,968**	**191,572**[c]

Source: Wyle Laboratories 2012

Notes:

a Arrivals include both straight-in and carrier break.

b Patterns include intra facility, touch-and-go's, FCLP, and GCA Box Pattern operations.

c Aircraft operations modeled in the Noise Study only include the T-45C aircraft operations. General aviation operations (103 annual operations) are not included in the table.

Table 3-2. Projected Annual Air Operations for NOLF Joe Williams

Category	Operation Type	Day 0700-2200	Night 2200-0700	Total
T-45C	Departure	9,374	0	9,374
	Arrival[a]	9,374	0	9,374
	Pattern[b]	15,440	0	15,440
	Total	**34,188**	**0**	**34,188**

Source: Wyle Laboratories 2012

Notes:

a Arrivals include both straight-in and carrier break.

b Patterns include touch-and-go's, FCLP, and GCA Box Pattern operations.

3.3 RUNWAY AND FLIGHT TRACK UTILIZATION

Each airfield has designated runways, and those runways have designated flight tracks which provide for the safety, consistency, and control of an airfield. A flight track is a route an aircraft follows while conducting an operation at the airfield, between airfields, or a MOA. Flight tracks typically depict departure and arrival patterns to demonstrate how the aircraft fly in relation to the airfield.

Flight tracks are graphically represented as single lines, but flights vary due to aircraft performance, pilot technique, and weather conditions, such that the actual flight track is a band, often one-half to several miles wide. The flight tracks shown in this AICUZ Study are idealized representations based on pilot and ATC input. As discussed in Section 3.2 above, not only are operations tracked, but they are tracked according to flight track/runway.

As stipulated by AICUZ Instruction, APZs are determined necessary if a runway exceeds 5,000 annual operations. Therefore, flight track utilization is also pertinent to this AICUZ Study because of the role the flight tracks play in APZ development. APZs are presented and further discussed in Chapter 5.

Typical flight operations were discussed in Section 3.2 and include departure, straight-in arrival, overhead break arrival, touch-and-go operations, low approach, and FCLPs. Predominant arrival, departure, and pattern flight tracks for NAS Meridian and NOLF Joe Williams are shown on Figures 3-2 through 3-8 (provided at the end of this chapter) and depict operations between the two airfields (interfacility operations) and those occurring at NAS Meridian (intrafacility operations; i.e., departing one runway at NAS Meridian and arriving at another runway at NAS Meridian).

Abbreviations for the some of these flight operations include:

- Departure – D
- Straight-In Arrival – A
- Overhead Break Arrival – O
- FCLP – F

Individual flight track IDs are labeled according to the runway, flight operation, and numerical sequence for multiple flight tracks. An example flight track ID for NAS Meridian has been provided below and is color-coded for example purposes only:

NAS Meridian, Flight Track ID: **1RD1**

Runway: 01R
Flight Operation: Departure
Flight Track Sequence Number: 1

Tables 3-3 and 3-4, provided at the end of this chapter, identify dominant flight tracks at NAS Meridian and NOLF Joe Williams.

3.3.1 NAS Meridian

Operations at NAS Meridian are conducted on one of three runways, the parallel runways, 01L/19R and 01R/19L, or the cross-wind runway, 10/28. Based on historical averages and projected usage, the following percentages summarize airfield runway utilization. The parallel runways are the preferred runways and are used over 87 percent of the time. Over 50 percent of the departure and intra-facility departures are conducted off of Runway 19R, and 37 percent are conducted off of Runway 01R; the remaining 13 percent are conducted off of Runway 10. Likewise, straight-in arrivals are conducted 48 percent of the time on Runway 19R and 33 percent on Runway 01R. Carrier break arrivals, which account for approximately 56,000 annual operations, are conducted 55 percent of the time on Runway 19L and 42 percent of the time on Runway 01L; only 3 percent are conducted on Runway 28. Pattern operations, touch-and-go's and FCLPs, are performed 56 percent of the time on Runway 19L, 42 percent of the time on Runway 01L, and the remaining 2 percent are conducted on Runway 28. The GCA Box Pattern is performed 42 percent of the time on Runway 19R, 32 percent on 01R, and the remaining operations are performed on Runways 19L, 28, and 01L. Figures 3-2 through 3-5 depict typical flight tracks at NAS Meridian.

3.3.2 NOLF Joe Williams

Operations at NOLF Joe Williams are conducted on Runway 14/32. All operations, excluding the GCA Box Pattern, are conducted 70 percent of the time on Runway 32 and 30 percent of the time on Runway 14. All GCA Box Pattern operations are conducted on Runway 32. Figures 3-6 through 3-8 depict typical flight tracks at NOLF Joe Williams.

NAS Meridian

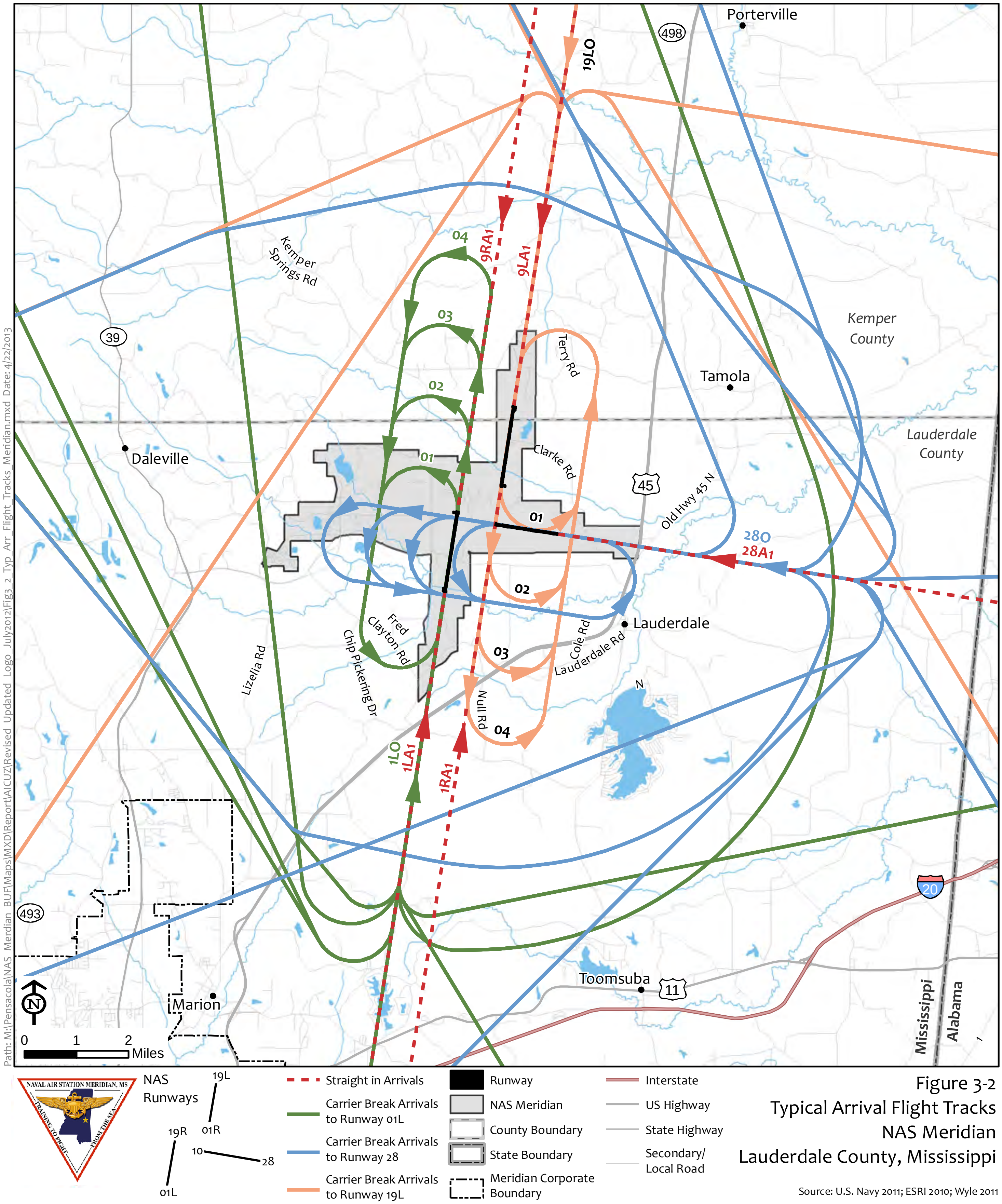
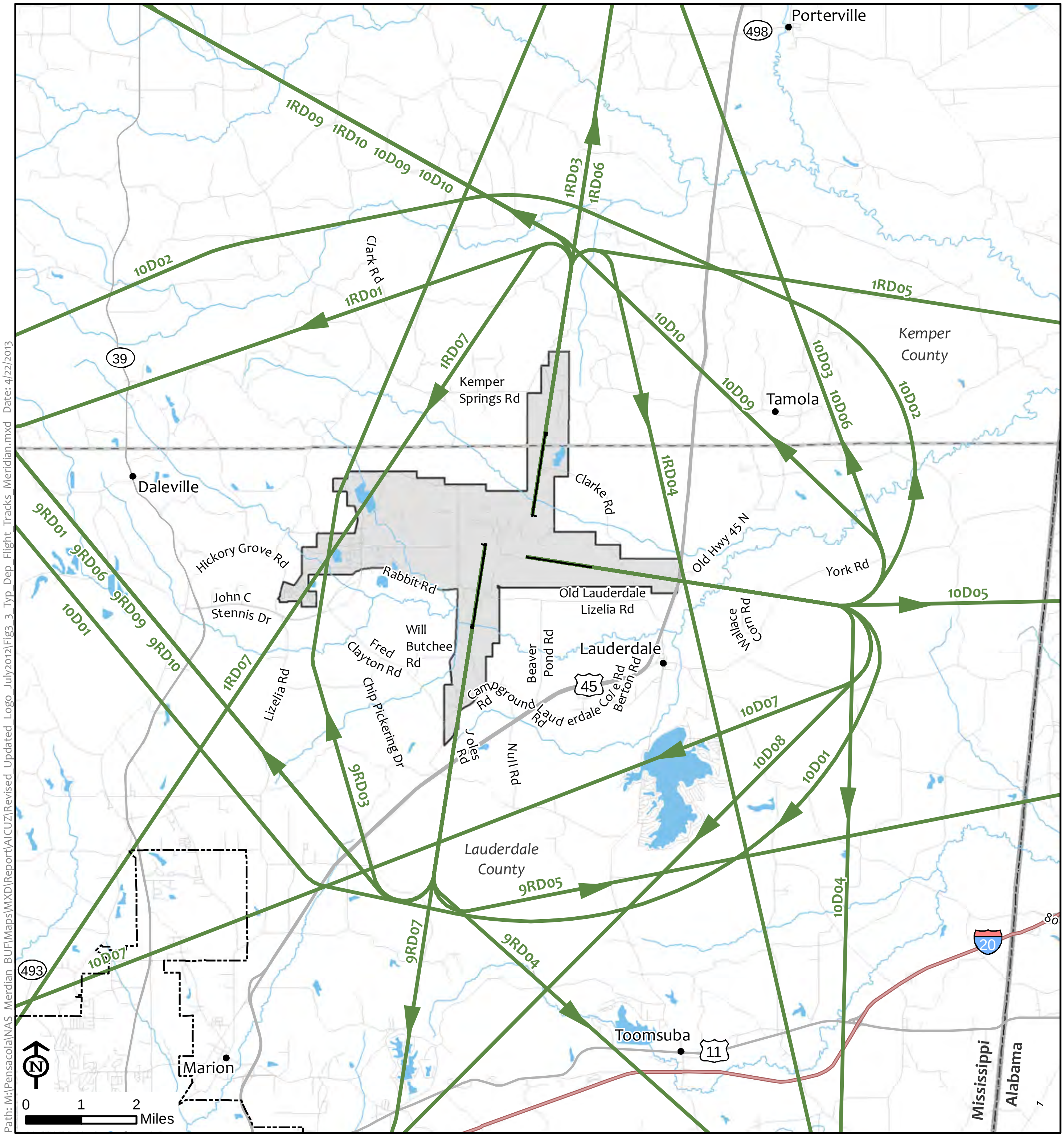


Figure 3-2
Typical Arrival Flight Tracks
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

NAS Meridian



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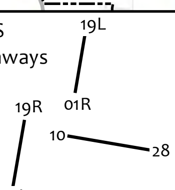
NAS Runways



- Departure Flight Tracks
- Runway
- NAS Meridian
- County Boundary
- State Boundary
- Interstate
- US Highway
- State Highway
- Secondary/Local Road
- Meridian Corporate Boundary

Figure 3-3
Typical Departure Flight Tracks
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

NAS Meridian

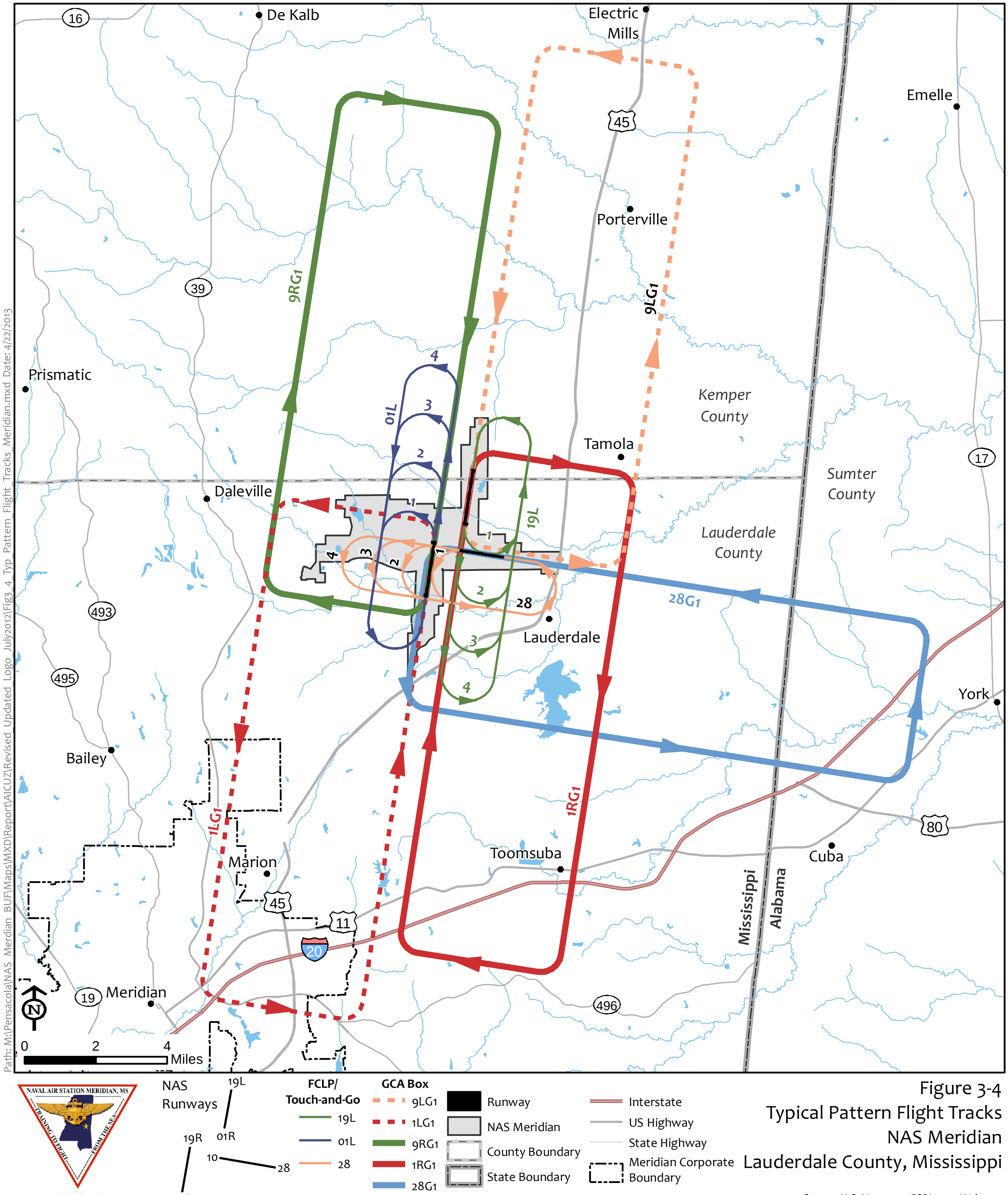
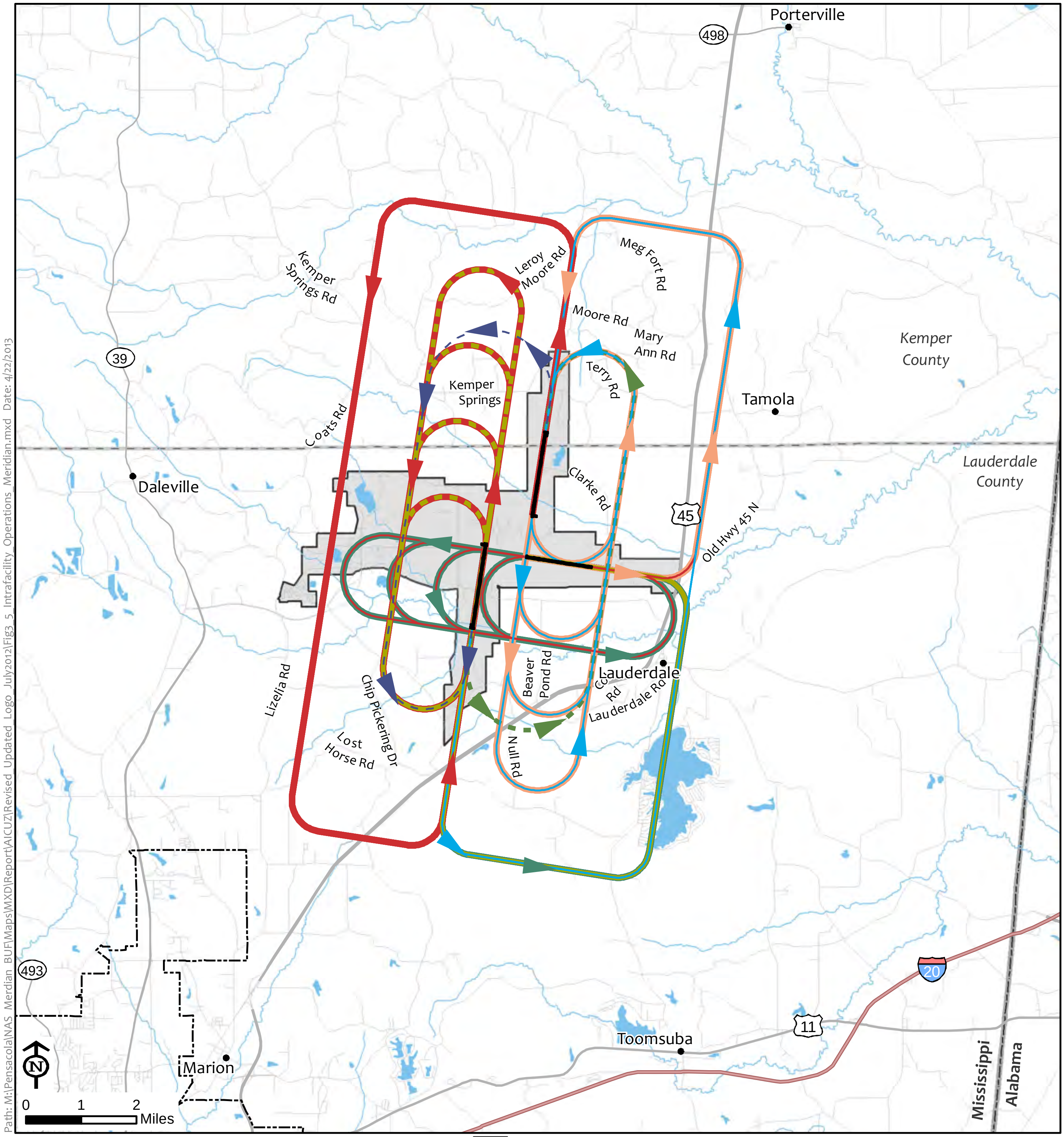


Figure 3-4
Typical Pattern Flight Tracks
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

NAS Meridian



NAS Runways: 19L, 01R, 19R, 01L, 10, 28

1R1L1	1O1LO	NAS Meridian	Interstate
9R9LO	1O9LO	Runway	US Highway
1R28O	1R1LO	County Boundary	State Highway
9R9L1	9R28O	State Boundary	Secondary/ Local Road
		Meridian Corporate Boundary	

Figure 3-5
Intra-facility Flight Tracks
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

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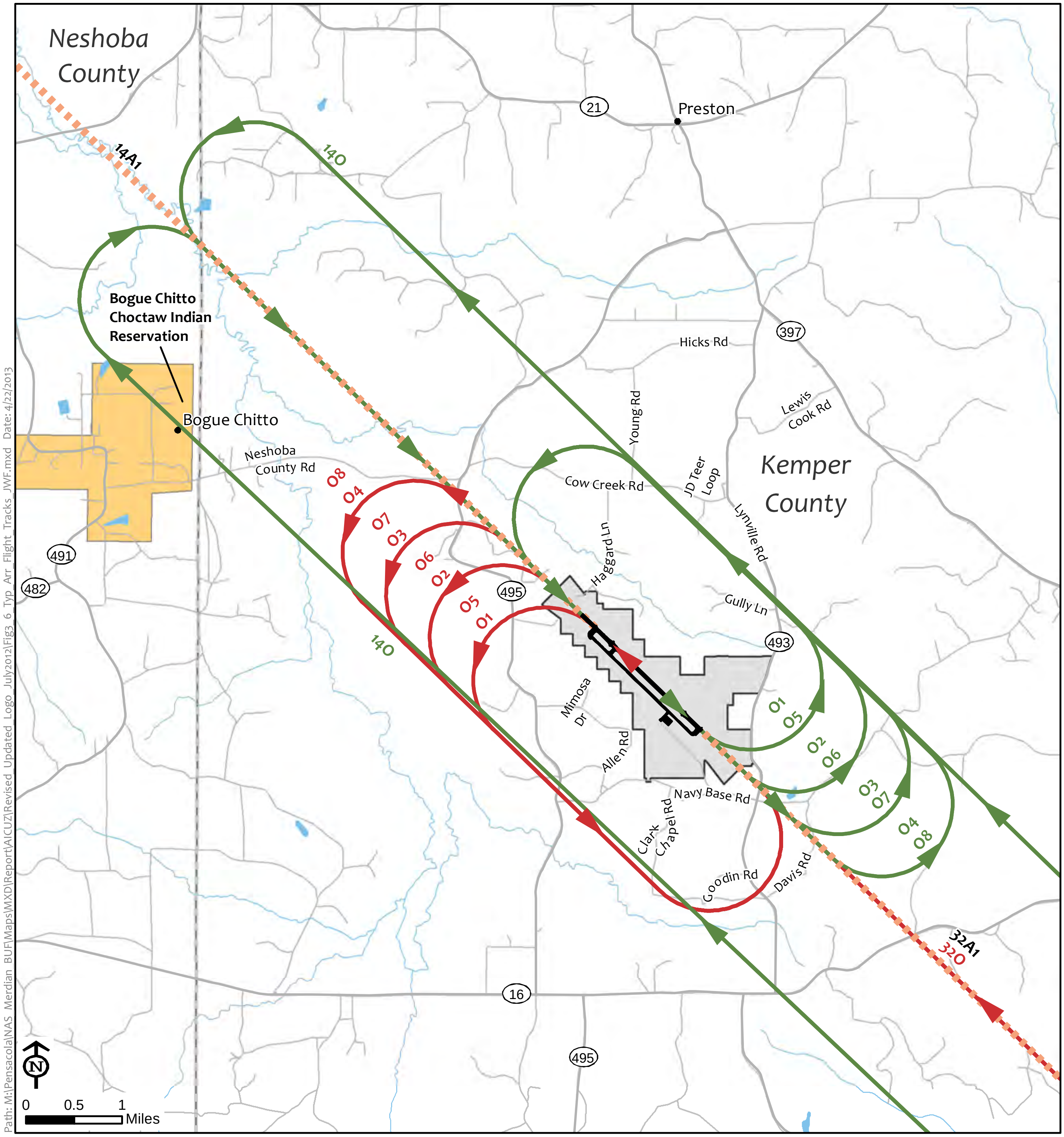
NOLF Joe Williams

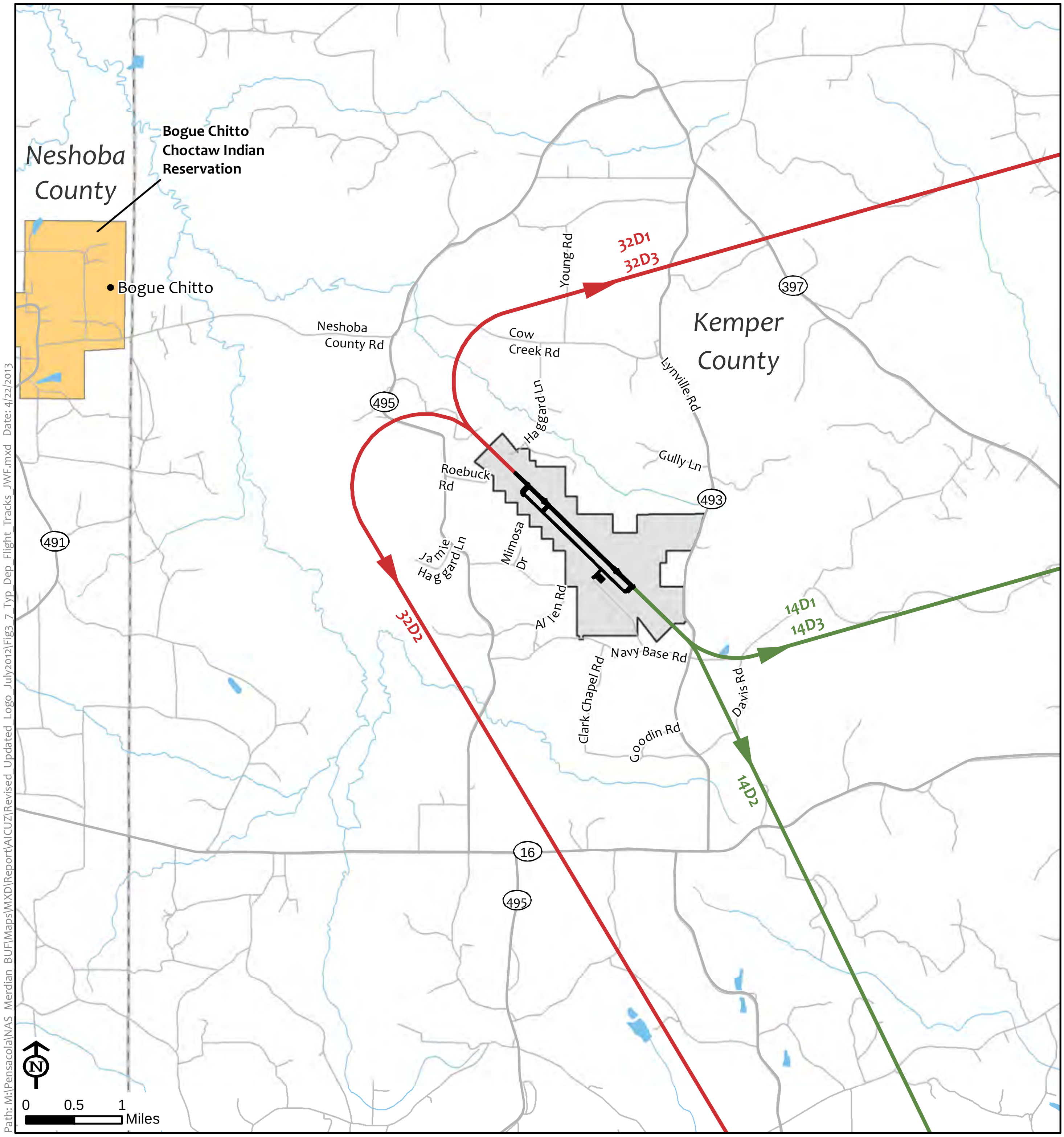


NOLF Runways (14 / 32)

- Straight in Arrivals
- Carrier Break Arrivals to Runway 32
- Carrier Break Arrivals to Runway 14
- Runway
- State Highway
- Secondary/Local Road
- NOLF Joe Williams
- County Boundary

Figure 3-6
Typical Arrival Flight Tracks
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011



14

NOLF Runways

32

Departures from Runway 32

Departures from Runway 14

Runway

County Boundary

State Highway

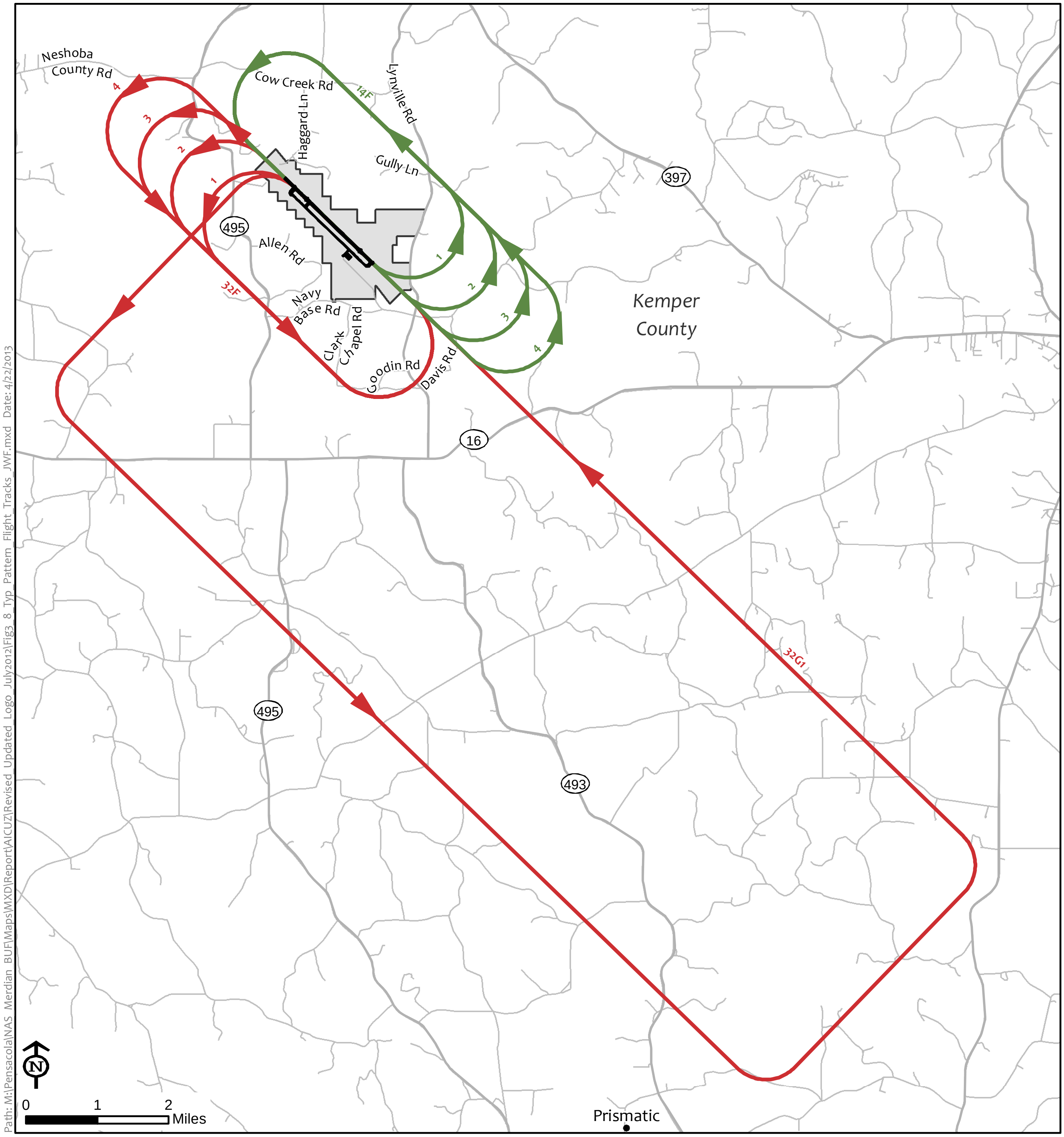
Secondary/Local Road

NOLF Joe Williams

Figure 3-7
Typical Departure Flight Tracks
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

NOLF Joe Williams



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NAVAL AIR STATION MERIDIAN, MS — TRAINING TO FIGHT — FROM THE SEA

NOLF Runways (14 / 32)

Runway 32 Typical Pattern
Runway 14 Typical Pattern
Runway
State Highway
Secondary/Local Road
NOLF Joe Williams

Figure 3-8
Typical Pattern Flight Tracks
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011

3-3. Dominant Flight Tracks at NAS Meridian

Operation Type	Runway	Flight Tracks	
		Destination of Departure/ Origin of Arrival	Track ID
Departures	**19R**	Meridian One West MOA - Area 1	9RD01
		Meridian One West MOA - Area 4	9RD03
	01R	Meridian One West MOA - Area 1	1RD01
		Meridian One West MOA - Area 4	1RD03
	10	Meridian One West MOA - Area 1	10D01
			10D02
		Meridian One West MOA - Area 4	10D03
Interfacility Departures	**19R**	Joe Williams	9RD09
			9RD10
	01R		1RD09
			1RD10
	10		10D09
			10D10
Straight-In Arrivals	**19R**	---	9RA1
	01R	---	1RA1
	28	---	28A1
	01L	---	1LA1
	19L	---	9LA1
Carrier Break Arrivals	**19L**	Meridian One West MOA - Area 1	9LO01
		Meridian One West MOA - Area 4	9LO09
		Pine Hill MOA	9LO13
		Birmingham MOA	9LO17
	01L	Meridian One West MOA - Area 1	1LO01
		Meridian One West MOA - Area 4	1LO09
		Pine Hill MOA	1LO13
		Birmingham MOA	1LO17

3-3. Dominant Flight Tracks at NAS Meridian

Operation Type	Runway	Flight Tracks	
		Destination of Departure/ Origin of Arrival	Track ID
Carrier Break Arrivals (cont.)	28	Meridian One West MOA - Area 1 (North Side Approach)	28O01
		Meridian One West MOA - Area 1 (South Side Approach)	28O05
		Meridian One West MOA - Area 4	28O09
		Pine Hill MOA	28O13
		Birmingham MOA	28O17
		SEARAY Range	28O21
Interfacility Carrier Break Arrivals	19L	Joe Williams - Runway 32	9LO33
		Joe Williams - Runway 14	9LO37
	01L	Joe Williams - Runway 32	1LO33
		Joe Williams - Runway 14	1LO37
	28	Joe Williams - Runway 32	28O33
		Joe Williams - Runway 14	28O37
Intrafacility	01R to 01L	Pattern	1R1L1
	19R to 19L	Pattern	9R9L1
Intrafacility with Overhead Arrival	19R to 19L	Pattern	9R9LO1
	01R to 01L	Pattern	1R1LO1
	10 to 01L	Pattern	101LO1
	10 to 19L	Pattern	109LO1
	01R to 28	Pattern	1R28O1
	19R to 28	Pattern	9R28O1
Touch & Go Patterns	19L	Pattern	9LF1
	01L	Pattern	1LF1
	28	Pattern	28F1
FCLP Patterns	19L	Pattern	9LF1
	01L	Pattern	1LF1
	28	Pattern	28F1

3-3. Dominant Flight Tracks at NAS Meridian

Operation Type	Runway	Flight Tracks: Destination of Departure/ Origin of Arrival	Flight Tracks: Track ID
GCA Box Patterns	19R	Pattern	9RG1
	01R	Pattern	1RG1
	19L	Pattern	9LG1
	28	Pattern	28G1
	01L	Pattern	1LG1

3-4. Dominant Flight Tracks at NOLF Joe Williams

Operation Type	Runway	Flight Tracks: Destination of Departure/ Origin of Arrival	Flight Tracks: Track ID
Departures	32	NAS Meridian Runway 19L	32D1
		NAS Meridian Runway 01L	32D2
		NAS Meridian Runway 28	32D3
	14	NAS Meridian Runway 19L	14D1
		NAS Meridian Runway 01L	14D2
		NAS Meridian Runway 28	14D3
Straight-In Arrivals	32	NAS Meridian	32A1
	14	NAS Meridian	14A1
Carrier Break Arrivals	32	NAS Meridian Runway 01R	32O1
		NAS Meridian Runway 19R	32O5
		NAS Meridian Runway 10 (North Flow)	32O9
		NAS Meridian Runway 10 (South Flow)	32O13
	14	NAS Meridian Runway 01R	14O1
		NAS Meridian Runway 19R	14O5
		NAS Meridian Runway 10 (North Flow)	14O9
		NAS Meridian Runway 10 (South Flow)	14O13

3-4. Dominant Flight Tracks at NOLF Joe Williams

Operation Type	Runway	Flight Tracks	
		Destination of Departure/ Origin of Arrival	Track ID
Touch & Go Patterns	32	Pattern	32F1
	14	Pattern	14F1
FCLP Patterns	32	Pattern	32F1
	14	Pattern	14F1
GCA Pattern	32	Pattern	32G1

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4

AIRCRAFT NOISE

How an installation manages the aircraft noise it generates can play a key role in shaping an installation's relationship with an adjacent community. It is also a key factor in local land use planning. Since noise from aircraft operations has the potential to significantly impact areas surrounding NAS Meridian and NOLF Joe Williams, the Navy has established certain areas around the installations as noise zones, using the guidance provided in the AICUZ instruction. Noise Zones provide the community and planning organizations the tools needed to safely plan for development in the areas surrounding the airfields. The contours developed as part of this AICUZ Study are based on aircraft type, aircraft operations, and when the aircraft are flown.

This chapter discusses noise associated with aircraft operations, including average noise levels, noise abatement/flight procedures, noise complaints, sources of noise, and airfield-specific noise contours.

4.1 WHAT IS SOUND/NOISE?

Sound is vibrations in the air which can be generated by a multitude of sources. Some sources of noise include roadway traffic, recreational activities, railway activities, and aircraft operations. When the sound becomes invasive or unwanted, it becomes noise. Generally, sound becomes noise to a listener when it interferes with normal activities. For further discussion of noise and its effect on people and the environment, see Appendix A.

Typical A-Weighted Sound Levels and Common Sounds

0 db – Threshold of Hearing
20 dB – Ticking Watch
45 dB – Bird Calls (distant)
60 dB – Normal Conversation
70 dB – Vacuum Cleaner (3 ft)
80 dB – Alarm Clock (2 ft)
90 dB – Motorcycle (25 ft)
100 dB – Ambulance Siren (100 ft)
110 dB – Chain Saw
120 dB – Rock Concert
130 dB – Jackhammer
140 dB – Threshold of Pain

** Refer to Appendix A for additional examples and details on sound levels.*

Common Measurements of Noise/Sound

A-Weighted Decibels, dBA: An expression of the relative loudness of sounds in air as perceived by the human ear where the decibel values of sounds at low frequencies are reduced. By contrast, unweighted decibels make no correction for audio frequency.

Decibels, dB: This unit of measurement is used to represent the intensity of a sound, also called a sound level.

Day-Night Average Sound Level, DNL: A composite metric that incorporates both the intensity of a sound and its duration within a 24-hour period.

** Refer to Appendix A for additional information and details on sound.*

On an A-weighted scale, barely audible sound is set at 0 decibels (dB), and normal speech has a sound level of approximately 60 to 65 dB. Generally, a sound level above 120 dB will begin to provide discomfort to a listener (Berglund and Lindvall 1995), and the threshold of pain is 140 dB.

In this AICUZ Study, all sound or noise levels are measured in A-weighted decibels (dBA), which represent sound pressure adjusted to the range of human hearing with intensity greater than barely audible sound, which is set at 0 dB. When the use of A-weighting is understood, the adjective "A-weighted" is often omitted and the measurements are expressed as dB. In this AICUZ Study, dB units refer to A-weighted sound levels.

The noise exposure from aircraft at NAS Meridian, as with other installations, is measured using the day-night average sound level (DNL) noise metric. The DNL noise metric, established in 1980 by the Federal Interagency Committee on Urban Noise (FICUN), presents a reliable measure of community sensitivity to aircraft noise and has become the standard metric used in the United States (except California, which uses a similar metric, Community Noise Exposure Level [CNEL]).

DNL averages the sound energy from aircraft operations at a location over a 24-hour period. DNL also adds an additional 10 dB to events occurring between 10:00 p.m. and 7:00 a.m. This 10-dB "night-time penalty" represents the added intrusiveness of sounds due to the increased sensitivity to noise when ambient noise levels are low.

By combining factors most noticeable about noise annoyance—maximum noise levels, duration, the number of events over a 24-hour period, and nighttime events—DNL provides a single measure of overall noise impact. Scientific studies and social surveys have found DNL correlates with community annoyance (FICUN 1980, U.S. Environmental Protection Agency [EPA] 1982, American National Standards Institute [ANSI] 1990, Federal Interagency Committee on Noise [FICON] 1992). Although DNL provides a single measure of overall noise impact, it 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 dBA could result from a few noisy events or a large number of quieter events.

The DNL is depicted on a map as a noise contour that connects points of equal noise value in 5-dBA increments (60, 65, 70, 75, 80, and 85 DNL). The AICUZ Program generally divides noise exposure into three categories, known as “noise zones,” for land use planning purposes:

- **Noise Zone 1:** Less than 65 DNL; low or no noise impact.
- **Noise Zone 2:** 65 to 75 DNL; moderate impact, where some land use controls are required.
- **Noise Zone 3:** Greater than 75 DNL; most severely impacted area and requires the greatest degree of land use control.

Land use recommendations within these noise zones are discussed and provided in Chapter 6. Calculated noise contours do not represent exact measurements and are discussed further in Section 4.3. Noise levels inside a contour may be similar to those outside a contour line. Where the contour lines are close together, the change in noise level is greater. Where the lines are far apart, the change in noise level is gradual.

4.2 Noise Abatement and Complaints

Impacts from noise associated with NAS Meridian and NOLF Joe Williams occur in areas off station, with areas in closer proximity to aircraft operations experiencing greater impacts. NAS Meridian is aware of land uses surrounding its airfields, and the installation takes precautions to reduce noise impacts to sensitive areas. However, given the training requirements and high level of activity on the installation, noise complaints are occasionally filed with the station. Noise abatement procedures instituted by NAS Meridian and noise complaints are discussed below.

4.2.1 Noise Abatement

NAS Meridian minimizes aircraft noise in the community, also called noise abatement or avoidance, and all naval aviators and students are required to comply with noise abatement procedures. Noise abatement procedures also apply to engine run-up and maintenance operations conducted on station which are written into the Air Operations Manual.

Training on Aircraft Carriers

The Navy cannot alter critical portions of flight patterns to accommodate noise complaints without increasing the risk to student pilots training to land on carriers. For example, the pattern altitude for flight crews performing FCLPs is 600 feet AGL at NAS Meridian and NOLF Joe Williams because that is the standard altitude for the pattern at the carrier. Students need to practice landing with the same carrier pattern they will have to fly at sea. However, there are other measures currently being implemented to reduce off-station noise impacts. Noise abatement procedures at NAS Meridian and NOLF Joe Williams are briefly discussed below:

- Flight crews (pilots and ground maintenance) are briefed on noise abatement procedures and noise sensitive areas detailed in Inflight Guides;
- Flight crews are briefed on the existing patterns and the need to maintain the patterns;
- Transient aircraft are required to secure afterburners no later than the airfield boundary and climb rapidly upon departure, thereby taking the noise away from the community;
- Limits on nighttime flying are established, typically with no aircraft flights after 11:00 p.m., except during certain periods of daylight savings when hours are extended until 12:00 a.m.;

- In addition to the ATC tower and radar, McCain Field is also equipped with Tactical Air Navigation (TACAN) devices to assist with pattern control and an Instrument Landing System (ILS);
- Prolonged periods of high-power run-ups are avoided;
- Hush houses will be used, wherever possible, for maintenance activities; and
- Limited operations are performed on Sunday to avoid church services, except on surge days.

NAS Meridian personnel are active members in the communities surrounding the airfields and are continuously reaching out to stakeholders to establish open communication and resolution of noise issues.

4.2.2 Noise Complaints

The origin and nature of noise complaints within the geographic region is often a tangible barometer of the success or failure of noise abatement procedures. Noise complaints are related to the intensity and frequency of the events as well as the individual sensitivity of the person impacted. Complaints can arise outside the areas depicted by noise contours. This is frequently due to a single event that is unusual, such as when an aircraft flies over an area not commonly overflown or new aircraft operating in the region. In general, individual response to noise levels varies and is influenced by factors including:

- The activity an individual was engaged in at the time of the noise event;
- The individual's general sensitivity to noise;
- The time of day or night;
- The length of time an individual is exposed to a noise;
- The predictability of noise; and
- Weather conditions.

Noise contours and land use recommendations are based on average annoyance responses of a population, but some people have greater noise sensitivity than others. Generally, a small increase in noise level will not be noticeable but, as the change in noise level increases, individual perception is greater, as shown in Table 4-1.

If a noise complaint is received, the Operations Duty Officer records the specifics of the caller's concern in a noise complaint form (i.e., date, time, location).

↓

The noise complaint form is then passed to the ATC Officer who conducts an investigation and may place a follow-up call to the complainant, if warranted.

↓

The ATC Officer then notifies the Air Operations Officer who informs the Community Planning and Liaison Officer (CPLO) for follow-up and the CO/Executive Officer (XO), if needed.

↓

The Air Operations Officer forwards the issue to TRAWING ONE, if warranted. If forwarded, the noise complaint is then discussed and commented on at the squadron level and they provide an explanation to the Air Operations Officer. TRAWING ONE and the Air Operations Officer discuss and implement any changes to operational procedures that may be needed.

Table 4-1. Subjective Responses to Noise

Change	Change in Perceived Loudness
1 decibel	Requires close attention to notice
3 decibels	Barely noticeable
5 decibels	Quite noticeable
10 decibels	Dramatic - twice or half as loud
20 decibels	Striking - fourfold change

As with most airfields, a majority of NAS Meridian noise complaints result from nighttime operations. The number of noise complaints has varied year to year, and peaked in 1999 with the transition from the T-2 and A-4 to the louder T-45C. In recent years, the number of noise complaints has been minimal at both NAS Meridian and NOLF Joe Williams.

If there are concerns or complaints about aircraft noise in the area, citizens are encouraged to contact representatives at the Operations Duty Desk (telephone number listed below) to log their complaints.

Noise Complaints

NAS Meridian
(601) 679-2505

4.3 Airfield Noise Sources and Noise Modeling

The Navy conducts noise studies, as needed, to assess the noise impacts of aircraft operations. This 2012 AICUZ Study presents the projected (CY 2020) noise contours at NAS Meridian and NOLF Joe Williams. The Navy utilized NOISEMAP, a widely accepted computer model that projects noise impacts around military airfields. NOISEMAP calculates DNL contours resulting from aircraft operations using such variables as power settings, aircraft model and type, maximum sound levels, and duration and flight profiles. The contours generally follow the flight paths of aircraft.

The main sources of noise at an airfield are maintenance run-ups and flight operations. As part of this AICUZ Study, data from NAS Meridian was compiled and incorporated into the model to generate noise contours. The inputs and data collected include:

- Type of operation (arrival, departure, and pattern);
- Number of operations per day;
- Time of day;
- Flight track;
- Aircraft power settings, speeds, and altitudes;
- Number and duration of pre-flight and maintenance run-ups;
- Terrain (surface type); and
- Environmental data (temperature and humidity).

The 2012 AICUZ Noise contours are provided in Section 4.4.

4.4 2012 AICUZ Noise Contours

Noise contours provide a military installation, local planning organizations, and the public with a graphical representation of potential noise related impacts associated with aircraft operations.

These contours can assist in locating, identifying, and addressing any incompatible land uses and assist in plans for future development.

A moderate increase from current operations is projected for NAS Meridian and NOLF Joe Williams through CY 2020.

Noise contours provide NAS Meridian, local community planning organizations, and the general public with maps of the modeled noise related impacts of aircraft operations. Noise contours, when overlaid with local land uses, create a useful tool to help locate and address any incompatible land uses and can assist in planning for future development.

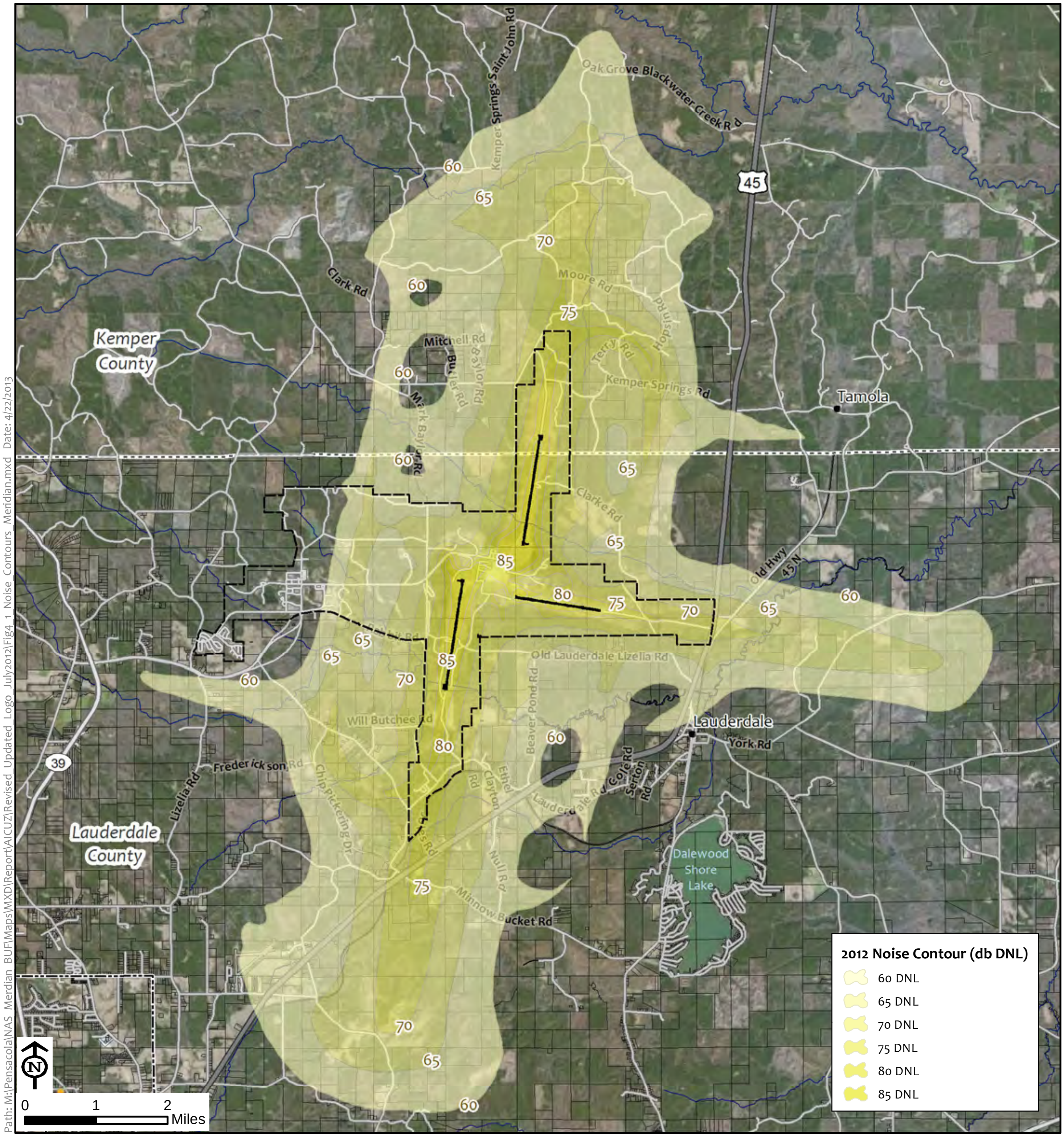
Noise contours provided in this AICUZ Study are identified as the 2012 AICUZ noise contours, based on the year of the Study release, but represent projected operations out to CY 2020. Aircraft operations are projected into the future to help ensure that the future operational capability of the air installation is accounted for. This AICUZ Study forecasts aircraft operations as far into the future as possible to assess an air station's impact on the local community. Therefore, projected operations are incorporated into this 2012 AICUZ Study. Projected operations for NAS Meridian and NOLF Joe Williams vary from current operations—there is an increase in flight operations at both installations through CY 2020 (see Chapter 1, Tables 1-3 and 1-4).

The 2012 AICUZ noise contours for NAS Meridian are presented in the following sections along with detailed descriptions of the noise environments for each airfield. Also provided are comparisons and figure overlays of the 2004 AICUZ Study and the 2012 AICUZ noise contours. The comparison helps to identify changes to noise exposure based on projected changes in aircraft operations and allows the targeting of land use incompatibility and follow-on potential recommendations to mitigate noise impacts. Land use and recommendations for addressing incompatibility issues within noise zones for each airfield are provided and discussed in Chapter 6.

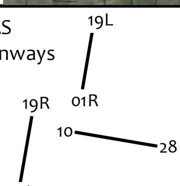
4.4.1 2012 AICUZ Noise Contours for NAS Meridian

As shown on Figure 4-1, the 2012 AICUZ noise contours align with all three runways and extend outward from the installation along the typical flight tracks. The contours follow the dominant flight tracks, and noise propagates outward from those paths. The 60 DNL contour extends approximately 4 miles in all directions around the airfield.

NAS Meridian



NAS Runways



US Highway

State Highway

Secondary/Local Road

Parcel Boundary

Installation Boundary

Runway

Meridian Corporate Boundary

County Boundary

Figure 4-1
2012 AICUZ Noise Contours
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; Microsoft Virtual Earth 2011; Wyle 2011

Path: M:\Pensacola\NAS Meridian BUF\Maps\MXD\Report\AICUZ\Revised Updated Logo July2012\Fig4 1 Noise Contours Meridian.mxd Date: 4/22/2013

The 65 DNL contour extends north into Kemper County, approximately 3.25 miles from the northern air station boundary, and is driven mainly by departures on runway 01R. Likewise, the 65 DNL contour extends east, approximately 3.25 miles from US-45 or the eastern edge of the station boundary, mainly due to departures on runway 10. The contour also extends approximately 3.25 miles from the southern edge of the air station boundary into Lauderdale County, mainly due to departures on runway 19R. Finally, the 65 DNL contour extends approximately 1.6 miles west of the southwestern boundary of the air station as a result of GCA operations on flight and, to a lower extent, closed pattern operations (touch-and-go and FCLPs).

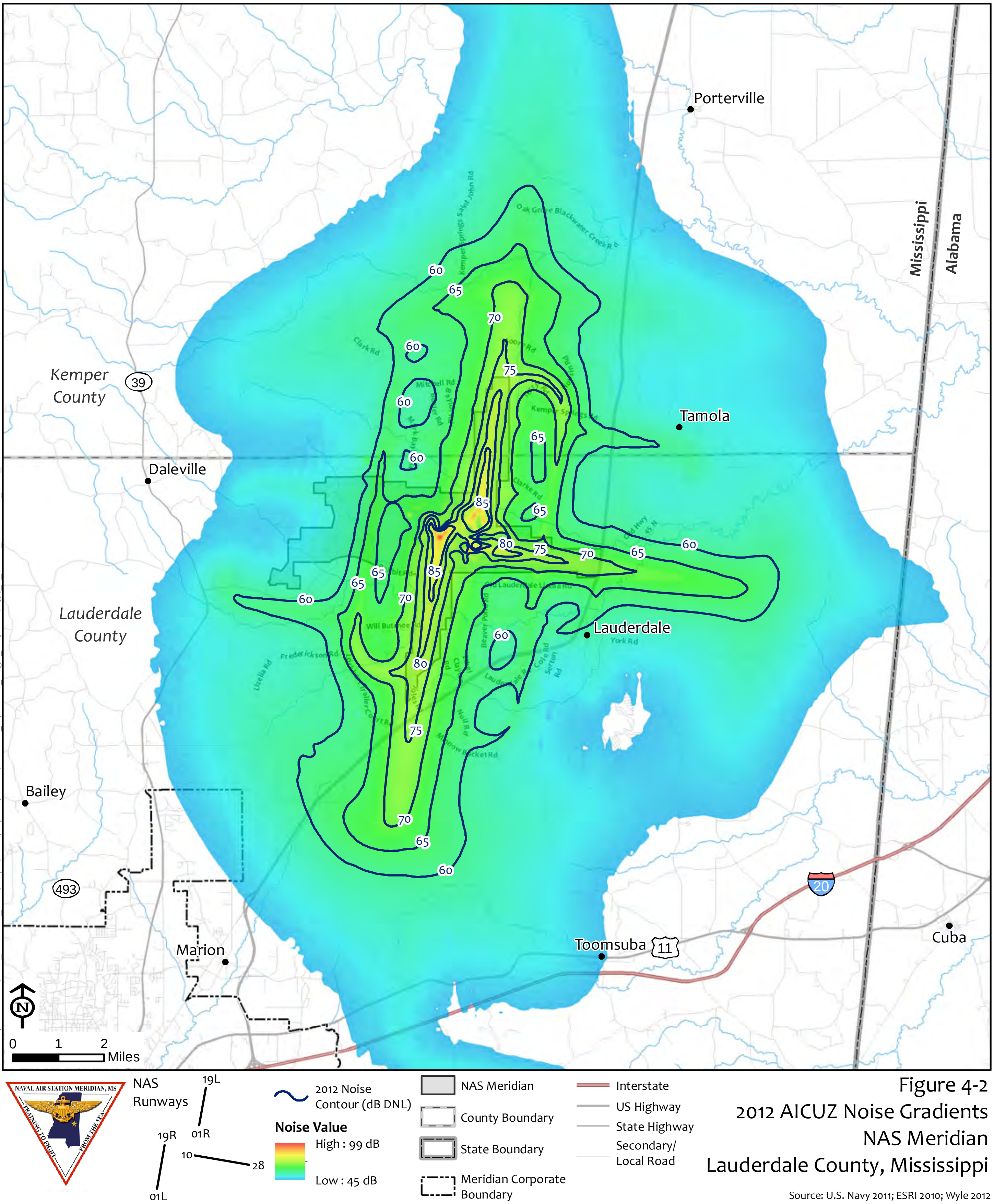
The 70 DNL contour also extends approximately 2 miles off station in the same general shape as the 65 DNL contour, and the 75 DNL extends slightly off station off the runway ends. Contours greater than 80 DNL do not extend off station and are concentrated around the runways.

Figure 4-2, provides a DNL color gradient of the noise propagating from NAS Meridian into Lauderdale County. The highest noise levels are concentrated within the installation and decrease to much lower levels in Lauderdale County. The figure also depicts the noise outside the 65 DNL noise contour, which is deemed minimal by the AICUZ Program.

Comparison of 2004 and 2012 AICUZ Noise Contours for NAS Meridian

The 2012 AICUZ noise contours have increased in overall size from the 2004 AICUZ noise contours (see Figure 4-3). The general shape of the contours has remained the same, with a slight increase in the degree the contours extend off station. The increase in size is concentrated around the runway ends. The 2012 AICUZ noise contours extend further off station at the runway ends as compared to the 2004 AICUZ Study.

NAS Meridian

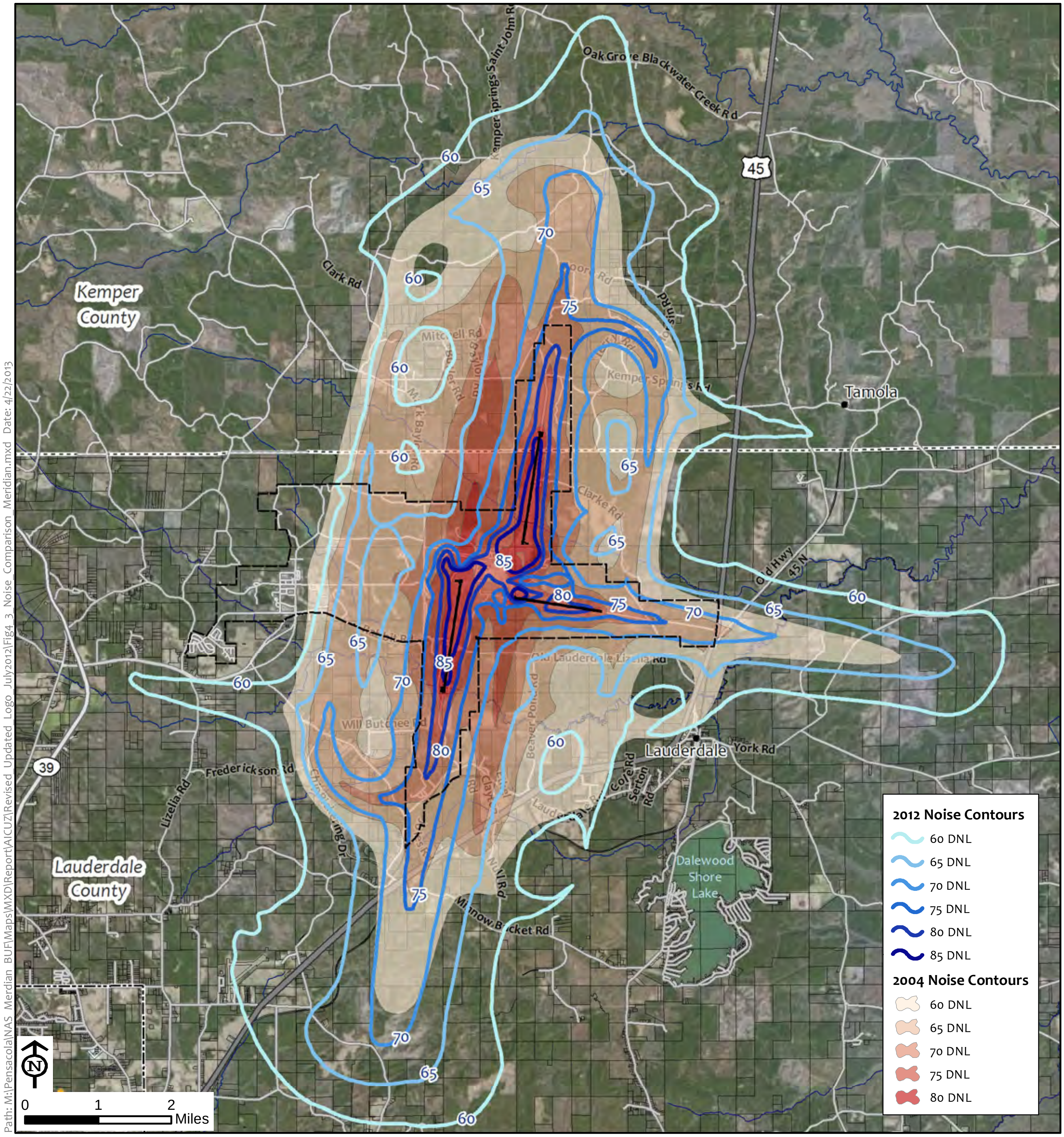


Path: M:\Pensacola\NAS_Meridian_BUF\Maps\MXD\Report\AICUZ\Revised Updated Logo_July2012\Fig4_2_Noise_Gradients_NAS_Meridian.mxd Date: 4/22/2013

Figure 4-2
2012 AICUZ Noise Gradients
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2012

NAS Meridian



NAVAL AIR STATION MERIDIAN, MS — TRAINING TO FIGHT... FROM THE SEA

NAS Runways: 19L / 01R, 19R / 01L, 10 / 28

US Highway; State Highway; Secondary/ Local Road; Parcel Boundary; Installation Boundary; Runway; Meridian Corporate Boundary; County Boundary

Figure 4-3
Comparison of 2004 and 2012 AICUZ Noise Contours
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; Microsoft Virtual Earth 2011; Wyle 2011

The off station area impacted by the noise contours has increased by approximately 13,000 acres as indicated in Table 4-2. Off station areas impacted by the greater than 65 DNL in this study total 16,326 acres compared to 10,652 acres in the 2004 AICUZ Study, for an increase of 5,671 acres. However, the majority of the increased acreage (7,711 acres) is within in the 60-65 DNL zone. This contour range falls within Noise Zone 1 (Section 4.1), which is categorized as having low or no noise impact.

Table 4-2. Areas within Noise Zones (DNL), NAS Meridian

Noise Zone	Total Off Station Land Area	
	2004 AICUZ Noise Zones (acres)	2012 AICUZ Noise Zones (acres)
60-65 DNL	10,249	17,960
65-70 DNL	7,662	11,343
70-75 DNL	2,219	4,393
75+ DNL	771	587
TOTAL AREA	**20,901**	**34,283**

As described above and depicted on Figure 4-3, the 2012 AICUZ noise contours have changed in overall size from the 2004 AICUZ Study. The differences between the 2004 and 2012 AICUZ noise contours are the result of various updates to the modeled data reflecting projected operations at NAS Meridian. The updates resulting in changes include integration of new flight tracks and modifications to existing flight tracks, updates to flight track utilization, adjustments to numbers of operations conducted during day and acoustical night periods, runway utilization percentages for all operations types, updates to the composition of airfield operations, primarily projected number of pattern operations relative to arrival and departure operations, improved mapping techniques, and a revision to the modeled T-45 departure altitude profile resulting in a reduced rate of climb.

4.4.2 2012 AICUZ Noise Contours for NOLF Joe Williams

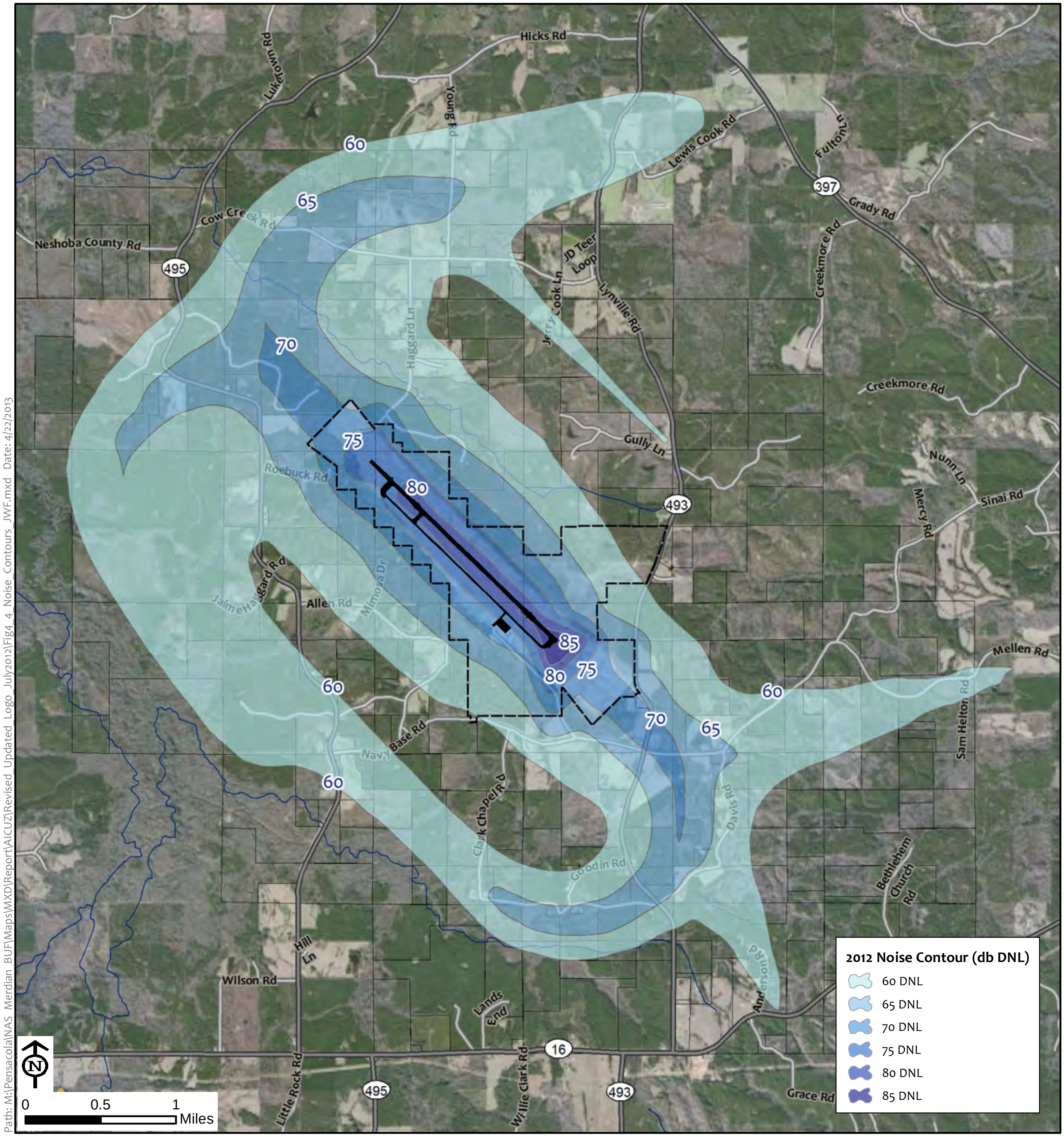
As shown on Figure 4-4, the 2012 AICUZ noise contours for NOLF Joe Williams align with the single runway and extend outward from the installation along the typical flight tracks. The contours follow the dominant flight tracks and propagate outward from those paths. The 60 DNL contour extends approximately 1.25 miles off the runway ends to the northwest and southeast and approximately 0.5 mile to the northeast and southwest.

The 65 DNL contour extends northeast of the NOLF boundary by approximately 1.6 miles. The DNL noise exposure in this area (‘horn’ shape) of the contour is driven mainly by departures on runway 32. The 65 DNL contour extends southeast (‘horn shape’) of the NOLF boundary by approximately 0.75 mile, mainly due to departures on runway 14, and approximately 1.4 miles from the southern edge of the NOLF boundary, mainly due to pattern operations and carrier-break arrivals on runway 32. The 65 DNL contour also extends approximately 1.3 miles northwest of the NOLF boundary as a result of departures on runway 32.

The 70 DNL contour extends minimally off station immediately following the runway ends. The 75 and greater DNL contours are contained exclusively on station.

Figure 4-5, provides a DNL color gradient of the noise propagating from NOLF Joe Williams into Kemper County. The highest noise levels are concentrated within the installation and decrease in Kemper County. Figure 4-5 also depicts the noise outside the 65 DNL noise contour, which is deemed minimal by the AICUZ Program.

NOLF Joe Williams



NOLF Runways (14 / 32)

State Highway

Secondary/Local Road

Installation Boundary

Runway

Parcel Boundary

Figure 4-4

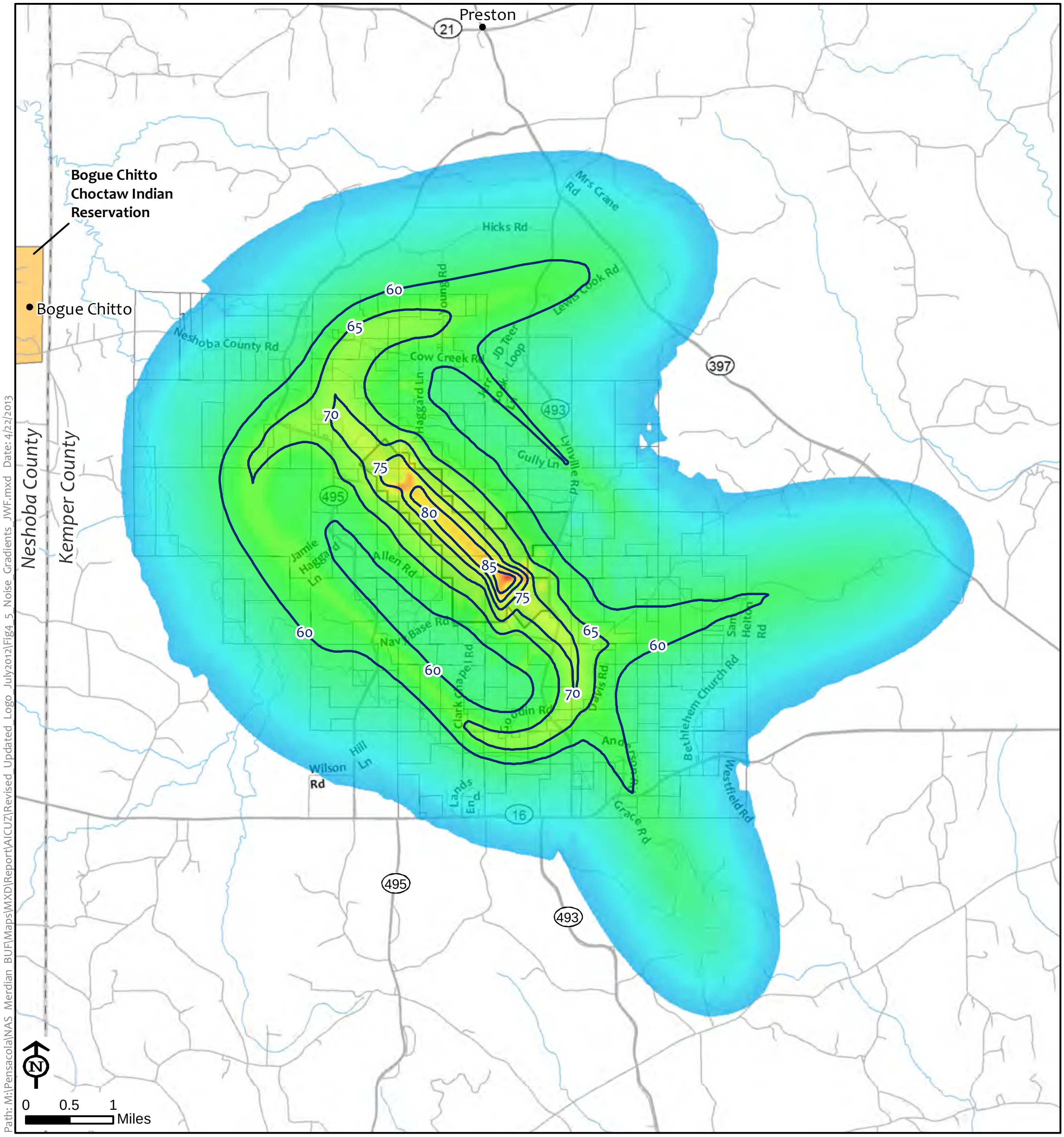
2012 AICUZ Noise Contours

NOLF Joe Williams

Kemper County, Mississippi

Source: U.S. Navy 2011; Microsoft Virtual Earth 2011; Wyle 2011

NOLF Joe Williams



Path: M:\Pensacola\NAS_Meridian_BUFF\Maps\MXD\Report\AICUZ\Revised_Updated_Logo_July2012\Fig4_5_Noise_Gradients_JWF.mxd Date: 4/22/2013

NOLF Runways (14–32)

2012 Noise Contour (dB DNL)

Noise Value

High : 99 dB

Low : 45 dB

State Highway

Secondary/Local Road

NOLF Joe Williams

County Boundary

Parcel Boundary

Figure 4-5
2012 AICUZ Noise Gradients
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2012

Comparison of 2004 and 2012 AICUZ Noise Contours for NOLF Joe Williams

The 2012 AICUZ noise contours for Joe Williams have remained similar in size when compared to 2004 AICUZ noise contours, as shown on Figure 4-6. The general shape of the contours has remained the same, with a slight increase in the degree the contours extend off station, primarily to the northeast. The 'horns' in the 2012 AICUZ noise contours extend further off station than those in the 2004 AICUZ Study.

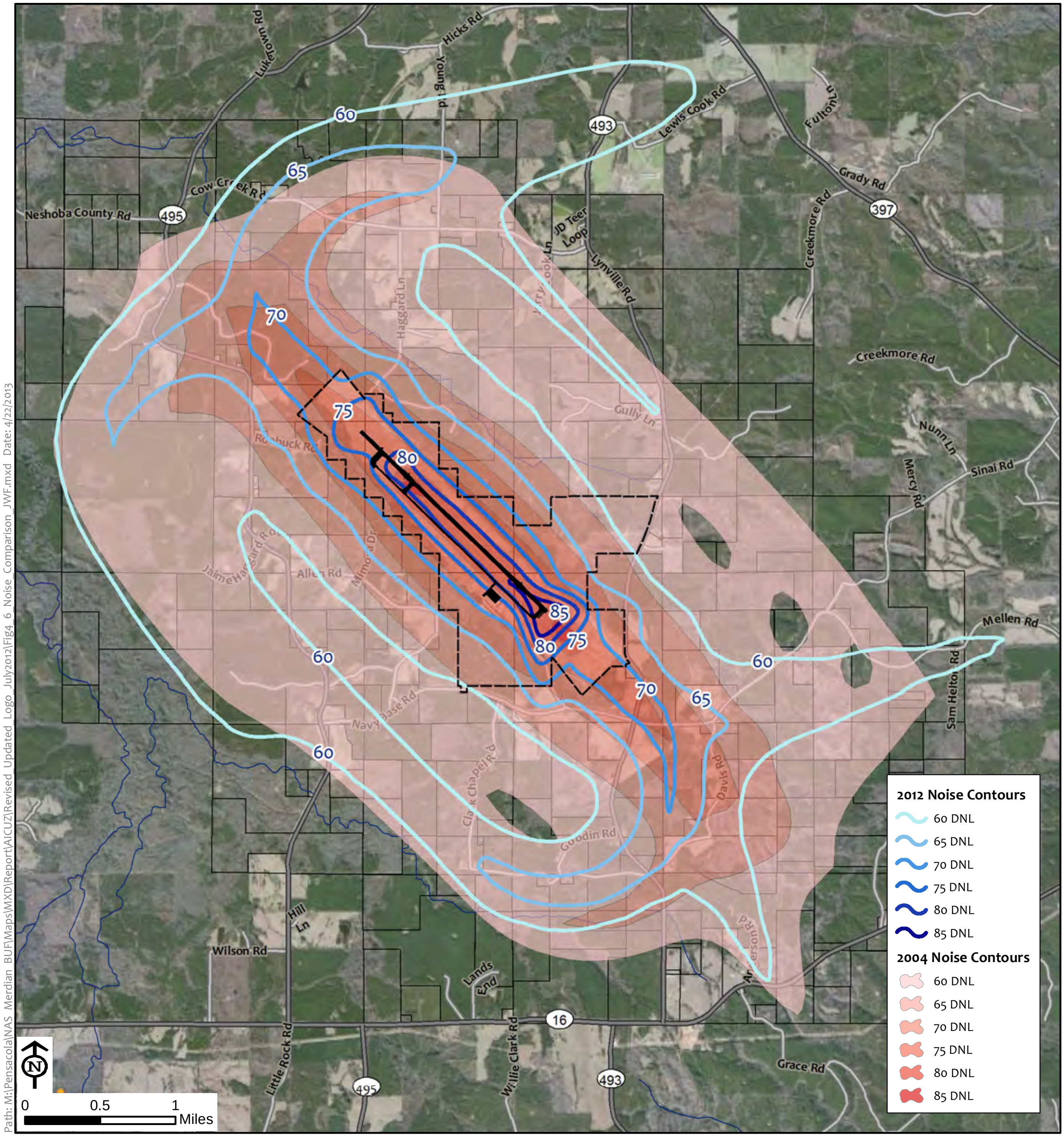
The off station area impacted by the noise contours has decreased by approximately 2,600 acres, as shown in Table 4-3. There is an overall decrease in the acreage impacted for all noise zones.

Table 4-3. Areas within Noise Zones (DNL), NOLF Joe Williams

Noise Zone	Total Off Station Land Area	
	2004 AICUZ Noise Zones (acres)	2012 AICUZ Noise Zones (acres)
60-65 DNL	7,806	6,043
65-70 DNL	2,125	1,825
70-75 DNL	794	327
75 + DNL	82	1
Total Area	**10,807**	**8,196**

As described above and depicted on Figure 4-6, the 2012 AICUZ noise contours have remained similar in size and shape when compared to the 2004 AICUZ Study, with a few minor differences. The differences are the result of various updates to the modeled data reflecting projected operations at NOLF Joe Williams. The updates resulting in changes include modification to flight tracks and integration of new flight tracks, updates to runway utilization, updates in the projected number of closed pattern operations relative to arrival and departure operations (83 percent in baseline to 45 percent in CY 2020), decreased operational level (approximately 50 percent), a revision to the modeled T-45 departure altitude profile resulting in a reduced rate of climb, and improved mapping techniques.

NOLF Joe Williams



NOLF Runways 14 32

State Highway
Secondary/Local Road
Installation Boundary
Runway
Parcel Boundary

Figure 4-6
Comparison of 2004 and 2012 AICUZ Noise Contours
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; Microsoft Virtual Earth 2011; Wyle 2011

5

AIRFIELD SAFETY

Community and airfield safety is paramount to the Navy, and is a shared responsibility between the Navy and the surrounding communities, each playing a vital role in its success. As such, the Navy has established a flight safety program and areas of accident potential around NAS Meridian and NOLF Joe Williams to assist in preserving the health, safety, and welfare of the people living near the airfield. Cooperation between the Navy and the community results in strategic and effective land use planning and development surrounding naval airfields. This AICUZ Study provides the tools to reach the shared safety goal.

Identifying safety issues assists the community in developing land uses compatible with airfield operations. These issues include hazards around the airfield that obstruct or interfere with aircraft arrivals and departures, pilot vision, communications, or aircraft electronics, and areas of accident potential. While the likelihood of an aircraft mishap occurring is remote, one can occur. Aircraft safety and mishaps at NAS Meridian are discussed in detail in this chapter.

In addition, the Navy establishes APZs which are conceptually developed based on historical data for aircraft mishaps that occurred near airfields. This AICUZ Study presents the 2012 AICUZ APZs for NAS Meridian and NOLF Joe Williams. The accident potential concept describes the probable impact areas if an accident were to occur, which is to be distinguished from the probability of an accident occurring.

5.1 FLIGHT SAFETY AND AIRCRAFT MISHAPS

APZs identify probable impact areas if an accident were to occur; however, APZs do not predict the probability of an accident occurring.

Flight safety programs are designed to reduce the hazards that can cause aircraft mishaps; the APZs are designed to minimize the potential harm if a mishap were to occur.

5.1.1 Flight Safety

Flight safety not only includes measures for pilot safety during aircraft operations, but also for the safety of those in the community. The FAA and the military define flight safety zones (imaginary surfaces) below aircraft arrival and departure flight tracks around the airfield. Heights of structures and trees are restricted in these imaginary surfaces, and the FAA evaluates proposed construction to mitigate impacts. The flight safety zones are designed to reduce the hazards that can cause an aircraft mishap. This section discusses hazards to flight safety that should be avoided in the airfield vicinity and measures to avoid potential pilot interferences.

Bird/Animal Strike Hazard

Wildlife can be a significant hazard to flight operations. Birds are drawn to different habitat types found in the airfield environment (edges, grass, brush, forest, water, and even the warm pavement of the runways). Although most bird and animal strikes do not result in crashes, they can cause structural and mechanical damage to aircraft, as well as loss of flight time. Most bird collisions occur when the aircraft is at an elevation of less than 1,000 feet. Due to the speed of the aircraft, collisions with wildlife can happen with considerable force and can cause substantial damage. To reduce the potential of a bird/animal strike hazard (BASH), the FAA and the military recommend locating land uses that attract birds at least 10,000 feet from active movement areas of the airfields. Land uses that attract birds and other wildlife include transfer stations, landfills, golf courses, wetlands, stormwater ponds, dredge disposal sites, and hazardous wildlife attractants.

Windshield Damage from a Vulture Strike

Design modifications also can be used to reduce the attractiveness of these types of land uses to birds and other wildlife.

Electromagnetic Interference (EMI)

New generations of military aircraft are highly dependent on complex electronic systems for navigation and critical flight and mission-related functions. Consequently, care should be taken in siting any activities that create EMI. EMI is defined by the ANSI as any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in electronic warfare, or unintentionally, such as high-tension line leakage. Megawatt wind turbines cause EMI and pose a hazard to air navigation. Additionally, EMI may be caused by atmospheric phenomena, such as lightning and precipitation static, and by non-telecommunication equipment, such as vehicles and industry machinery. EMI also affects consumer devices, such as cell phones, FM radios, television reception, and garage door openers.

Lighting

Bright lights, either direct or reflected, in the airfield vicinity can impair a pilot's vision, especially at night. A sudden flash from a bright light causes a spot or "halo" to remain at the center of the visual field for a few seconds or more, rendering a person virtually blind. This is particularly dangerous at night when the flash can diminish the eye's adaptation to darkness. Partial recovery takes only a few minutes, but full recovery typically requires 40 to 45 minutes. Visible lasers, including low-powered legal laser pointers, are emerging as a safety concern for pilots. Visual interference with pilot performance due to lasers can result in temporary flashblindness, glare, disruptions, and distractions. These are most hazardous during critical phases of flight—landings, take-offs, and emergency maneuvers.

Smoke, Dust, and Steam

Industrial or agricultural sources of smoke, dust, fog, and steam in the airfield vicinity could obstruct a pilot's vision during takeoff, landing, or other periods of low-altitude flight.

Imaginary Surfaces

The Navy and FAA identify a complex series of imaginary planes and transition surfaces that define the airspace that needs to remain free of obstructions around an airfield. Obstruction free imaginary surfaces help ensure safe flight approaches, departures, and pattern operations. Obstructions include natural terrain and man-made features, such as buildings, towers, poles, wind turbines, cell towers, and other vertical obstructions to airspace navigation. Fixed-wing runways and rotary-wing runways/helipads have different imaginary surfaces. Brief descriptions of the imaginary surfaces for fixed-wing Class B runways (NAS Meridian and NOLF Joe Williams are both Class B runways) are provided on Figure 5-1 and in Table 5-1. In general, no aboveground structures are permitted in the primary surface of Clear Zones, and height restrictions apply to transitional surfaces and approach and departure surfaces. Height restrictions are more stringent as one approaches the runway and flight path.

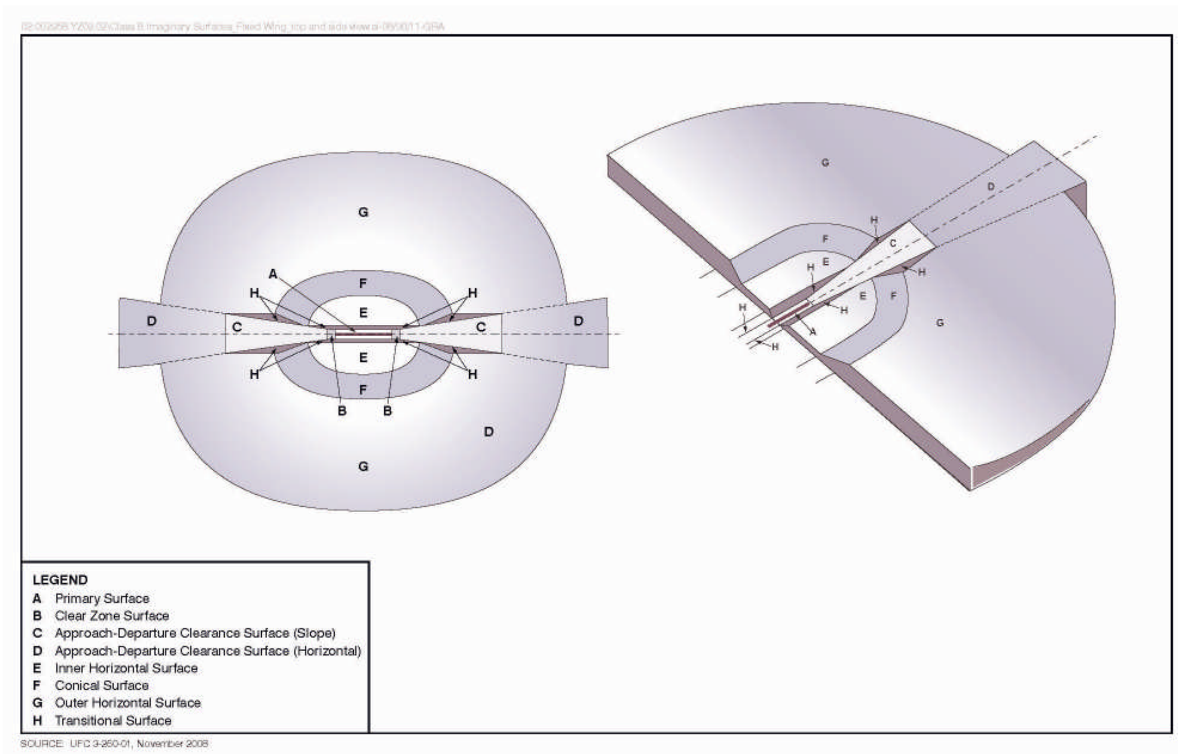


Figure 5-1. Imaginary Surfaces and Transition Planes for Class B Fixed-Wing Runways

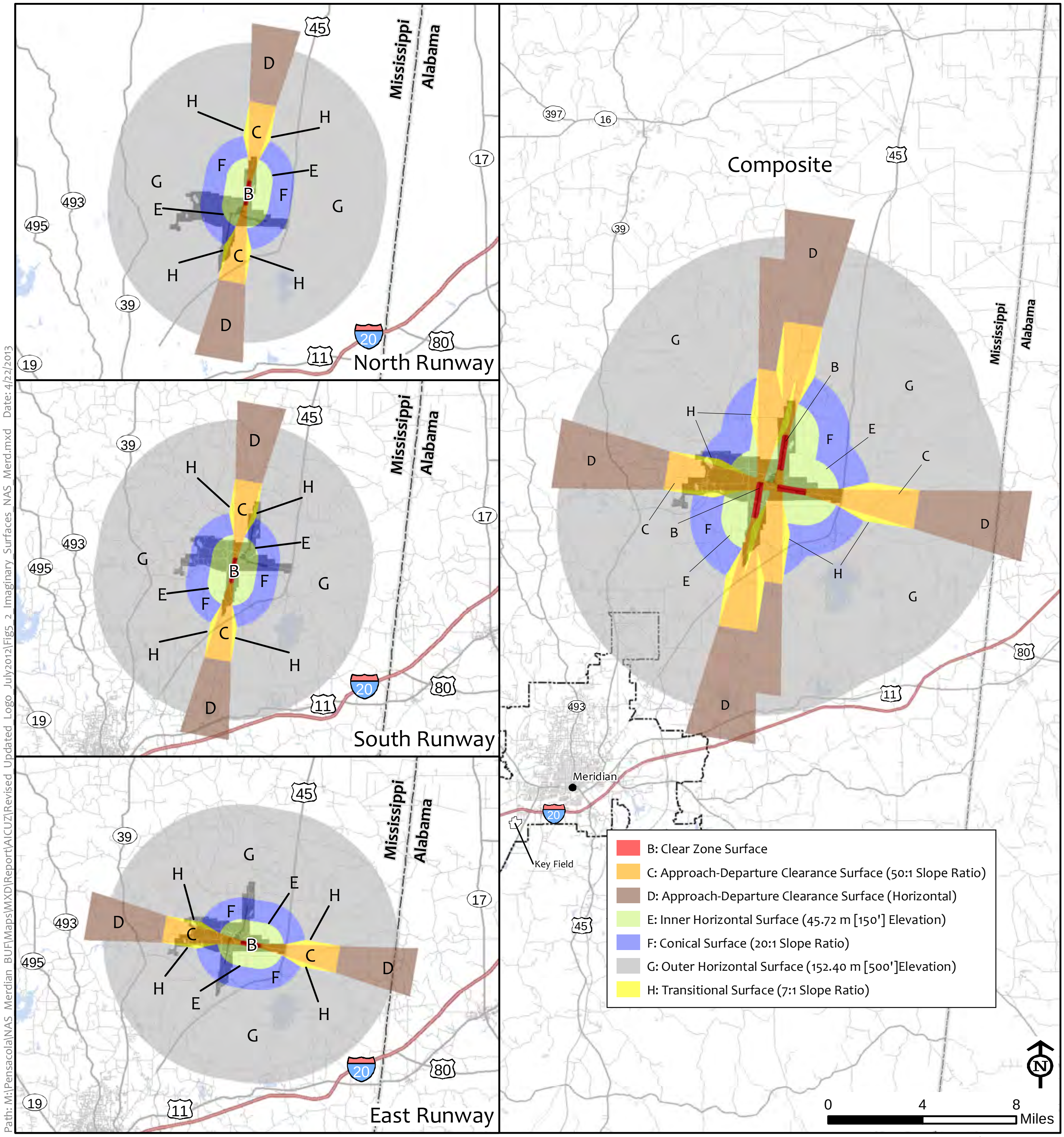
Table 5-1. Imaginary Surfaces – Class B Fixed-Wing Runways

Planes and Surfaces	Geographical Dimensions
Primary Surface	Aligned (longitudinally) with each runway and extending 200 feet from each runway end. The width is 1,500 feet.
Clear Zone	Located immediately adjacent to the end of the runway and extending 3,000 feet beyond the end of the runway. 1,500 feet wide and flaring out to 2,284 feet wide.
Approach-Departure Clearance Surfaces	An inclined or combination inclined and horizontal plane, symmetrical about the runway centerline. The slope of the surface is 50:1 until an elevation of 500 feet and continues horizontally 50,000 feet from origination. The outer width is 16,000 feet.
Inner Horizontal Surface	An oval shaped plane 150 feet above the established airfield elevation. Constructed by scribing an arc with a radius of 7,500 feet around the centerline of the runway.
Outer Horizontal Surface	A horizontal plane located 500 feet above the established airfield elevation, extending outward from the conical surface for 30,000 feet.
Conical Surface	An inclined plane that extends from the inner horizontal surface outward and upward at a 20:1 slope and extends for 7,000 feet and to a height of 500 feet above the established airfield elevation.
Transitional Surface	An inclined plane that connects the primary surface and the approach-departure clearance surface to the inner horizontal surface, conical surface, and outer horizontal surface. These surfaces extend outward and upward at right angles to the runway centerline and extended at a slope of 7:1 from the sides of the primary surface and from the sides of the approach surfaces.

Source: Naval Facilities Engineering Command (NAVFAC) 1982 and DOD 2008

Imaginary surfaces at NAS Meridian and NOLF Joe Williams are depicted on Figures 5-2 and 5-3, respectively. As noted above, each runway has assigned imaginary surfaces; therefore, since NAS Meridian has three runways, imaginary surfaces are applied to each runway. As shown on Figure 5-2, each runway is presented with the imaginary surfaces as well as a composite of the three. NOLF Joe Williams has only one runway and, therefore, one set of imaginary surfaces.

NAS Meridian



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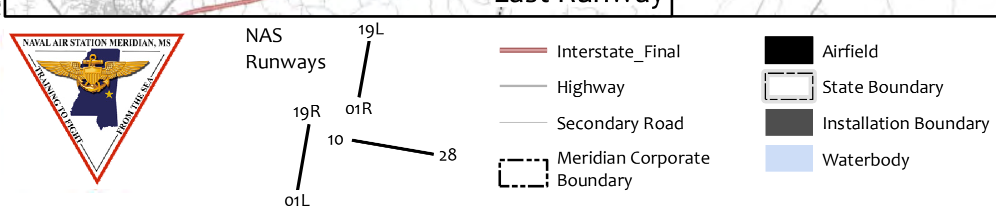
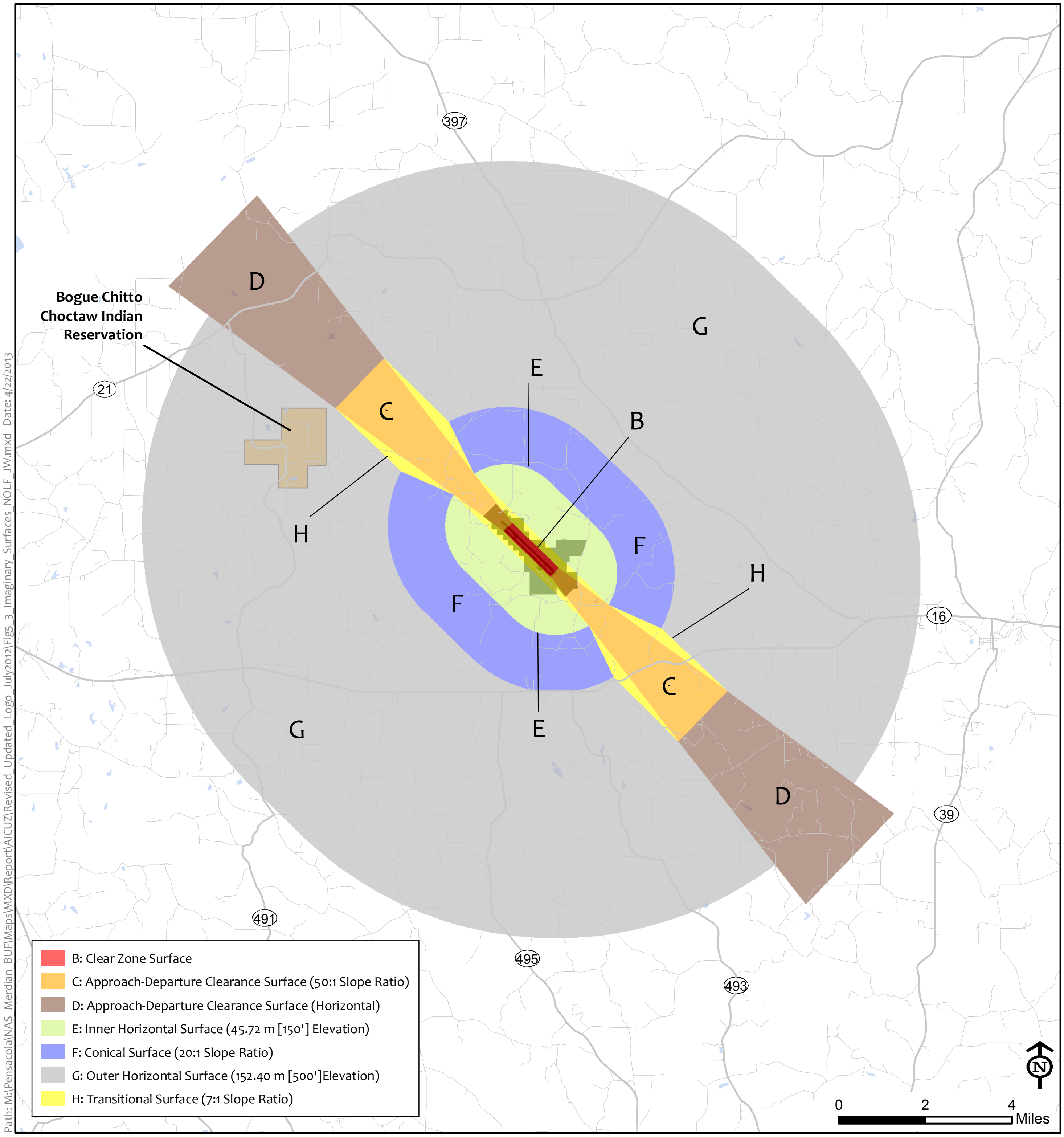


Figure 5-2
Imaginary Surface
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011, ESRI 2010

NOLF Joe Williams



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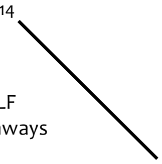


Highway
Secondary Road
Airfield
Installation Boundary

Figure 5-3
Imaginary Surface
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011, ESRI 2010

5.1.2 Aircraft Mishaps

The Navy categorizes aircraft mishaps into one of three groups: Class A, Class B, or Class C. The classification system is based on the severity of injury to individuals involved and the total property damage. The most severe is a Class A mishap and the least severe is a Class C mishap. Table 5-2 summarizes the Navy mishap classifications.

Table 5-2. Naval Aircraft Mishap Classifications

Mishap Class	Total Property Damage	Fatality/Injury
A	$2,000,000 or more and/or aircraft destroyed	Fatality or permanent total disability
B	$500,000 or more but less than $2M	Permanent partial disability or three or more persons hospitalized as inpatients
C	$50,000 or more but less than $500K	Nonfatal injury resulting in loss of time from work beyond day/shift when injury occurred

Source: Naval Safety Center 2010

There have been five Class A mishaps at NAS Meridian since 2000, all involving the T-45C aircraft and all occurring in the vicinity of NAS Meridian. One mishap resulted in a fatality; for all others aircrew ejected and/or survived with minor injuries. There have been other Class B and Class C mishaps which have occurred on or around the airfield, predominantly involving bird strikes. There was one Class B mishap at NOLF Joe Williams in 2008 involving a bird strike.

5.2 Accident Potential Zones

Recognizing the need to identify areas of accident potential, in the 1970s and 1980s the military conducted studies of historic accident and operations data throughout the military. The studies showed that most aircraft mishaps occur on or near the runway, diminishing in likelihood with distance from the runway. Based on the study, the DOD has identified APZs as areas where an aircraft accident would most likely occur if an accident were to take place. Subsequently, APZs are not a prediction of the number of accidents or the odds of an accident occurring; APZs only reflect the most likely location of an accident.

The Navy recommends that land uses with a high concentration of people (apartments, churches, schools) be located outside APZs.

APZs follow departure, arrival, and pattern flight tracks. They are based upon analysis of historical data and are designed to minimize the potential harm if a mishap were to occur by limiting activities in the designated APZs. APZs are used by the Navy and local planning agencies to ensure compatible development in close proximity to runway ends and slightly beyond. Although the likelihood of an accident is remote, the Navy recommends that certain land uses that concentrate large numbers of people, such as apartments, churches, and schools, be avoided within the APZs.

All runways at NAS Meridian and NOLF Joe Williams are classified as Class B runways.

APZ configurations and dimensions are derived from the AICUZ Instruction and have been established for all runway classifications. There are three different APZs: Clear Zone, APZ I, and APZ II. APZs are, in part, based on the number of operations conducted at the airfield—more specifically, the number of operations conducted for specific flight tracks. All runways at NAS Meridian and NOLF Joe Williams are classified as Class B runways. The components of standard APZs for Class B runways are defined in the AICUZ Instruction as follows, and identified on Figure 5-4:

- **Clear Zone.** The Clear Zone is a trapezoidal area lying immediately beyond the end of the runway and outward along the extended runway centerline for a distance of 3,000 feet. The Clear Zone measures 1,500 feet in width at the runway threshold and 2,284 feet in width at the outer edge. A Clear Zone is required for all active runways and should remain undeveloped.
- **APZ I.** APZ I is the rectangular area beyond the Clear Zone which still has a measurable potential for aircraft accidents relative to the Clear Zone. APZ I is provided under flight tracks which experience 5,000 or more annual operations (departures or approaches). APZ I is typically 3,000 feet in width and 5,000 feet in length and may be rectangular or curved to conform to the shape of the predominant flight track.

- **APZ II.** APZ II is the rectangular area beyond APZ I (or the Clear Zone, if APZ I is not used) which has a measurable potential for aircraft accidents relative to APZ I or the Clear Zone. APZ II is always provided where APZ I is required. The dimensions of APZ II are typically 3,000 feet in width by 7,000 feet in length and, as with APZ I, may be curved to correspond with the predominant flight track.

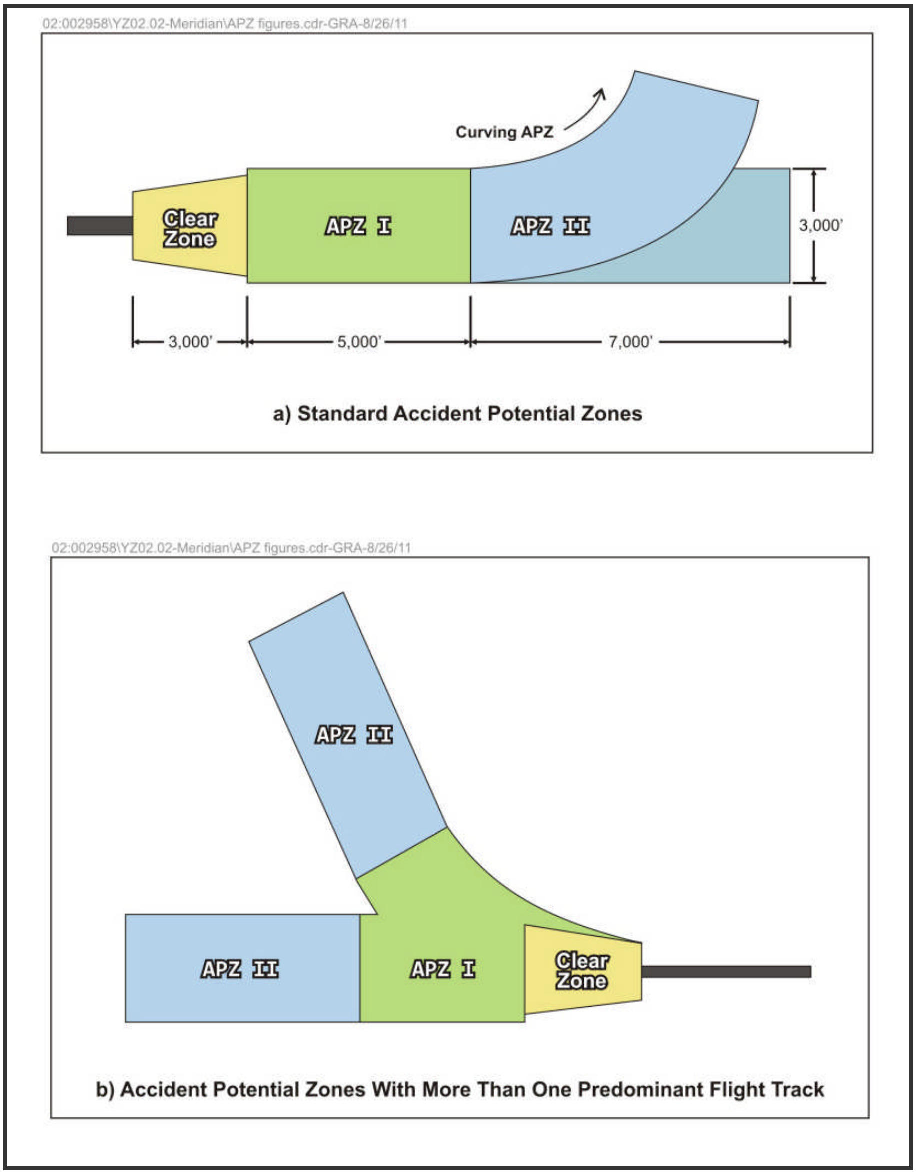


Figure 5-4. Accident Potential Zones for Class B Runways

An accident is more likely to occur in APZ I than in APZ II, and is more likely to occur in the Clear Zone than in APZ I or APZ II. APZs extend from the end of the runway, but apply to the predominant arrival and departure flight tracks used by the aircraft. Therefore, if an airfield has more than one predominant flight track to or from the runway, APZs can extend in the direction of each flight track, as shown on Figure 5-4(b).

Within the Clear Zone, most uses are incompatible with military aircraft operations. For this reason, the Navy's policy is to acquire real property interests in land within the Clear Zone to ensure that incompatible development does not occur. Within APZ I and APZ II, a variety of land uses are compatible; however, people-intensive uses (e.g., schools, apartments, churches) should be restricted because of the greater risk in these areas.

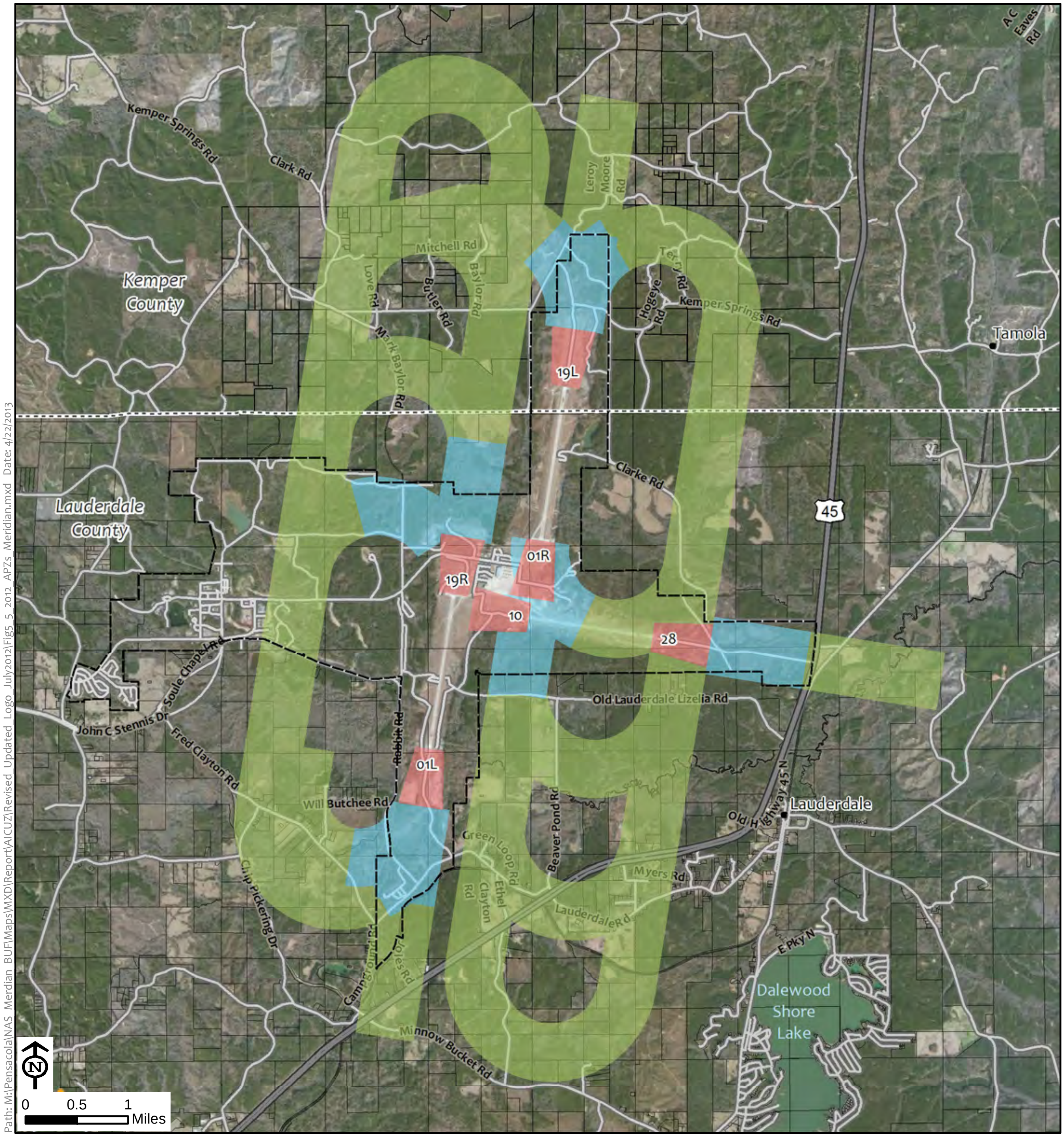
The following sections present the 2012 AICUZ APZs for NAS Meridian and NOLF Joe Williams, including a detailed analysis of areas impacted. Also provided are comparisons and figure overlays for the 2004 AICUZ Study and the 2012 AICUZ APZs. The comparison helps identify changes to APZs based on projected aircraft operations and targets land use recommendations to mitigate incompatible development. Land use and recommendations within APZs for each airfield are provided and discussed in Section 6.3.

5.2.1 2012 AICUZ APZs for NAS Meridian

The NAS Meridian 2012 AICUZ APZs have been developed based on annual aircraft operations, the installation's unique training environment, and the need for APZ protection. Figure 5-5 illustrates the 2012 AICUZ APZs as generated as part of this AICUZ Study.

New APZs are warranted for departures (straight out APZs) off of Runways 19R, 19L, 01R, 01L (APZ I only) and 10, carrier break arrivals (curved APZs) onto Runways 19L and 01L, and FLCP pattern (closed loop APZ) onto Runway 19L. New APZs were adopted for carrier break arrivals onto Runway 19L which follow the third and fourth breaks in the pattern.

NAS Meridian



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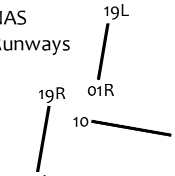
NAS Runways



- US Highway
- Secondary/Local Road
- Installation Boundary
- Parcel Boundary
- County Boundary

2012 APZs

- Clear Zone
- APZ I
- APZ II

Figure 5-5
2012 AICUZ APZs
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ENE 2011; ESRI 2010; Microsoft Virtual Earth 2011

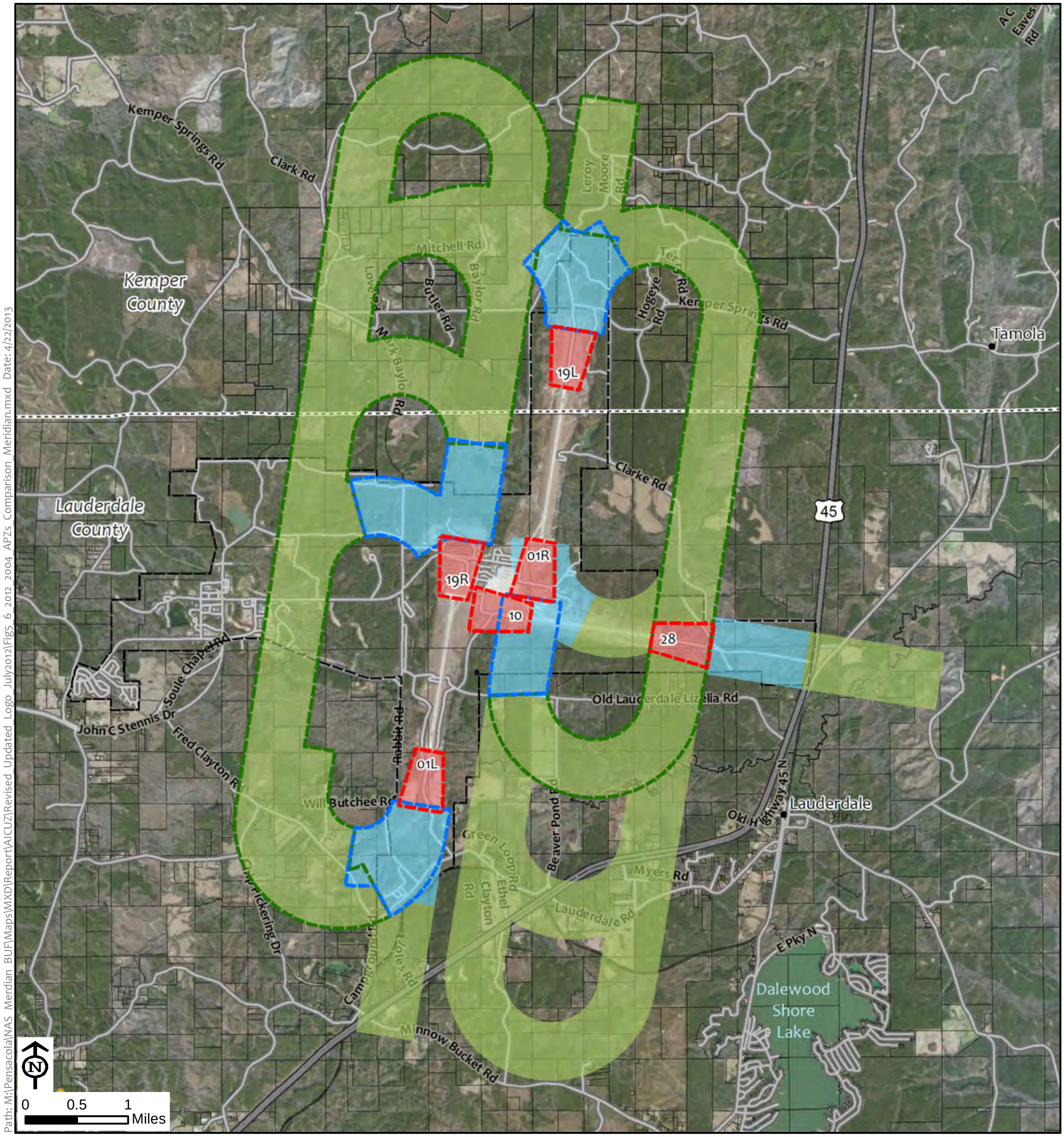
The 2004 AICUZ APZs represent a reasonable reflection of the air stations mission as well as dominant flight tracks currently flown on station. Therefore, the 2004 AICUZ APZs were adopted as part of the 2012 AICUZ APZs due in part to the increased operations at the airfield, unique SNA training environment, congested airspace around the installation, and concerns of incompatible development. The composite 2012 AICUZ APZs (Figure 5-5) reflect the newly developed APZs and the retention of the 2004 AICUZ APZs.

Figure 5-6 compares the 2004 AICUZ APZs with the 2012 AICUZ APZs. Since the 2004 AICUZ APZs were retained in full, the only differences are the new 2012 AICUZ APZs. The 2004 AICUZ Clear Zones were modified to adhere to dimensions provided in the AICUZ Instruction. As such, the land area within the Clear Zones and APZs has increased when compared to the 2004 AICUZ APZs, as shown in Table 5-3.

Table 5-3. Land Area within Clear Zones and Accident Potential Zones for NAS Meridian

APZ Zone	Total Off Station Land Area (acres)
2012 AICUZ Clear Zone	0
2012 AICUZ APZ I	622
2012 AICUZ APZ II	11,805
2012 AICUZ APZ Total Area	**12,427**
2004 AICUZ Clear Zone	0
2004 AICUZ APZ I	559
2004 AICUZ APZ II	8,225
2004 AICUZ APZ Total Area	**8,784**

NAS Meridian



NAS Runways: 19L, 01R, 19R, 10, 28, 01L

- US Highway
- Secondary/Local Road
- Installation Boundary
- Parcel Boundary
- County Boundary

2012 APZs
- Clear Zone
- APZ I
- APZ II

2004 APZs
- Clear Zone
- APZ I
- APZ II

Figure 5-6
Comparison of 2004 and 2012 AICUZ APZs
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ENE 2011; ESRI 2010; Microsoft Virtual Earth 2011

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5.2.2 2012 AICUZ APZs for NOLF Joe Williams

The NOLF Joe Williams 2012 AICUZ APZs were also developed based on annual aircraft operations and the installation's unique training mission. Figure 5-7 illustrates the 2012 AICUZ APZs generated as part of this AICUZ Study. New APZs are warranted for departure (straight out APZs I) off of Runway 32, and carrier break and pattern arrivals (curved APZs) onto Runways 14 and 32.

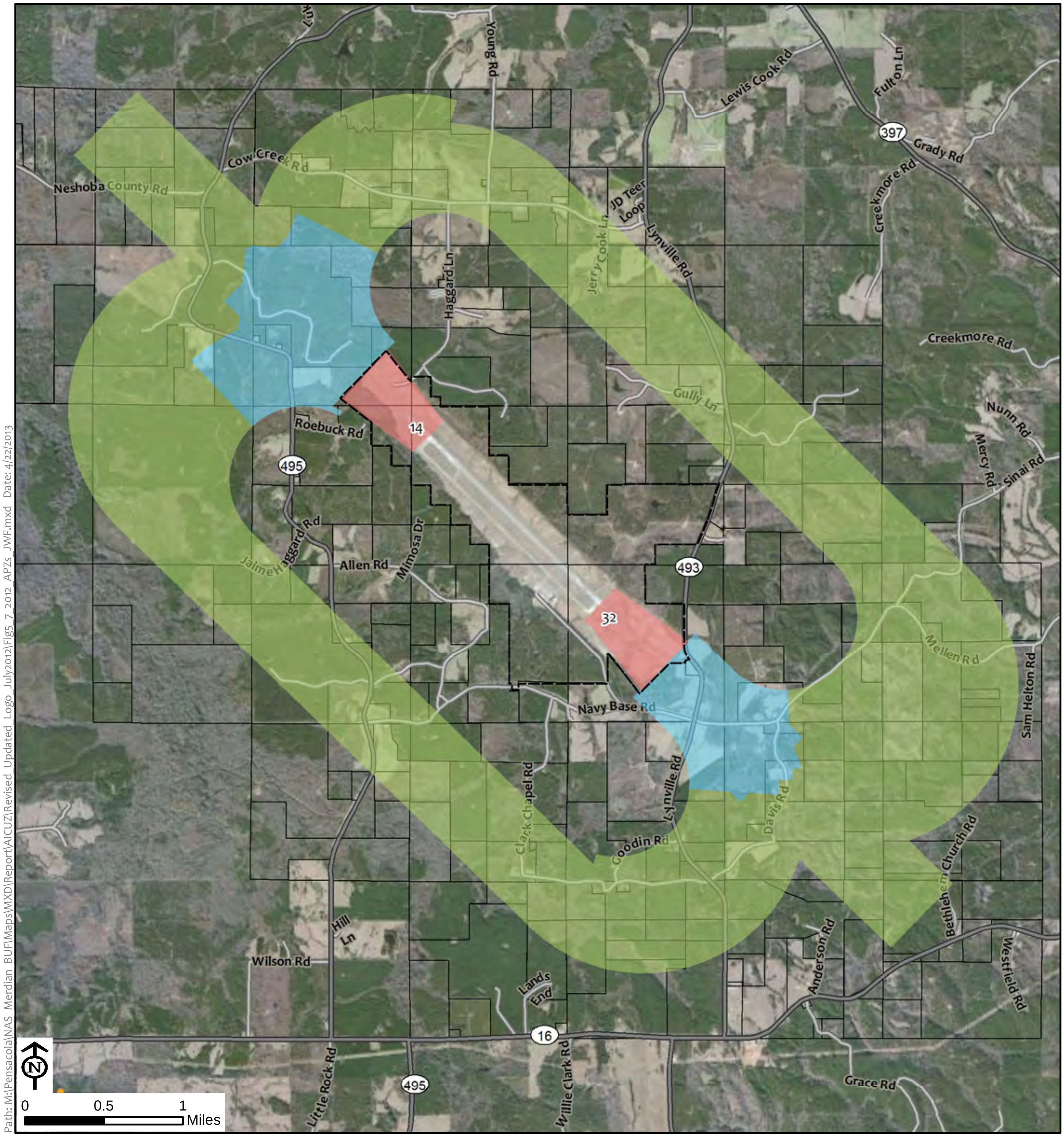
The 2004 AICUZ APZs represent a reasonable reflection of the installation's mission and dominate flight tracks currently flown on station. Therefore, as with NAS Meridian, the 2004 AICUZ APZs for NOLF Joe Williams were adopted as part of the 2012 AICUZ APZs, due in part to the unique SNA training environment and encroachment concerns. The composite 2012 AICUZ APZs (Figure 5-7) reflect the newly developed APZs and the retention of the 2004 AICUZ APZs.

Figure 5-8 compares the 2004 AICUZ APZs with the 2012 AICUZ APZs. Since the 2004 AICUZ APZs were retained in full, the only differences are the new 2012 AICUZ APZs. The 2004 AICUZ Clear Zones were modified to adhere to dimensions provided in the AICUZ Instruction. As such, the off-station land area within the Clear Zones has decreased. The land area within the Clear Zones and APZs has increased when compared to the 2004 AICUZ APZs, as shown in Table 5-4.

Table 5-4. Land Area within Clear Zones and Accident Potential Zones for NOLF Joe Williams

APZ Zone	Total Off Station Land Area (acres)
2012 AICUZ Clear Zone	2
2012 AICUZ APZ I	1,357
2012 AICUZ APZ II	6,820
2012 AICUZ APZ Total Area	**8,179**
2004 AICUZ Clear Zone	28
2004 AICUZ APZ I	1,015
2004 AICUZ APZ II	6,532
2004 AICUZ APZ Total Area	**7,575**

NOLF Joe Williams



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14

NOLF Runways

32

- State Highway
- Secondary/Local Road
- Installation Boundary
- Parcel Boundary

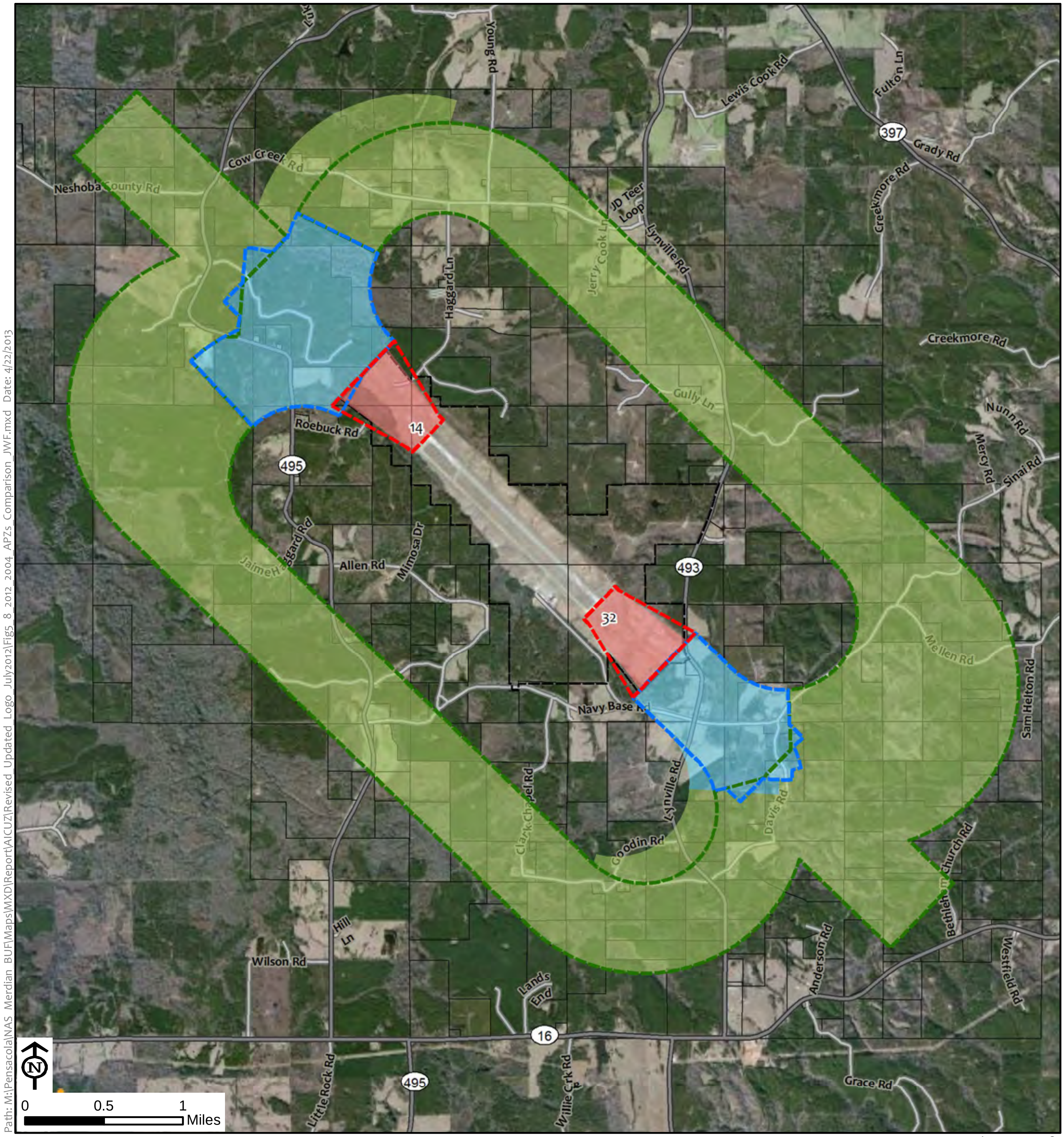
2012 APZs

- Clear Zone
- APZ I
- APZ II

Figure 5-7
2012 AICUZ APZs
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ENE 2011; ESRI 2010; Microsoft Virtual Earth 2011

NOLF Joe Williams



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14

NOLF Runways

32

- State Highway
- Secondary/Local Road
- Installation Boundary
- Parcel Boundary

2012 APZs

- Clear Zone
- APZ I
- APZ II

2004 APZs

- Clear Zone
- APZ I
- APZ II

Figure 5-8
Comparison of 2004 and 2012 AICUZ APZs
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ENE 2011; ESRI 2010; Microsoft Virtual Earth 2011

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6

LAND USE COMPATIBILITY ANALYSIS

APZs and noise contours make up the AICUZs for an air installation. The AICUZs define the minimum recommended area within which land use controls are needed to protect the health, safety, and welfare of those living or working near a military airfield and to preserve the flying mission. The AICUZ combined with the guidance and recommendations set forth in this AICUZ Study are the fundamental tools necessary for the planning process. The Navy recommends that the 2012 AICUZ noise contours and APZs be adopted into individual county planning studies, regulations, and processes to best guide compatible development around the installations.

The information presented in this chapter is intended for consideration by NAS Meridian, government entities at the city, state, and county level, surrounding communities, as well as other interested groups and participating agencies. The purpose of this AICUZ Study is to present data in a community planning format to encourage cooperative land use planning between NAS Meridian and the surrounding community so that future growth and development are compatible with the operational missions and to seek ways to lessen the operational impacts on adjacent land (Navy 1988). Although ultimate control over land use and development surrounding the installation is the responsibility of local governments, through the provision of information in this AICUZ Study, the Navy encourages local governments to plan for compatible development.

This chapter addresses land use compatibility by examining existing and planned land uses near NAS Meridian. It also addresses local planning authorities in place in the region and their related regulatory authority.

6.1 LAND USE COMPATIBILITY GUIDELINES AND CLASSIFICATIONS

Navy Land Use Compatibility Recommendations

Noise-sensitive land uses (e.g., houses, churches, schools) be placed outside high noise zones.

People-intensive uses (e.g., apartments, theaters, churches, shopping centers) be placed outside APZs.

The Navy has developed land use compatibility recommendations for APZs and noise zones. The guidelines recommend that noise-sensitive land uses (e.g., houses, churches, schools) be placed outside high noise zones, and people-intensive uses (e.g., apartments, theaters, churches shopping centers) not be placed in APZs. Certain land uses are considered incompatible with APZs and high noise zones, while other land uses may be considered compatible or compatible under certain conditions (compatible with restrictions). The land use compatibility analysis conducted for NAS Meridian was based on the Navy's land use compatibility recommendations, which are presented in Appendix B.

Table 6-1 shows existing generalized land use classifications and the associated land use compatibility with each land use designation for noise zones and APZs. These generalized land uses in Table 6-1 do not represent the local community's land use designations. Local land use and zoning for each county and airfield are discussed in the remainder of this chapter. Table 6-1 provides only generic land use categories for the purpose of illustrating a basic and high-level understanding of land use compatibility across some common land use types.

Table 6-1. Land Use Classifications and Compatibility Guidelines

	Land Use Compatibility Noise Zone (DNL)						Land Use Compatibility with APZs		
	Noise Zone 1		Noise Zone 2		Noise Zone 3		Clear Zone	APZ I	APZ II
	<55	55-65	65-70	70-75	75-80	>80			
Single-Unit, Detached (residential)	Compatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Compatible (1)
Multi-Family Residential, (apartment, transient lodging)	Compatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible
Public Assembly	Compatible	Compatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible
Schools and Hospitals	Compatible	Compatible	Compatible (2)	Compatible (2)	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible
Manufacturing (ex. petrol/chem.; textile)	Compatible	Compatible	Compatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Compatible
Parks	Compatible	Compatible	Compatible	Compatible	Incompatible	Incompatible	Incompatible	Compatible (4)	Compatible (4)
Business Services	Compatible	Compatible	Compatible	Compatible (2)	Compatible (2)	Incompatible	Incompatible	Compatible (3)	Compatible (3)
Agriculture, Forestry, and Mining	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible

Source: Adapted from OPNAVINST 11010.36C, Navy 2008

Notes:
This generalized land use table provides an overview of recommended land use. To determine specific land use compatibility, see Appendix B.
(1) Maximum density of 1-2 dwellings per acre.
(2) Land use and related structures generally compatible; however, measures to achieve NLR 25 or 30 must be incorporated into design and construction of the structures.
(3) Maximum floor area ratio that limits people density may apply.
(4) Facilities must be low intensity.

Key:

(light blue)	Compatible
(dark blue)	Incompatible

6.2 PLANNING AUTHORITY

Military installations can make <u>recommendations</u> or <u>advise</u> local government and agencies on land use outside the fence, but development of the land is <u>dictated</u> by local land use planning, ordinances, and regulations.

The development and control of lands outside of the installation fence are beyond the authority of NAS Meridian. Development of these lands is dictated by local land use planning, ordinances, and regulations. NAS Meridian is located in unincorporated areas of Lauderdale and Kemper Counties. Therefore, the land use ordinances covering the off-installation property within the AICUZ footprint are within the jurisdiction of the two counties. However, land use practices of the nearby city of Meridian also impact NAS Meridian. Land use planning programs, polices, and regulations for Lauderdale and Kemper

Counties, the City of Meridian, and the East Central Planning and Development District (ECPDD) are addressed in this section.

6.2.1 Lauderdale and Kemper Counties

The 1978 NAS Meridian AICUZ Study established AICUZ areas for the airfields and strategies for promoting compatible land use within the AICUZ footprint. At that time, the strategies were not adopted by Lauderdale and Kemper Counties; however, following the recommendations in the 1987 AICUZ Update, and under the authority of Section 61-7-13 Mississippi Code, both Lauderdale and Kemper Counties created and adopted AICUZ ordinances in September 1992 and January 1995, respectively (Navy 2004). The AICUZ provisions of both county ordinances were never updated to reflect the 2004 AICUZ Study Update. These county ordinances are equivalent and work collectively to promote compatible development around NAS Meridian (Navy 2004).

Both Lauderdale and Kemper Counties have a five-member Board of Supervisors that adopts regulations (e.g., AICUZ ordinances) affecting unincorporated areas of their respective county.

Lauderdale and Kemper Counties are each divided into five separate districts, with each district electing a duly appointed supervisor to oversee the district, as well as the county as a whole. The majority of NAS Meridian is located in District 2 of Lauderdale County (with small portions within Districts 1 and 2 of Lauderdale and Kemper Counties, respectively) and NOLF Joe Williams is located in District 4 of Kemper County. Each county's five-member Board of Supervisors is the governing body that meets to make policy decisions pertaining to their respective county. The Boards are responsible for adopting an annual budget, establishing the annual property tax rate, setting policies, goals and objectives to direct the county's growth and development, and carrying out other responsibilities as set forth by State of Mississippi statutes. In addition, the Boards of County Supervisors typically conduct public hearings on budget/taxes, solid waste plans, road system maps, and zoning (Mississippi Association of Supervisors et al. 2003). The Boards also adopt local regulations affecting the unincorporated areas of the county to protect the public (e.g., AICUZ ordinances).

Lauderdale County's Board appointed an Airport Zoning Commission in 1992 to study and make recommendations regarding the adopted AICUZ ordinances. The Commission rarely meets for airport zoning issues, but does act as a Planning Board for subdivision developments. Lauderdale County has subdivision regulations that provide limited development authority to ensure that proper lot layout, design, and improvements are included in new residential developments. However, the subdivision regulations do not address the problem of existing incompatible land uses, nor do they contain specific language on restricting development within the AICUZ footprint.

Neither Lauderdale nor Kemper County has an official county-wide planning department. Most planning actions related to comprehensive planning, land use regulations, and zoning are under the jurisdiction of the individual cities and municipalities in each county.

6.2.2 City of Meridian

The Meridian Planning Commission is the local planning authority for the City of Meridian and was responsible for developing the City of Meridian Comprehensive Plan.

The City of Meridian Comprehensive Plan and city ordinances do not contain any specific language on the AICUZ Program or coordination with NAS Meridian regarding land use decisions.

The local planning authority for the City of Meridian is the Meridian Planning Commission, which provides comprehensive planning services to guide city decision makers. The Commission developed the City of Meridian Comprehensive Plan, outlining policies to guide the physical and economic development of the city and its surrounding planning area (City of Meridian 2009). The City of Meridian adopted a comprehensive zoning ordinance in 1994. The general purpose and intent of the zoning ordinance is the attainment of the goals and objectives of the people of the Meridian as expressed in the City of Meridian Comprehensive Plan (City of Meridian 2009). The City Council adopted the Comprehensive Plan in November 2003, with the latest revision to the document occurring in September 2009. The Comprehensive Plan was developed to "bring about coordinated physical development in accordance with present and future needs. . . ." in compliance with Sections 17-1-1 through 17-1-39 of the Mississippi Code. The Comprehensive Plan delineated additional planning areas that are outside of existing municipal boundaries, but are within the City of Meridian's logical growth path. The City of Meridian annexed 9.3 square miles of land in 2008, much of it between the City of Meridian and NAS Meridian (NAS Meridian 2011b). The Comprehensive Plan is implemented by zoning ordinances, subdivision regulations, building codes, and a capital improvements program (City of Meridian 2009).

Aside from the City of Meridian Comprehensive Plan, the region's local governments conduct limited land use planning. The City of Meridian Comprehensive Plan and city ordinances do not contain any specific language on the AICUZ Program or coordination with NAS Meridian on land use decisions.

6.2.3 East Central Planning and Development District

The ECPDD assists towns and counties (including Kemper and Lauderdale Counties and the City of Meridian) with economic and community development efforts and can influence development decisions for areas within the AICUZ footprint.

The ECPDD, located in Newton, Mississippi, is one of ten planning and development districts in the state and was officially designated in 1968 by the Economic Development Administration as a result of the Public Works and Economic Development Act of 1965 (Mississippi Association of Planning and Development Departments [MAPDD] 2007). ECPDD serves nine counties and thirty-one municipalities, including both Lauderdale and Kemper Counties and the City Meridian. The ECPDD assists the towns and counties with economic and community development efforts, with an emphasis on planning, developing, and coordinating local and regional projects and programs and with an interpretation of federal and state regulations and guidelines (MAPDD 2007).

ECPDD completed a Comprehensive Economic Development Strategy (CEDS) plan in 2007 for counties in the district. The plan provides a thorough analysis of the region and delineates the economic goals and objectives of the region, as well as strategic action steps toward accomplishing them. As a regional planning and development organization, the ECPDD can influence development within the AICUZ footprint by aiding the local governments to adopt the study recommendations in the development of policies, plans, and regulations for the physical and economic growth of the region.

6.2.4 Mississippi Military Communities Council

The MMCC monitors developments concerning military installations throughout Mississippi, and advises decision makers regarding BRAC activities.

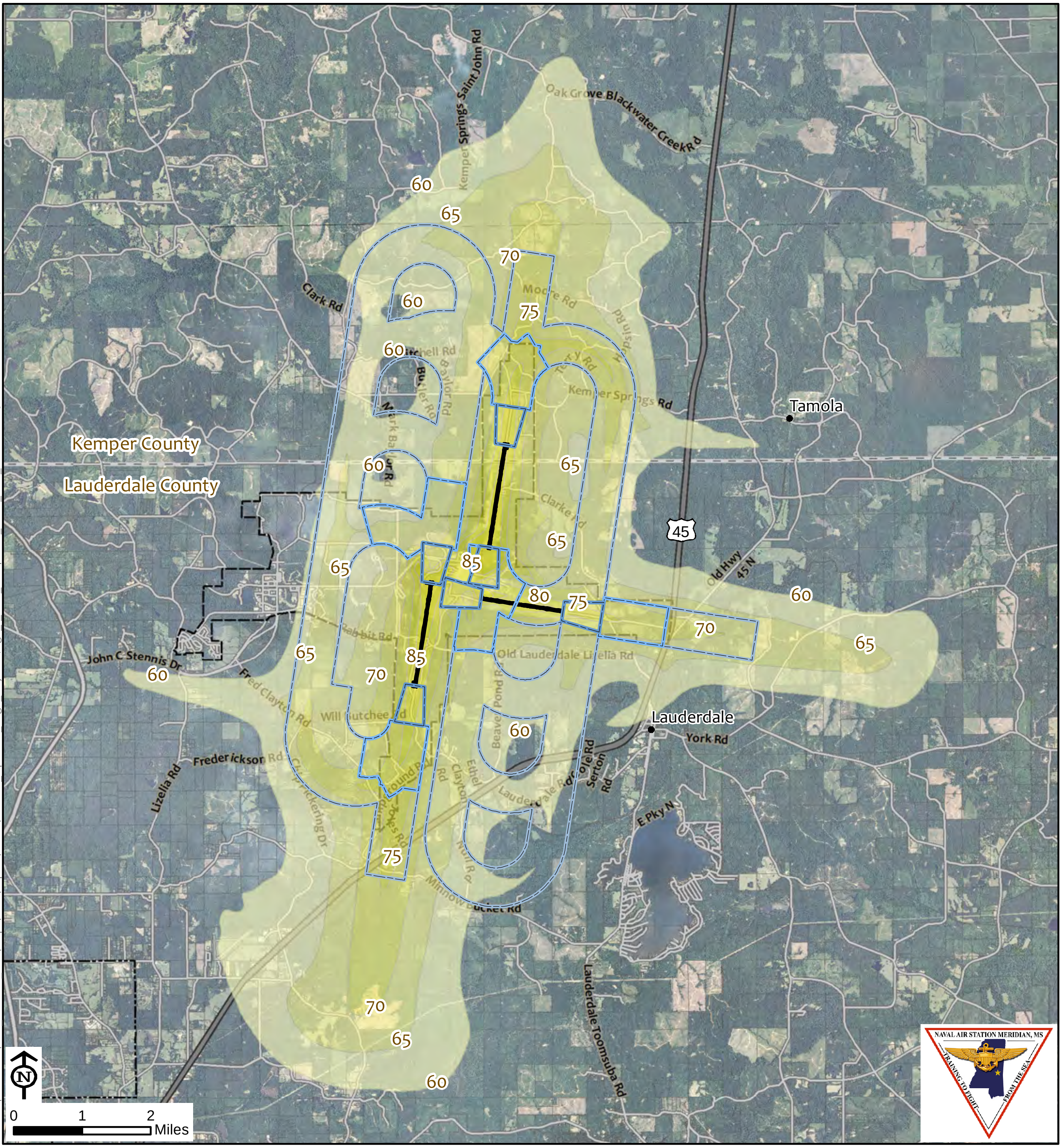
In January 2004, the Governor established the Mississippi Military Communities Council (MMCC) through an executive order to advise state leaders on Base Realignment and Closure (BRAC) activities and "regarding opportunities to enhance, expand, add or otherwise improve missions, programs, facilities, operations on or affecting the military installations in the State" (MMCC 2011). The MMCC is charged with monitoring developments concerning Mississippi's military installations and to advise executive and legislative officials of the State of Mississippi regarding the ongoing efforts by the DOD to close, realign, restructure, streamline, or other actions that would impact, military installations located within the state. The MMCC also identifies opportunities to enhance, expand, add, or otherwise improve missions, programs, facilities, and operations on or affecting the military installations. The MMCC promotes coordinating efforts by state government agencies and local governments to ensure the longevity of Mississippi's military bases. Each military installation in the state may be represented on the MMCC by their respective community teams. Currently, the MMCC is comprised of 23 committee members and 13 legislative members.

6.3 Land Use Compatibility Analysis

The composite AICUZ map, which is comprised of the 2012 AICUZ noise contours and APZs, is also commonly known as the "AICUZ footprint." The AICUZ footprints for NAS Meridian and NOLF Joe Williams are used as the basis for the land use compatibility analysis and are provided on Figures 6-1 and 6-2, respectively.

As noted above, NAS Meridian and NOLF Joe Williams are located in unincorporated areas of Lauderdale and Kemper Counties. Therefore, the land use ordinances covering the off-installation property within the AICUZ footprint are within the jurisdiction of the two counties. Currently, neither county has an official county-wide planning authority, and all land use and zoning issues are managed by the Board of Supervisors.

NAS Meridian



Path: M:\Pensacola\NAS Meridian BUF\Maps\MXD\Report\AICUZ\Revised Updated Logo July2012\Fig6 1 2012 Composite aerial NAS Meridian120511.mxd Date: 4/22/2013

NAS Runways: 19L, 01R, 19R, 01L, 10, 28

Runway
Installation Boundary
County Boundary
Parcel Boundary
US Highway
State Highway
Secondary/Local Road
Meridian Corporate Boundary

2012 APZs
Clear Zone
APZ I
APZ II

2012 Noise Contours
60 DNL
65 DNL
70 DNL
75 DNL
80 DNL
85 DNL

Figure 6-1
2012 Composite AICUZ Map
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

NOLF Joe Williams

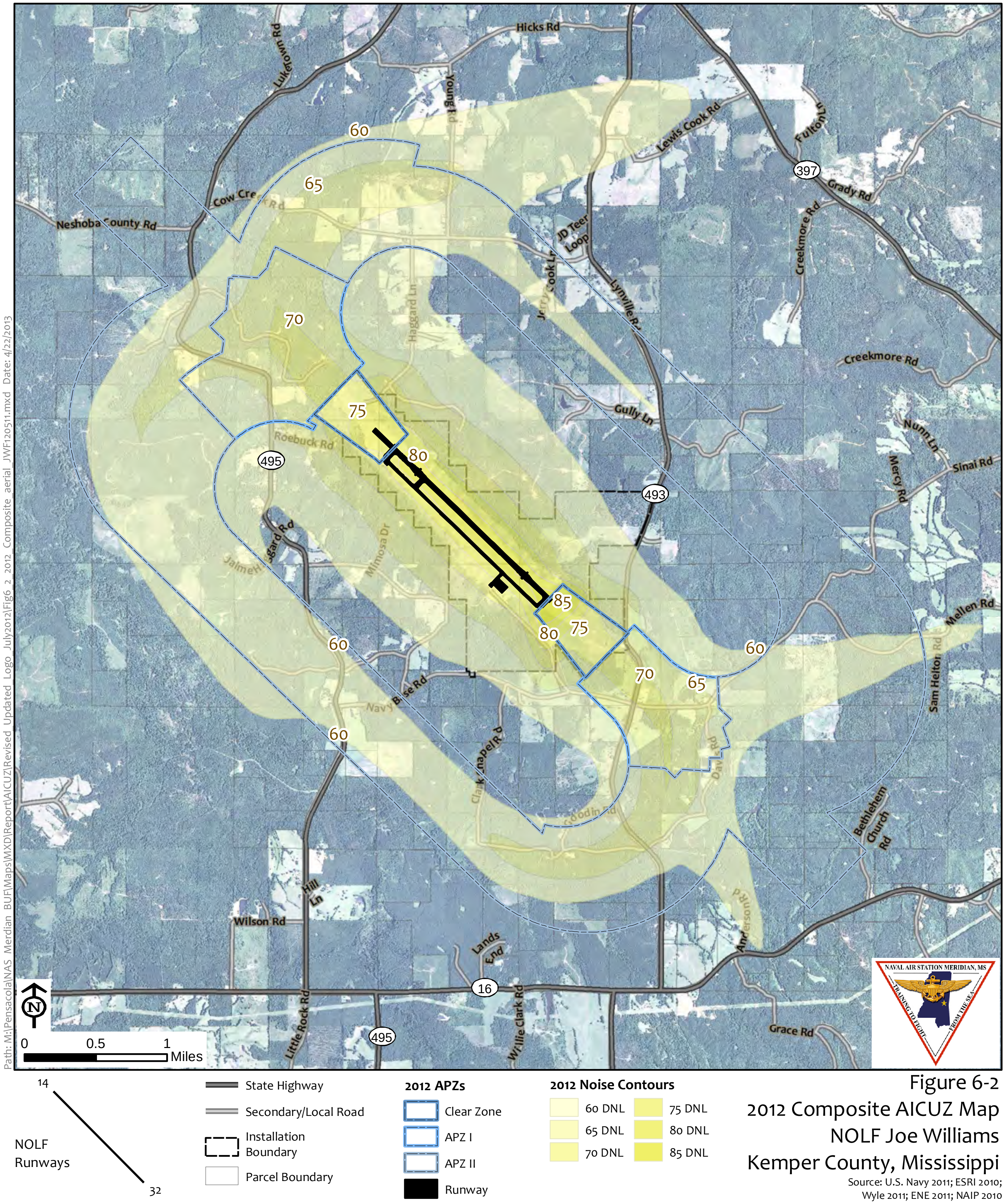


Figure 6-2
2012 Composite AICUZ Map
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

This section addresses land use compatibility within the AICUZ footprints by examining existing and planned land uses near NAS Meridian and NOLF Joe Williams. The land use criteria used in this AICUZ Study to evaluate compatibility was previously presented in Table 6-1, along with a description of the local planning authority in the area, provided in Section 6.2. The analysis was based on the Navy's land use compatibility recommendations which are presented in Appendix B. Land use patterns and zoning in the immediate vicinity of NAS Meridian and NOLF Joe Williams, along with the land use compatibility assessment, are discussed below.

6.3.1 Existing Land Use

The term "land use" refers to the management of land and the extent to which land has been modified.

Land use is a term given to describe the management of land and the extent to which it has been modified. Typical uses include developed land, agricultural areas, residential, commercial, open water, and forested areas. Patterns of land use arise naturally in communities and are fundamental to the physical form of the county and municipalities, and are usually a key component of the comprehensive plans which are the primary policy documents that guide local land use and development. The limited land use data surrounding airfields in Lauderdale and Kemper Counties has not been converted into a Geographic Information System (GIS) format; therefore, the classification and analysis of the surrounding land for this report was conducted by using United States Geological Survey (USGS) Land Cover data. USGS Land Cover data present only broad land use data in terms of what is developed and what is the predominate agronomic land cover; thus, it was also necessary to utilize aerial photos, county online mapping systems, individual parcel data, other reports, and discussions with local officials to fully interpret existing land use.

Existing Land Use Surrounding NAS Meridian

Land use surrounding NAS Meridian features low-density development and includes:

- Residential
- Light Commercial
- Water/Wetlands
- Agricultural
- Forest Land

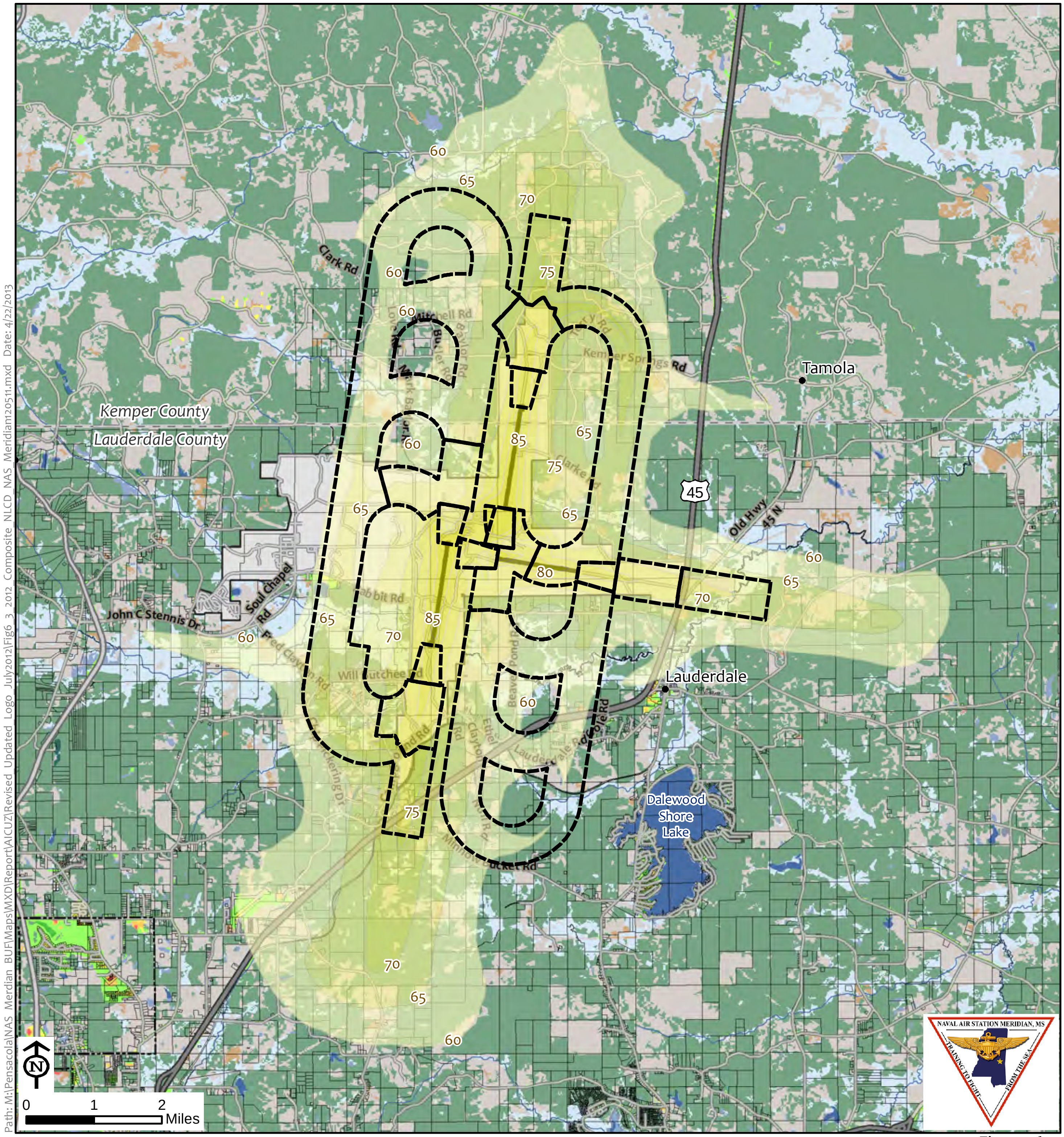
The land use surrounding NAS Meridian features low to medium-intensity development with a mix of residential, light commercial, water/wetlands, agricultural, and forest lands. Figure 6-3 illustrates the existing land cover/use surrounding NAS Meridian. In addition, Figure 6-4 illustrates existing structures and points of interest, such as residential, commercial, and recreational structures, surrounding the airfield which provides additional insight into the land use type and development intensity.

The vast majority of land use surrounding the air field is identified as forest/agricultural. However, scattered around the airfield and within that forest/agricultural designation are low-intensity developed uses which can be characterized as mainly residential uses. Lands indicated as developed, open spaces by the USGS are associated with the regional and local roadway infrastructure. Lands indicated as developed, low- and medium-intensity by the USGS are associated with residential and light commercial land uses.

The residential uses surrounding NAS Meridian are typically single-family dwellings (including manufactured homes) on large parcels (greater than 1.0 acre). However, there are limited areas surrounding NAS Meridian where the residential density increases to more than one dwelling per acre. The majority of the development around NAS Meridian has occurred to the south along local and regional roadway corridors in the unincorporated areas of the county.

There are single-family residence and manufactured homes (medium density) west of the South Runway along Rabbit Road and near McElroy's Lake. In addition, there are low-density residential land uses (greater than 1.0-acre parcels) along Fred Clayton Road and Lockhart Trailer Court Road to the southwest including manufactured homes. Directly south of the airfield, there are residential units that are located along Campground Road and Fred Clayton Road. Scattered residential uses exist along Campground Road east of the South Runway near the US-45 intersection, along Null Road south of US-45, and down Old Lauderdale-Lizelia Road and Beaver Pond Road.

NAS Meridian



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NAS Runways: 19L, 01R, 19R, 01L, 10, 28

- US Highway
- State Highway
- Secondary/Local Road
- Runway
- County Boundary
- Installation Boundary
- Parcel Boundary
- APZ Boundary

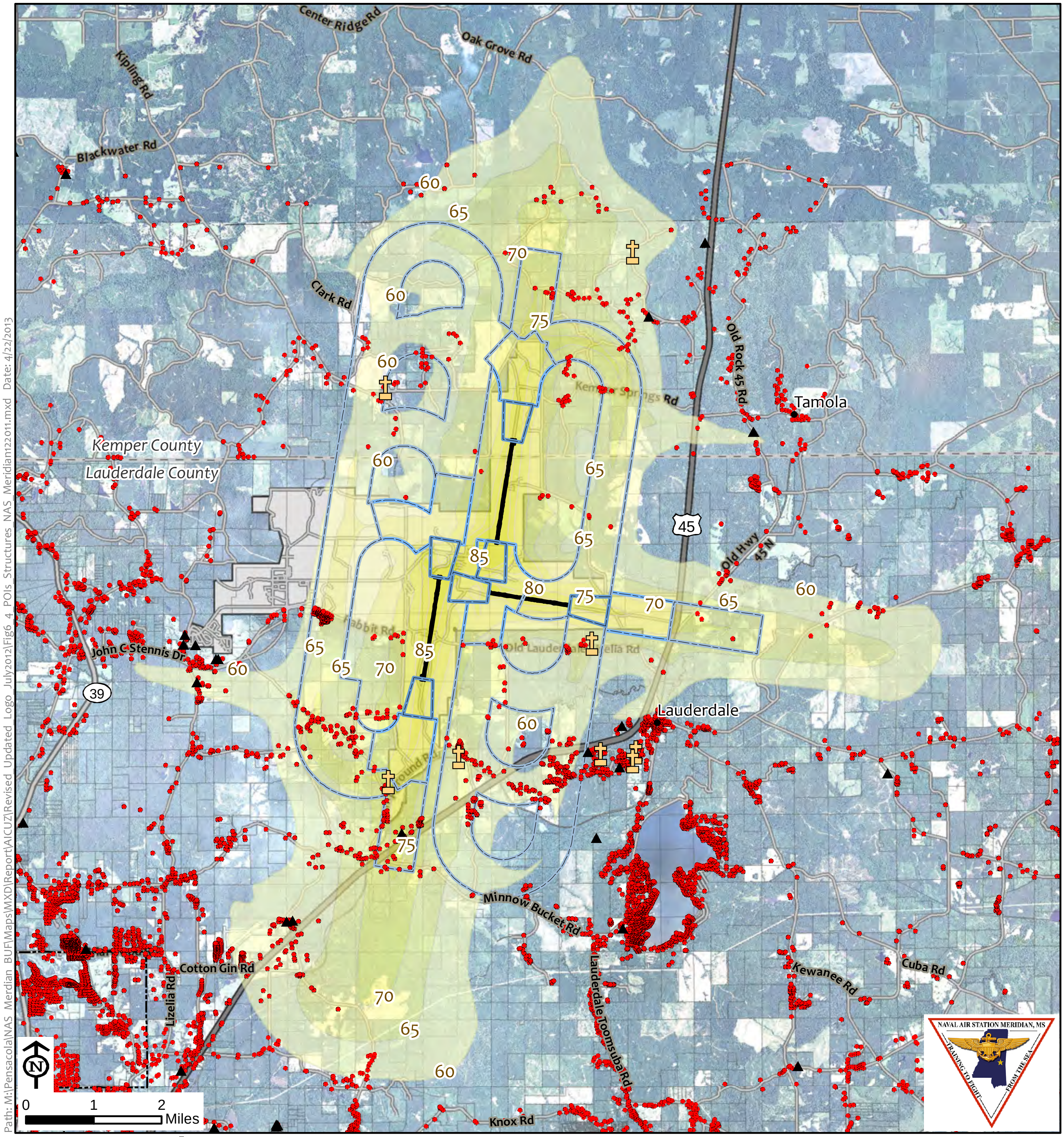
2012 Noise Contours
- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL
- 80 DNL
- 85 DNL

Landcover
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Forest
- Grassland/Shrub
- Cultivated Crops
- Wetlands
- Meridian Corporate Boundary

Figure 6-3
2012 Composite AICUZ Map
with Existing Landcover
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; USGS 2011; ENE 2011

NAS Meridian



NAS Runways
19L
01R
19R
10
28
01L

Church
Installation Boundary
County Boundary
Parcel Boundary
Meridian Corporate Boundary
US Highway
State Highway
Secondary/ Local Road
Runway
Cell Tower
Building

2012 APZs
Clear Zone
APZ I
APZ II

2012 Noise Contours
60 DNL
65 DNL
70 DNL
75 DNL
80 DNL
85 DNL

Figure 6-4
2012 Composite Map with Structures and Points of Interest
NAS Meridian
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

There are numerous churches and worship facilities surrounding NAS Meridian which are indicated on Figure 6-4. Churches and other types of gathering places are important in the analysis because they are public assembly locations and are people-intensive land uses. There are medium-density residential uses surrounding NAS Meridian in the form of manufactured housing developments and other manufactured homes located on East Cook Road between US-45 and York Road. These residential developments are located on parcels less than 1.0 acre in size.

Developed land east of the airfield is mainly located along Old Highway 45 N with scattered residential uses along York Road. These residential units are typically located on parcels larger than 1.0 acre and can be considered low-density. There are scattered, light commercial land uses centered around the small unincorporated community of Lauderdale, just southeast of the airfield, which include a gas station, post office, small grocery store, and a Dollar General store.

North of NAS Meridian, into Kemper County, the lands are less developed and more rural, with large tracts of land for forestry/agricultural uses; however, there are low-density residential developments scattered throughout. The majority of the residential and other developed areas are located along Kemper Springs Road, Hogeye Road, and Hook Hopson Road.

Land use surrounding NAS Meridian is mainly low-density development; however, increased accessibility on local roadways may intensify development south of the airfield, including residential development.

Some current land uses surrounding NAS Meridian are considered incompatible with certain APZs and noise contours.

Overall, the land use around NAS Meridian reveals a pattern of low-density development, as there is still a large amount of undeveloped property. However, there are areas that may experience an increase in development and densities in the future due to their increased accessibility via regional roadways (US-45) and their proximity to other services. It is reasonable to assume that as commercial development increases along the US-45 segment and other roadway connectors south of the airfield towards the city of Meridian, this could act as an attractant for additional residential development, as well. From a land use compatibility standpoint, some of the residential and other land uses surrounding NAS Meridian are currently incompatible with certain APZs and noise contours. An evaluation of specific land use compatibility is discussed later in this section.

Existing Land Use Surrounding NOLF Joe Williams

Land use surrounding NOLF Joe Williams is rural, low-density development and includes:

- Residential
- Water/Wetlands
- Agricultural
- Grassland
- Forest Land

Land use surrounding NOLF Joe Williams features rural, low-density development with a mix of residential, water/wetlands, agricultural, grassland, and forest lands. Figure 6-5 illustrates existing land cover/use surrounding NOLF Joe Williams. In addition, Figure 6-6 illustrates existing structures and points of interest surrounding the airfield, and provides additional insight into the land use type and development intensity.

The vast majority of land use surrounding the NOLF Joe Williams is undeveloped forested and/or agricultural lands. However, scattered around airfield are low-density residential uses on large parcels (greater than 1.0 acre) which include manufactured homes. Many of the residential land uses are associated with farm residences supporting livestock (e.g., cattle).

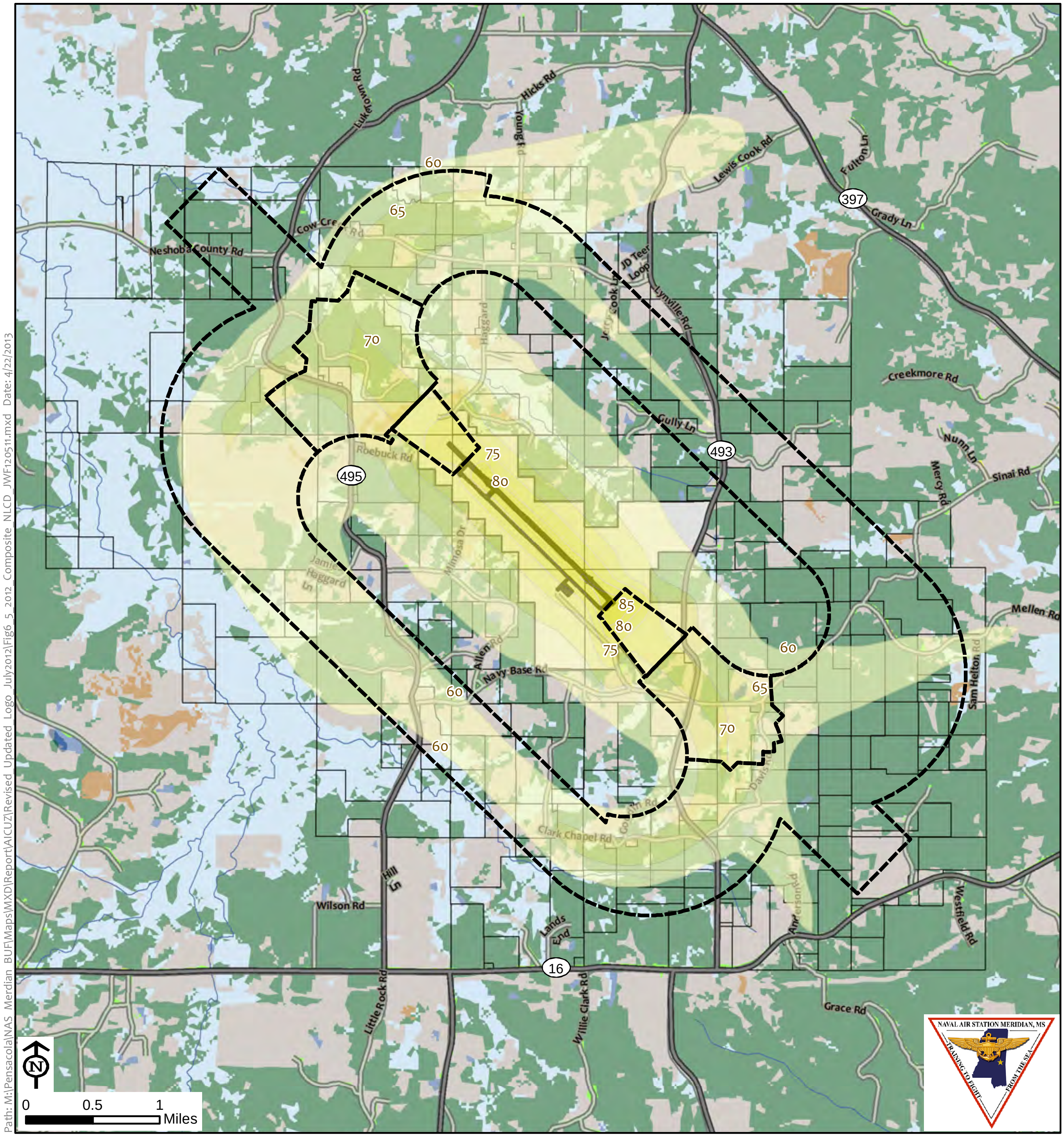
The majority of residential development around NOLF Joe Williams has occurred along the two state highways that traverse north-south on either side of the airfield. Highway 495 is located to the west, and Lynville Road (Highway 493) is located to the east. Other local roadways in which residential land uses are located include Air Base Road just south of the airfield, and Cow Creek Road just to the north.

Land use surrounding NOLF Joe Williams is mainly low-density development, with an abundance of open land.

Some current land uses surrounding NOLF Joe Williams are considered incompatible with certain APZs and noise contours.

There are no commercial or industrial land uses surrounding NOLF Joe Williams. Overall, the land use around NOLF Joe Williams reveals a pattern of low-density development, as there is still a great deal of undeveloped open land. However, from a land use compatibility standpoint some of the residential uses surrounding NOLF Joe Williams are incompatible in certain APZs and noise contours. An evaluation of specific land use compatibility is discussed later in this section.

NOLF Joe Williams



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NOLF Runways: 14 / 32

State Highway
Secondary/Local Road
Runway
Installation Boundary
Parcel Boundary
APZ Boundary

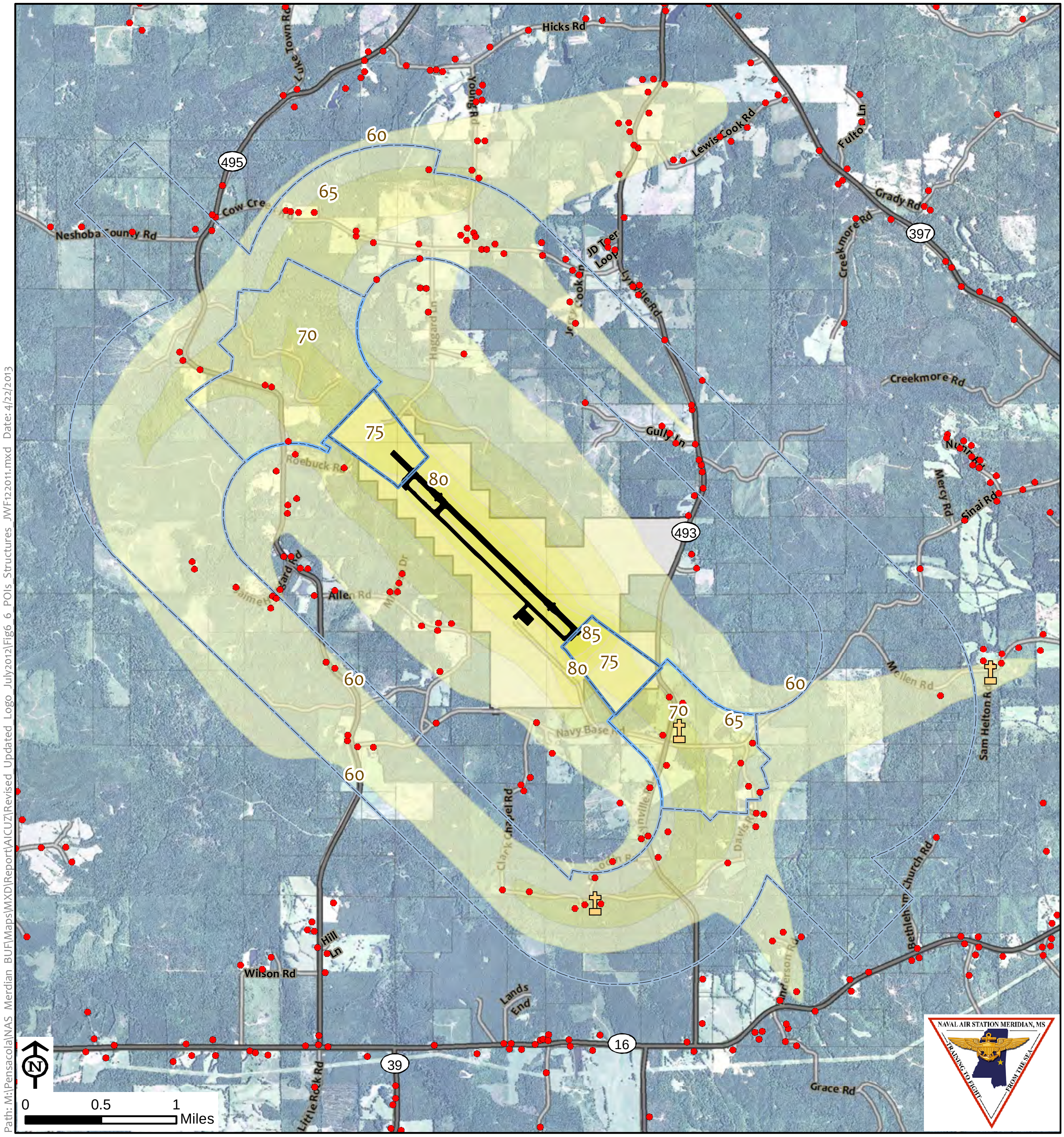
2012 Noise Contours
60 DNL
65 DNL
70 DNL
75 DNL
80 DNL
85 DNL

Landcover
Open Water
Developed, Open Space
Developed, Low Intensity
Forest
Grassland/Shrub
Cultivated Crops
Wetlands

Figure 6-5
2012 Composite AICUZ Map
with Existing Landcover
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; USGS 2011; ENE 2011

NOLF Joe Williams



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14

NOLF Runways

32

State Highway

Secondary/ Local Road

Installation Boundary

Parcel Boundary

2012 APZs

Clear Zone

APZ I

APZ II

Runway

Church

Building

Cell Tower

2012 Noise Contours

60 DNL

65 DNL

70 DNL

75 DNL

80 DNL

85 DNL

Figure 6-6
2012 Composite Map with
Structures and Points of Interest
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

6.3.2 Existing Zoning Surrounding the Airfields

Zoning is the system used by local governments to control the physical development of land and the type of uses to which each individual property may be utilized.

Zoning is a term used in urban planning for a system of land use regulations. Zoning is the system used by local governments to control the physical development of land and the type of uses to which each individual property may be utilized. Zoning codes provide the regulatory framework to direct development, influence how the various uses interact with each other, and prevent incompatibility. Zoning addresses not only the use of property, but the scale and intensity of the use. Due to the rural nature of the areas as well as being located in unincorporated portions of Lauderdale and Kemper counties, there are very few zoning regulations in place for areas surrounding NAS Meridian and NOLF Joe Williams.

Because NAS Meridian and NOLF Joe Williams are both located in unincorporated portions of their respective counties, there are very few zoning regulations in place for lands surrounding the installations. In addition, the counties' have limited resources for the enforcement of ordinances that could prevent incompatible development.

The limited zoning that is in effect around the airfields was adopted by the counties' Boards of Supervisors and Airport Zoning Commissions and was based on the 1987 AICUZ footprint. The AICUZ Ordinance addressed AICUZ guidelines and compatibility at NAS Meridian and NOLF Joe Williams and is supposed to mirror the AICUZ footprint. However, the counties have limited resources to enforce the AICUZ Ordinance and prevent incompatible development. Thus, the development of lands surrounding the airfields does not appear to be guided by any binding land use zoning regulations.

6.3.3 Future Land Use Surrounding the Airfields

Future development of land is traditionally outlined in local land use plans and regulations that are developed and adopted by local authorities. Many of these plans include future land use maps that clearly identify what land use type and intensity will be allowed in specific areas. However, due to limited resources, neither Lauderdale County nor Kemper County has developed a future land use map for the county, which includes the areas surrounding the airfields. The City of Meridian's Comprehensive Plan outlines future land use within its jurisdictional boundaries, but this does not include any lands in the vicinity of NAS Meridian.

Based on area development trends surrounding the installations, the area with the greatest potential for growth will be land south of NAS Meridian along the US-45 corridor.

As previously stated, patterns of land use arise naturally in communities through the customs and practices of the people who live and work in the area. Thus, development around NAS Meridian and NOLF Joe Williams NOLF is expected to follow current development trends of low- to medium-density residential and light commercial development. Based on this trend, the area with the greatest potential for development that may result in an increase in density is south of NAS Meridian towards the city of Meridian and along the US-45 corridor.

6.4 COMPATIBILITY CONCERNS

In determining land use compatibility within the AICUZ footprint at NAS Meridian and NOLF Joe Williams, the Navy examined existing and future land use patterns near the airfields. To analyze whether existing land use is compatible with aircraft operations at NAS Meridian and NOLF Joe Williams, the 2012 AICUZ noise contours, the 2012 AICUZ APZs, and Clear Zones were overlaid on Lauderdale County and Kemper County parcel data, USGS land cover/use classification information, and aerial photos. The evaluation was done at the land parcel level using the Navy's land use compatibility guidance. Table 6-1 (presented previously in this chapter) provides a generalized breakdown of land use compatibility, and Appendix B provides the Navy's land use compatibility classifications and the associated land use compatibility designations for noise zones and APZs from OPNAVINST 11011.36C.

6.4.1 NAS Meridian

The 2012 AICUZ noise contours for NAS Meridian that extend off the installation include 65-75 DNL noise zones, which pose a compatibility concern with certain types of land uses. In addition, there are incompatible land uses and existing compatibility concerns within APZs at NAS Meridian. As illustrated in previous figures, APZs impact areas off the installation in all directions. While the majority of the areas impacted are forest and grassland (i.e., agricultural), there are limited amounts of low- to medium-density residential areas located within certain APZs and noise zones. For analysis purposes, the area surrounding NAS Meridian has been divided into three main areas: north, east, and south. Each of these areas is discussed in detail below and illustrated on corresponding figures.

North Area

Land Use Compatibility Concerns: North Area

Area 1: Residential developments within the 65-75 and 75-80 DNL noise zone, and residential developments within APZ II. Residential development within the 65-75 DNL noise zone.

Area 2: Churches within APZ II.

Land use compatibility concerns north of NAS Meridian identified on Figure 6-7a are further discussed below.

Area 1: There are low-density residential developments located along Hogeye and Howard Johnson roads that fall within the 65-75 DNL noise zone (Noise Zone 2). Some of these roads are paved, which may encourage growth in this area. There are low-density residential developments, including mostly manufactured homes, located along Kemper Springs and Terrell roads, that fall within the 65-75 DNL noise zone (Noise Zone 2). In addition, there are one to two residences within the 75-80 DNL noise zone (Noise Zone 3). The structures within this area include both traditional “stick-built” homes and manufactured homes, with the majority being manufactured homes. Some of the residential developments are located within APZ II, and potentially pose a compatibility issue since they are situated on parcels close to 1.0 acre; the current trend has indicated that multiple manufactured homes are being clustered on the same parcel of land. Residential use within Noise Zones 2 and 3 is considered an incompatible land use and should be discouraged through community outreach and education and implementation of the Airfield Zoning Ordinance by the County.

Area 2: The Kemper Springs Baptist Church is located on the western segment of Kemper Springs Road and is situated within APZ II. Other historic churches with small congregations are also in the area. Because churches are gathering places with people-intensive land uses, they are incompatible with and strongly discouraged in all APZs, per the AICUZ instruction. In consideration of church services, when possible, the Community Planning and Liaison Officer (CPLO) contacts the churches to notify them of surge operations. When days are long in the summer, flight hours may change to after 12:00 p.m. to ensure enough hours of night practice, which also minimizes flying during church services.

NAS Meridian

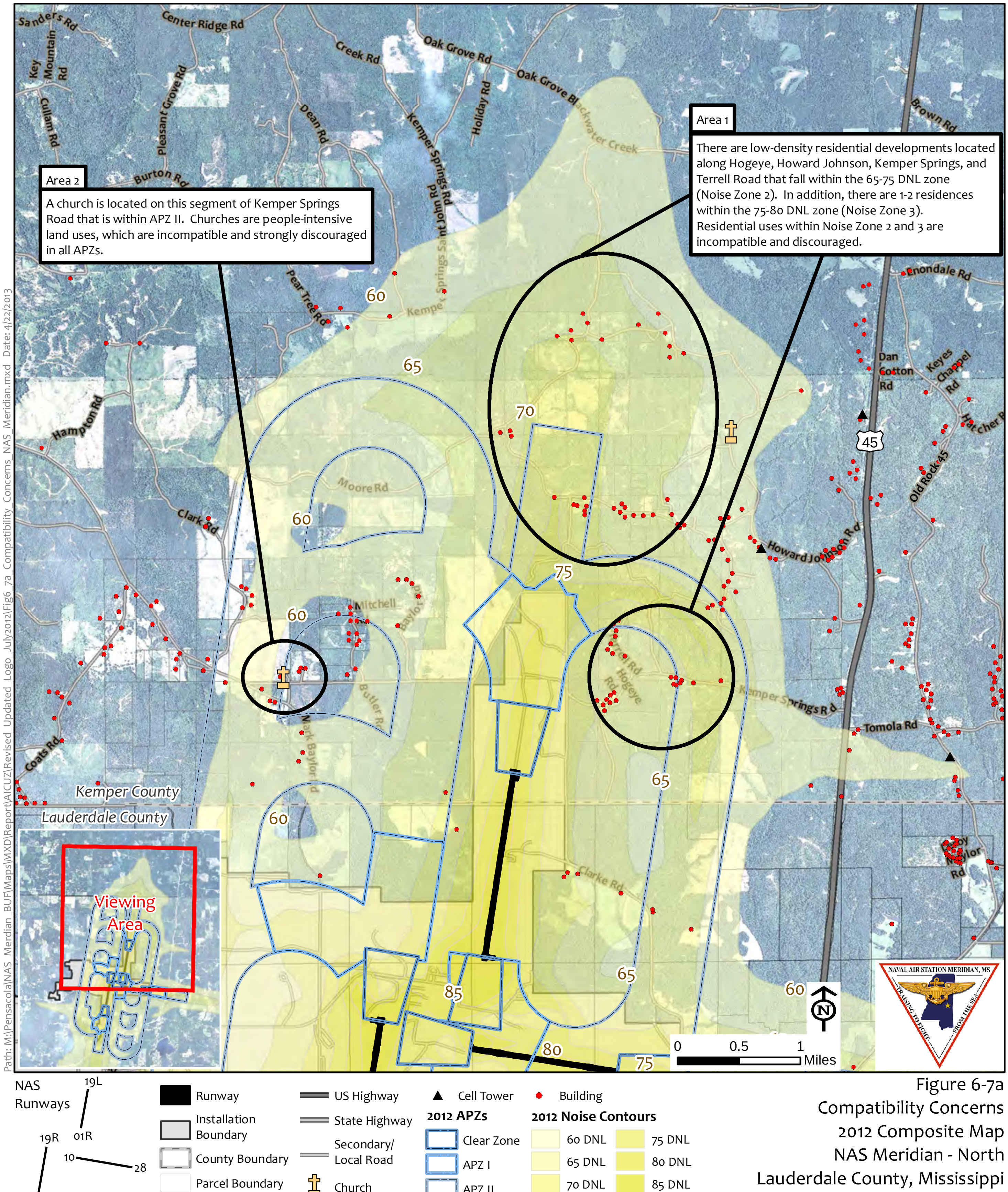

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Figure 6-7a
Compatibility Concerns
2012 Composite Map
NAS Meridian - North
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

East Area

Land Use Compatibility Concerns: East Area

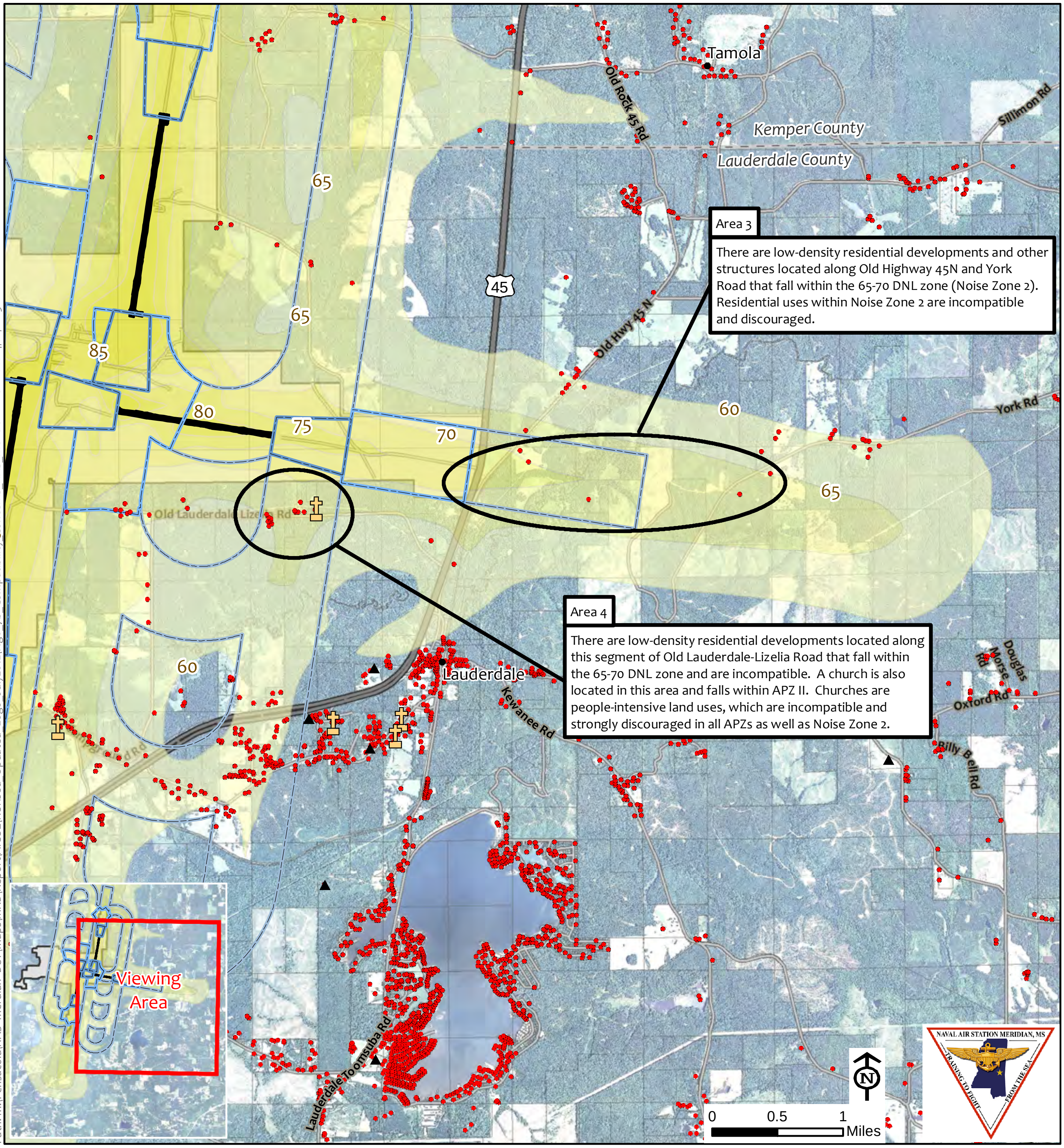
Area 3: Residential developments within the 65-70 DNL noise zone.

Area 4: Residential developments within the 65-75 DNL noise zone and APZ II. A church within APZ II.

Land use compatibility concerns east of NAS Meridian identified on Figure 6-7b are further discussed below.

Area 3: There are low-density residential developments and other structures located along Old Highway 45 N and York Road, just to the north of the small community of Lauderdale, that fall within the 65-70 DNL noise zone (Noise Zone 2). The structures are situated on parcels larger than 1.0 acre in size. Residential use within this area is incompatible with the Navy's land use compatibility recommendations for Noise Zone 2 and should be discouraged through community outreach and education, and implementation of the AICUZ Ordinance by the County.

Area 4: There are low-density residential developments located along Old Lauderdale Lizelia Road, just south of the east Clear Zone, which fall within the 65-70 DNL noise zone and are considered incompatible. Oak Grove Christian Methodist Episcopal Church is also located in this area and falls within APZ II. The residential parcels are predominantly manufactured homes and could pose a compatibility issue since they are situated on parcels close to 1.0 acre. As previously stated, the current trend has indicated that multiple manufactured homes are being clustered on the same parcel of land and, thus, may exceed the recommended density of one to two dwellings per acre outlined in the AICUZ instructions for APZ II. Churches are people-intensive land uses, making them incompatible in all APZs as well as Noise Zone 2.



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85

75

NAS Runways: 19L, 01R, 19R, 10, 28, 01L

Runway
Installation Boundary
County Boundary
Parcel Boundary

US Highway
State Highway
Secondary/ Local Road
Church

Cell Tower

2012 APZs
Clear Zone
APZ I
APZ II

Building

2012 Noise Contours
60 DNL
65 DNL
70 DNL
75 DNL
80 DNL
85 DNL

Figure 6-7b
Compatibility Concerns
2012 Composite Map
NAS Meridian - East
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

South Area

Land Use Compatibility Concerns: South Area

Area 5: Residential developments within the 65-70 DNL noise zone and APZ I.

Area 6: Residential developments within APZ II.

Area 7: Residential developments within the 65-70 DNL noise zone. A church within APZ II.

Area 8: Residential developments within the 65-75 and 75-80 DNL noise zone.

Area 9: Residential developments within the 65-75 DNL noise zone.

Area 10: Residential developments within the 65-70 and 70-75 DNL noise zones and APZ II.

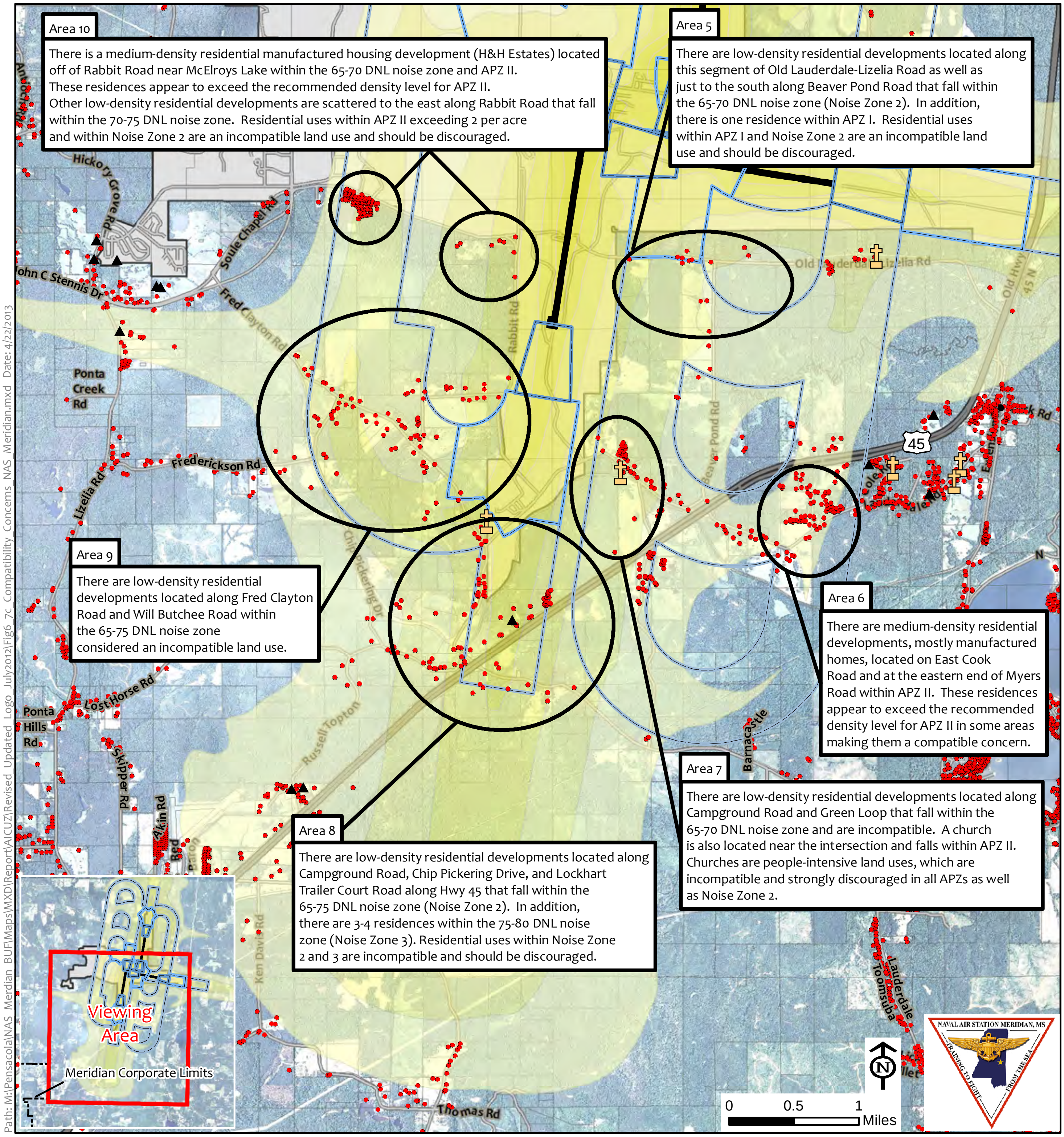
Land use compatibility concerns south of NAS Meridian corresponding to the areas identified on Figure 6-7c are further discussed below.

Area 5: There are low-density residential developments located along the western portion of Old Lauderdale-Lizelia Road as well as just to the south along Beaver Pond Road that fall within the 65-70 DNL noise zone (Noise Zone 2). In addition, there is one residence within the APZ I associated with runway 01R that is currently abandoned. Per the Navy's AICUZ instruction, residential uses within APZ I and Noise Zone 2 are an incompatible land use and should be discouraged through community outreach and education and implementation of the Airfield Zoning Ordinance by the County.

Area 6: There are medium-density residential developments located in a subdivision on East Cook Road just south of US-45 off of Myers Road within APZ II. This 16-lot subdivision has seven manufactured homes and five traditional homes. In addition, there are other homes located at the eastern end of Myers Road within the same APZ II. These residences are mostly manufactured homes and appear to exceed the recommended density level of one to two dwellings per acre for APZ II in some areas.

Area7: There are low-density residential developments located along Campground Road and Green Loop that fall within the 65-70 DNL noise zone. The majority of the residences on Green Loop are manufactured homes. The Pine Grove Church is located across from the Green Loop properties on Campground Road and falls within APZ II. Churches are people-intensive land uses, making them incompatible and strongly discouraged in all APZs as well as Noise Zone 2.

NAS Meridian



NAS Runways: 19L, 01R, 19R, 01L, 10, 28

Runway · Installation Boundary · County Boundary · Parcel Boundary · US Highway · State Highway · Secondary/Local Road · Church · Cell Tower · Building

2012 APZs: Clear Zone · APZ I · APZ II

2012 Noise Contours: 60 DNL · 65 DNL · 70 DNL · 75 DNL · 80 DNL · 85 DNL

Figure 6-7c
Compatibility Concerns
2012 Composite Map
NAS Meridian - South
Lauderdale County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

Area 8: There are low-density residential developments scattered along the southern portion of Campground Road, along Chip Pickering Drive and Lockhart Trailer Court Road, and along the northern side of US-45 that fall within the 65-75 DNL noise zone (Noise Zone 2). In addition, there are three to four residences in this area that fall within the 75 and greater DNL noise contour (Noise Zone 3). Residential uses within Noise Zones 2 and 3 are incompatible per the Navy's land use recommendations.

Area 9: There are low-density residential developments located along Fred Clayton Road and Will Butchee Road within the 65-75 DNL noise zone (Noise Zone 2) and are considered an incompatible land use. The residential parcels include both traditional built homes and manufactured homes situated on parcels larger than 1.0 acre in size and, thus, do not exceed the recommended density of one to two dwellings per acre outlined in the AICUZ instructions for APZ II.

Area 10: There is a medium-density residential manufactured housing development (H&H Estates) located off of Rabbit Road near McElroy's Lake, just south of the installation boundary line, within the 65-70 DNL noise zone as well as APZ II. There are approximately 60 manufactured homes within this manufactured home development at three to four units per acre. Thus, the development exceeds the recommended density level of one to two dwellings per acre for APZ II outlined in the Navy's AICUZ guidance. In addition, there are other single-family residences scattered along Rabbit Road to the east that fall within the 70-75 DNL noise zone. Residential uses within APZ II exceeding two residences per acre and within Noise Zone 2 are an incompatible land use.

6.4.2 NOLF Joe Williams

Land Use Compatibility Concerns

Area 1: Residential dwellings within the 65-70 DNL noise zone and APZ II. BASH issues from chicken livestock that attract vultures.

Area 2: Residential dwellings within the 65-70 DNL noise zone and APZ I. BASH issues from chicken livestock that attract vultures.

Area 3: Residential dwellings and a church within the 65-70 DNL noise zone and APZ I.

Area 4: Residential dwellings within the 65-70 DNL noise zone. A church within APZ II.

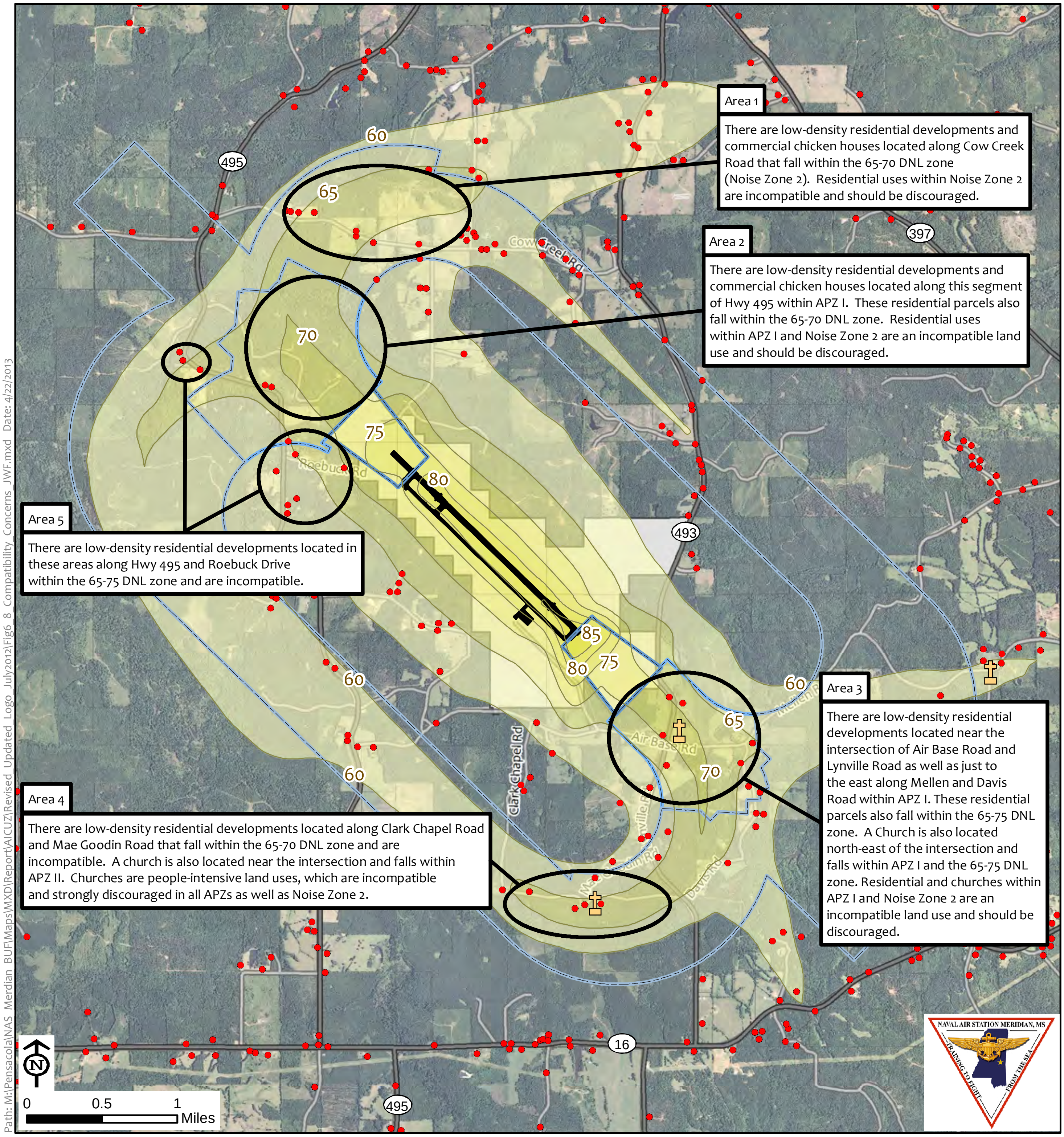
Area 5: Residential dwellings within the 65-70 DNL noise zone.

2012 AICUZ noise contours for NOLF Joe Williams that extend off the installation include 65-70 DNL noise zone, which pose a compatibility concern with certain types of land uses. In addition, there are incompatible land uses and existing compatibility concerns within APZs at NOLF Joe Williams. As illustrated in previous figures, APZs impact areas off the installation in all directions. Areas impacted are mainly forest and grassland (e.g., pasture and agricultural), but limited amounts of low-density residential areas are located within certain APZs and noise zones. Land use compatibility concerns surrounding NOLF Joe Williams corresponding to the areas identified on Figure 6-8 are detailed below.

Area 1: North of the airfield, there are two to three low-density residential developments located along Cow Creek Road that fall within the 65-70 DNL noise zone (Noise Zone 2). These dwellings include both traditional "stick-built" homes and manufactured homes and are situated on parcels larger than 1.0 acre. Residential uses within Noise Zone 2 are incompatible and should be discouraged through community outreach and education and the implementation of the Airfield Zoning Ordinance by the County. These residences are also located within APZ II; however, this is acceptable since the housing density in this area is within the recommended density limit of one to two dwellings per acre, as outlined in the AICUZ instructions for APZ II. In addition, there are three full-size commercial chicken houses located within this area. Noise effects on wildlife, chickens, and livestock are addressed in Appendix A. If improperly disposed of, dead chickens may result in a BASH issue for the installation and a safety concern for the pilots. Dead chickens attract vultures, which is the bird species that cause the highest percentage of damage per strike at NAS Meridian.

Area 2: There are two low-density residential developments (greater than 1.0-acre parcel) including manufactured homes located along Highway 495 within the APZ I northwest of NOLF Joe Williams. These residential parcels also fall within the 65-70 DNL noise zone.

NOLF Joe Williams



Path: M:\Pensacola\NAS Meridian BUF\Maps\MXD\Report\AICUZ\Revised Updated Logo July2012\Fig6 8 Compatibility Concerns JWF.mxd Date: 4/22/2013

14

NOLF Runways

32

Runway

Installation Boundary

Parcel Boundary

State Highway

Secondary/ Local Road

Church

Building

Cell Tower

2012 Noise Contours

60 DNL

65 DNL

70 DNL

75 DNL

80 DNL

85 DNL

Figure 6-8
Compatibility Concerns
2012 Composite Map
NOLF Joe Williams
Kemper County, Mississippi

Source: U.S. Navy 2011; ESRI 2010; Wyle 2011; ENE 2011; NAIP 2010

The AICUZ instruction states that these residential uses are incompatible with land use recommendations for APZ I and Noise Zone 2 and should be discouraged through community outreach and education and implementation of the Airfield Zoning Ordinance by the County. In addition, there are two full-size commercial chicken houses located within this area which pose a BASH issue.

Area 3: There are multiple (three to four) low-density residential properties located with APZ I southeast of the airfield and within the 65-75 DNL noise zone. These dwellings include both traditional built homes and manufactured homes situated on parcels larger than 1.0 acre in size. The properties are located near the intersection of Air Base Road and Lynville Road as well as just to the east along Mellen and Davis roads. These residences are incompatible with the Navy's land use compatibility recommendations for APZ I and Noise Zone 2. Bluff Springs Baptist Church is located northeast of the intersection within the APZ I and the 65-70 DNL noise zone. Churches are incompatible and strongly discouraged in all APZs as well as Noise Zone 2.

Area 4: Low-density residential properties south of the airfield along Clark Chapel Road and Mae Goodin Road present compatibility concerns. These residential parcels fall within the 65-70 DNL noise zone and are considered incompatibility. In addition, a church, Clarks Chapel, is located near the intersection of Clark Chapel Road and Mae Goodin Road and falls within APZ II. Churches are considered public assembly locations and are people-intensive land uses, which are deemed incompatible and strongly discouraged in any APZ as well as Noise Zone 2.

Area 5: There is one residential dwelling located along Highway 495 within the 65-70 DNL noise zone. In addition, there are three residences along Roebuck Drive just south of the north-APZ II boundary within the 65-70 DNL noise zone. These dwellings include both traditional built homes and manufactured homes situated on parcels larger than 1.0 acre in size. The AICUZ instruction states residential uses are incompatible within Noise Zone 2 and should be discouraged through community outreach and education and implementation of the Airfield Zoning Ordinance by the County.

6.4.3 Future Compatibility Concerns

Future Compatibility Concerns

Increases in manufactured homes around airfields.

Commercial and residential development along US-45 to Marion and Meridian.

High potential for future residential and commercial development near Chip Pickering Road.

Measurable future growth in traditional homes or subdivisions around NAS Meridian and NOLF Joe Williams is not anticipated. The trend indicates that there will be an increase in manufactured homes around each airfield, primarily in zones 1, 2, 6, 7, 8, 9 and 10. This is due, in part, to the lower cost of these homes verses traditionally built homes and the access to land on which to place the manufactured home. Per the Navy's AICUZ instruction, residential uses within APZ I and Noise Zone 2 are an incompatible land use and should be discouraged through community outreach and education and the implementation of the Airfield Zoning Ordinance by the counties. There remains the potential for incompatible land use and the trend of clustering manufactured homes. Traditionally, manufactured homes are not equipped with quality sound attenuation and noise will remain the primary concern for residents.

The historic town of Lauderdale is showing signs of revitalization, with a recently expanded truck stop, a post office, and a newly constructed Dollar General store. Such commercial development often attracts additional commercial and residential establishments. Future incompatible development may occur along US-45 to Marion and Meridian.

Chip Pickering Road, in Area 10 (Lauderdale County), provides high-speed access to US-45, NAS Meridian, and Stennis Drive to Highway 39. Quality infrastructure often leads to commercial and residential development. This is an area of concern due to the existing residential homes and the high potential for future development.

7

Land Use Tools and Recommendations

This chapter discusses tools, alternative techniques, and recommendations that can be implemented to manage existing and future development within and around the AICUZ footprint. Successful AICUZ land use compatibility implementation is the collective responsibility of the Navy, federal, state and regional governments, business owners, real estate professionals, and private citizens. This chapter provides tools and recommendations that, when implemented, will continue to advance NAS Meridian and community partners to achieve their shared goal, "to protect the health, safety, and welfare of those living near military airfields, while preserving the defense flying mission."

A wide variety of land use strategies oriented toward the Navy, federal, state, and local levels are available for encouraging compatible land use within the established AICUZ footprints for NAS Meridian and NOLF Joe Williams. This chapter identifies stakeholders and their roles and responsibilities as they relate to successful AICUZ implementation. The federal, state, and local land use planning tools are described along with recommendations for implementation.

The purpose is to provide an information base for NAS Meridian, local governments and agencies, and private citizens to use in exploring, modifying, combining, and implementing polices, plans, and regulations necessary to help ensure the goal of the AICUZ Program.

7.1 Federal/Navy, Tools and Recommendations

Although ultimate control over land use and development in the vicinity of NAS Meridian and NOLF Joe Williams are the responsibilities of the local governments, the Navy has the ability and responsibility to conduct actions and implement programs in support of the local effort. At the installation level, the Installation Commander is responsible for ensuring a successful AICUZ Program. Pursuant to OPNAVINST 11010.36C, the Air Installation Commander at NAS Meridian is committed to and shall:

- Implement an AICUZ Program for the Air Installation and associated NOLF;
- Work with state and local planning officials to implement the objectives of the AICUZ Study;
- Continue to use a CPLO to assist in the execution of the AICUZ Study by the installation and to act as spokesperson for the Command regarding AICUZ matters;
- Promote attendance at AICUZ seminars by COs, executive officers (XOs), air operations and traffic control facility officers, and other aviation related staff to increase awareness of current trends and techniques for AICUZ Program development and implementation;
- Provide assistance in developing AICUZ information, including operational data needed to update the AICUZ Study;
- Work with local decision makers in the surrounding communities to evaluate and justify the retention of land or interest of land required for operational performance; and
- Notify the Chain-of-Command in the AICUZ Program office whenever local conditions merit update or review of the AICUZ Study.

The following are federal and/or Navy level regulations, programs, and recommendations that can be used or considered to control development within the AICUZ footprint.

7.1.1 Federal/Navy Level Tools

Environmental Review

Fundamentals of the AICUZ Study can be incorporated into the environmental review process for federal projects.

Federal agencies, including the Navy, are required to consider the environmental impacts of any federal project which could significantly impact the environment by conducting a comprehensive environmental review. The National Environmental Policy Act (NEPA) mandates complete disclosure of the environmental effects resulting from proposed federal actions, approvals, or funding. Impacts of the action are generally documented in an Environmental Impact Statement (EIS) or an EA. The environmental review process represents an excellent means for incorporating the fundamentals of the AICUZ Study in the planning review process of a project.

Housing and Urban Development (HUD) -24 CFR Part 51 Subpart D

HUD funding can be withheld from housing projects that are not within prescribed noise exposure levels or projects that are in Clear Zones and APZs.

The approval of all mortgage loans from the Federal Housing Administration or the Veterans Administration is subject to the requirements of Housing and Urban Development (HUD), CFR Part 51 Subpart D. The regulation sets forth a discretionary policy to withhold funds for housing projects when noise exposure is in excess of prescribed levels. Residential construction may be permitted inside the 65-DNL zone, provided sound attenuation is accomplished, though the added construction expense of noise attenuation may make siting in these noise exposure areas financially less attractive. Due to the discretionary makeup of the HUD policy, variances may also be permitted, depending on regional interpretation and local conditions. HUD also has a policy that prohibits funding for projects in Clear Zones and APZs, unless the project is compatible with the AICUZ.

Executive Order 12372, Intergovernmental Review of Federal Programs (July 1982)

For federal aid projects, Executive Order 12372 allows the introduction of AICUZ concepts and issues early in the review process.

As a result of the Intergovernmental Cooperation Act of 1968, the United States Office of Management and Budget requires all federal aid development projects to be coordinated with and reinforce state, regional, and local planning. Executive Order 12372 allows state governments to set up review periods and processes for federal projects and provides an early entry point into the process to introduce AICUZ concepts and to discuss AICUZ issues.

DOD Encroachment Partnering Program

Encroachment partnering is a cooperative, multi-party, real estate-based program used to mitigate the impacts of off-base land uses that are potentially incompatible with military operations. It implies that the DOD and its partner(s) are both willing and able to contribute to the cost and effort of acquiring these interests.

Title 10, United States Code (U.S.C.) § 2684a authorizes the Secretary of Defense or the Secretary of a military department to enter into agreements with an eligible entity or entities to address the use or development of real property in the vicinity of, or ecologically related to, a military installation or military airspace, to limit incompatible development or use of the property that would be incompatible with the mission of the installation or place other constraints on military training, testing and operations. Eligible entities include a state, a political subdivision of a state, and a private entity that has, as its principal organizational purpose or goal, the conservation, restoration, or preservation of land and natural resources, or a similar purpose or goal.

Encroachment partnering agreements provide for an eligible entity to acquire fee title, or a lesser interest, in land for the purpose of limiting encroachment on the mission of a military installation and/or to preserve habitat off the installation to relieve current or anticipated environmental restrictions that might interfere with military operations or training on the installation. The DOD can share the real estate acquisition costs for projects that support the purchase of fee or conservation or other restrictive easement for such property. The eligible entity negotiates and acquires the real estate interest for encroachment partnering projects with a voluntary seller. The eligible entity must transfer the agreed upon restrictive easement interest to the United States of America upon the request of the Secretary.

Public Land Acquisition

If a threat to an installation's operational integrity from incompatible development is identified, and the local community cannot resolve the threat, the Navy can obtain the land through purchase, voluntary agreement, or condemnation.

In accordance with OPNAVINST 11010.C36C, the Navy is permitted to acquire interest in properties (acquisition) to protect the operational integrity of its air installations. When threats to operational integrity from incompatible development are identified, and when local communities are unwilling or unable to take the initiative to address the threat using their own authority, consideration can be given to land acquisition. The first priority for acquisition, whether in fee or by restrictive easement, is the Clear Zone. The second priority is other APZs. Noise zones, outside the Clear Zone and APZs, may be considered for acquisition only when all avenues of achieving compatible use zoning or similar protection have been explored and the operational integrity of the installation is clearly threatened. Land can be purchased through negotiation and voluntary agreement of the land or it can be through condemnation procedures, using the power of eminent domain.

Adjustment of Operational Procedures

Adjustments to operational procedures can be made only after careful consideration of all options and only if the changes do not compromise the installation's mission.

The Navy can adjust operational procedures and initiate facility improvements to reduce the extent of exposure to noise (noise abatement) and mishaps. The options available to military authorities vary between installations due to specific local conditions, local air operations, and local mission requirements. Only after careful consideration of all options should changes in operational procedures be made. No changes that compromise the mission of the installation should be instituted.

7.1.2 Federal/Navy Level Recommendations

Community Outreach Activities

Public relations and education programs involve the use of information and provision knowledge to the citizenry regarding managing and understanding noise and land development problems. The Navy should continue community outreach efforts that have begun at NAS Meridian. Initiatives aimed at further protecting Navy assets should continue and/or be expanded. NAS Meridian representatives have participated in a compatible land use meeting with the local counties to identify areas where potential incompatible land uses exist. These meetings can also be used to address current and future aircraft related activity at

> The Navy should continue/ initiate these community outreach activities:
>
> - Continued attendance at local meetings and events
> - Attendance at county Boards of Supervisors meetings
> - Foster relationships with the Meridian Board of Realtors and Mississippi Homebuilders Association
> - The Mission Sustainment Team should hold regular meetings
> - Initiate a Statewide Commanders Council

the NAS Meridian, noise complaints (both the process for making them and how they are resolved), and other relevant topics related to the interaction between the NAS Meridian and its neighbors. Navy representatives working with the community serve to enhance the lines of communication and all parties' ability to address potential concerns that arise.

The installation CO and CPLO currently participate in several local meetings and events to further their community outreach efforts. The Navy recommends that participation and attendance at the following events continue in order to further foster community partnership and the implementation of this AICUZ Study:

- Navy League Meetings;
- Rotary Club Meetings;
- East Mississippi Business Development Corporation (EMBDC) Meetings; and
- Informal forums and Civic Meetings.

Future initiatives aimed at further protection of Navy assets and community outreach should expand. In addition to the ongoing community involvement, the CO or base representative should attend the Boards of Supervisors meetings in each county. Attendance and participation will keep the installation engaged in the local planning process and provide a forum to provide comments as they affect AICUZ planning.

To assist in establishing and encouraging real estate disclosures the CPLO should engage the Meridian Board of Realtors to build relationships, provide AICUZ related materials, and educate the board on the need for fair disclosure within the AICUZ footprint. Similarly the CPLO should engage the Mississippi Home Builders Association to work toward passage of building codes and incorporation of sound insulation.

On station, the Mission Sustainment Team for NAS Meridian, which consists of Operations, Public Affairs, Legal, Environmental, Security, Facilities, and the CPLO, should hold regular meetings to address encroachment related concerns across all disciplines on station. Likewise, the Navy-Meridian Team should be re-activated to assist in implementation of the 2012 AICUZ Study and to assist in other related issues.

Finally, the installation should continue to pursue initiation of a Statewide Commanders Council. Such a council would provide statewide consistency with regards to encroachment, provide a forum for knowledge sharing, and strengthen the military-community relationship.

These and similar initiatives where Navy representatives are working with the community serve to enhance the lines of communication and the ability of all parties to address potential concerns that arise.

Presentation of the AICUZ Program

NAS Meridian personnel should make presentations to community decision makers regarding the AICUZ Program. For the public, a website and community outreach materials should be developed.

The AICUZ Program can be a complex subject that requires discussion for clear understanding. NAS Meridian personnel have access to and should make presentations on the program to individuals or collectively to community decision makers, including regional and local planning councils/commissions, city councils, county Board of Supervisors, Council of Governments, and other interested agencies. Presentations provide an opportunity to inform and educate individuals or groups who make land use decisions (e.g., infrastructure siting, schools, zoning changes) and to answer any questions about the program.

As part of the presentation, a web site should be developed to include AICUZ-specific topics related to the NAS Meridian. Various materials for presentation and distribution should be developed or updated, including poster boards, an electronic or slide presentation, and fact sheets. This presentation information could be used as part of the community outreach activities to inform the general public on AICUZ issues on how the installation contributes to the local economy and the need for responsible land use planning.

Noise Complaint Monitoring and Response Program

NAS Meridian should continue its noise monitoring program to emphasize its commitment to the public regarding the control of noise.

NAS Meridian should continue its noise monitoring program for continuous assessment of noise generated from aircraft operations and prompt responses from complaints. This program evaluates alternative flight procedures for noise control; investigates all noise complaints; validates noise modeling associated with AICUZ documentations; and emphasizes NAS Meridian's commitment to the public that the control of noise is an important issue to the installation. Further, comprehensive records of noise complaints are maintained and proper responses to each complaint are ensured. Proper analyses of the complaints help abate future noise complaints, identify noise sensitive areas, and determine which operational activities are responsible for the noise complaints. The installation's response to noise complaints is further explained in Section 4.2.2.

Land Acquisition Program

NAS Meridian should continue its land acquisition program to protect the mission of the installation and to work with the counties during this effort.

NAS Meridian should continue their land acquisition program to protect the installation's military mission. The acquisition effort should remain focused on the Clear Zone and APZs lands, but should also provide for acquisition of land with high noise zones. The acquisition of fee title or restrictive easements over the impacted lands should support the efforts of the installation by addressing problematic areas. As part of NAS Meridian's overall strategy for minimizing incompatible land use, the station should continue to work with the local counties to address the acquisition and development efforts within their jurisdictions.

Engage in the Local Planning Process

The CO and or CPLO should attend public hearings and provide comments on actions affecting AICUZ planning.

The Navy representative for NAS Meridian, including either the CO and/or the base or regional CPLO, should attend public hearings and provide comments on actions that affect AICUZ planning for NAS Meridian and NOLF Joe Williams, including Joint Land Use Studies (JLUS), comprehensive plan issues, updates to Meridian's general plans, capital improvement plans, zoning, building code changes, and other land development regulation updates/ amendments impacting the states, counties, cities, and the installations.

7.2 STATE/REGIONAL, TOOLS AND RECOMMENDATIONS

State regulations and programs for Mississippi that impact land use controls and growth around the NAS Meridian can be used to control development within the AICUZ footprint. In addition, regional planning agencies and development organizations can control development by aiding and influencing the local governments in the development of policies, plans, and regulations necessary for the physical and economic growth of the region. The following sections are state/regional level tools and recommendations that can be used to control development within the AICUZ footprint.

7.2.1 State/Regional Level Tools

Growth Management Regulations

Mississippi counties can carry out an official plan for the purpose of bringing about coordinated physical development in accordance with current and projected needs.

Section 17-1, Mississippi Code (1972), as amended, grants each Mississippi county and municipality the authority to prepare, adopt, amend, and carry out an official plan (Comprehensive Plan), in whole or in part, for the purpose of bringing about coordinated physical development in accordance with present and future needs. The comprehensive planning and land development controls granted in Section 17 are implemented by zoning ordinances, subdivision regulations, building codes, and capital improvements programs. Adoption and implementation of airport zoning ordinances are also authorized under the Mississippi Code 61-7.

Regional Planning and Development District

The ECPDD can provide local decision makers with a view on how the needs of a city or county interrelate with Navy operations and where incompatible land uses may occur.

The key regional organization that supports the local governments in the vicinity of NAS Meridian and NOLF Joe Williams is the ECPDD. They provide technical and planning assistance to their member governments in the preparation of comprehensive plans, master plans, zoning ordinances, subdivision regulations, capital improvement plans, economic development plans, and grant applications. The planning district can coordinate with their member governments to provide local leaders with a view of the region, as a whole, and how city and county needs and issues interrelate with Navy operations. Through regional plans (e.g., Comprehensive Economic Development Strategy [CEDS]), the councils/commissions can aid in the community outreach efforts to inform local decision makers about the AICUZ Program and to identify areas where potential incompatible land uses may occur.

7.2.2 State/Regional Level Recommendations

Regional Planning Agencies

> **The ECPDD should encourage local governments to update their plans, zoning ordinances, regulations, and codes to reflect the 2012 AICUZ Study's noise contours, APZs, and Clear Zones.**

The regional planning organization, East Central Planning and Development District (ECPDD), should coordinate and support Kemper and Lauderdale Counties to help align future plans and update ordinances and any other applicable land use regulations to reflect the 2012 AICUZ Study noise contours, APZs, and Clear Zones. The efforts of the regional planning district should be to encourage local governments to strengthen and modify their guidelines by focusing on reducing and mitigating noise, accident potential, height obstructions, and land use incompatibility generated by aircraft operations to help ensure compatibility with the recommendations of Navy land use compatibility guidelines shown in Appendix B.

7.3 Local Government, Tools and Recommendations

While it is the responsibility of NAS Meridian to inform and educate community decision makers about the AICUZ Program, it is local land use decisions that will ultimately ensure the operational integrity of the installation. Local governments have the authority to implement regulations and programs for controlling development and managing and directing growth to ensure land use activity compatible within the AICUZ footprint. Local governments should recognize their responsibility in providing land use controls in those areas encumbered by the AICUZ footprint in order to protect the health, safety, and general welfare of the population. The following sections are local government level tools and recommendations that can be used to achieve this purpose.

7.3.1 Local Government Level Tools

Local Government Comprehensive Plans and Planning

Comprehensive plans should include specific language and maps regarding the AICUZ Program and for coordination with NAS Meridian regarding land use decisions.

As stated in Section 6.2., the local planning authorities surrounding NAS Meridian and NOLF Joe Williams are Kemper and Lauderdale counties. Development of the surrounding lands can be dictated by local comprehensive land use planning and regulations developed and adopted by these authorities. Local comprehensive plans can dictate public policy in terms of future land use, housing, transportation, infrastructure, conservation, recreation and open space, intergovernmental coordination, and capital improvements. The local governments and planning authorities should include specific language and maps on the AICUZ Program and footprint as well as language on coordination with NAS Meridian on land use decisions within their AICUZ Ordinance. Currently, only the City of Meridian has developed and adopted a comprehensive plan; however, the plan does not contain any specific language on the AICUZ Program or coordination with NAS Meridian since the AICUZ footprint is contained with the county limits, not the city of Meridian.

Joint Land Use Study (JLUS) Planning Initiative

The JLUS promotes community growth that is compatible with military training and missions by introducing AICUZ data into local planning and outreach programs and identifying actions that can be taken jointly by the community and installation to promote compatible development.

The JLUSs are cooperative planning initiatives between the installation and the surrounding cities/counties. The JLUS are funded through DOD planning assistance grants for state and local governments. The goal of the JLUS is to promote compatible community growth that supports military training and operational missions. They aid in the understanding and introduction of the AICUZ technical data into local planning and outreach programs. The jurisdictional partnership results in the identification of actions that can be taken jointly by the community and installation to promote compatible development and address current and future incompatible development.

Zoning

Zoning regulates the use of land and the placement and design of structures on the land. Zoning can restrict the height of structures and prohibit the creation of other hazards, including smoke, radio interference, and glare. Lauderdale and Kemper Counties' Boards of Supervisors have not adopted the 2004 AICUZ Update as part of the AICUZ ordinances. Lauderdale County has adopted subdivision regulations that provide limited development authority to ensure that proper lot layout, design, and improvements are included in new residential developments. The regulation requires approval of the development plan by the County Board of Supervisors. This approval process could be used as a tool to ensure new developments abide by the AICUZ compatibility guidance. With the AICUZ Ordinance and subdivision regulations, there are mechanisms available for use by the county governments in which NAS Meridian and NOLF Joe Williams are located to guide compatible development. However, the local counties have limited resources for enforcement and oversight of these regulations. It should be noted that zoning and regulations do not address the problem of existing incompatible land use within the AICUZ footprint; however, it can be used to address/prevent future non-conforming uses.

Zoning regulates the use of land and the placement and design of structures on land for future development, but does not address non-conforming existing development.

Building Codes

There are currently no building codes in East Mississippi outside the city of Meridian. However, if adopted, building codes can be used to ensure the noise attenuation measures of the AICUZ Program. Building codes may ensure consistency with the noise attenuation recommendations of the AICUZ Program as part of a new construction permit or for remodeling, expansion, or rebuilding. Using proper sound insulation, construction techniques, and materials can minimize the impacts of aircraft noise and reduces interference with regular indoor activities. Although building codes will not prevent incompatible development, they can aid in minimizing impacts to the utmost extent possible.

Building codes can aid in minimizing impacts from aircraft noise by ensuring that proper sound attenuation construction techniques are used.

Capital Improvements Programs

Capital improvements projects, such as potable water lines, sewage transmission lines, road paving and/or improvements, new right-of-way acquisitions, and schools, typically encourage new development in areas where it might not otherwise be economically or environmentally feasible. These types of capital improvements can be used to direct growth and types of growth toward areas compatible with the AICUZ Program and away from areas that are incompatible. Local government agencies and organizations can develop capital improvement programs that avoid extending capital improvements into or near high noise zones or APZs.

Capital improvement projects can be used to direct growth into areas that are compatible with the AICUZ Program.

Purchase of Development Rights

> Local governments can purchase development rights for property so that incompatible development around installations is avoided.

The local government may consider the purchase of development rights within the AICUZ footprint. As a result of purchasing the rights for property development, incompatible land use may be prevented from occurring near the installation. This program is most effective where development rights of agricultural or forested lands are purchased. The land is kept productive and no incompatible land use activities can be developed.

Transfer of Development Rights (TDR)

> By transferring development rights, property around an installation that is incompatible with noise contours and APZs can be transferred for property that is more favorable to that type of development.

The concept of transfer of development rights (TDR) is a land use planning tool that involves purchasing property development rights from one property (e.g., an area proposed for incompatible residential development near an air station) and transferring those rights to another piece of property (e.g., to an area well outside of noise contours and APZs that is more conducive to residential development). As a result, development of the original property with incompatible land uses is prevented near the installation. Another part of the TDR concept is the potential for developers to receive approvals for increased densities in the receiving areas as an inducement to the developer for agreeing to a TDR. TDRs also require local governments to adopt a TDR ordinance identifying sending and receiving areas in the jurisdiction.

Public Land Acquisition Programs

> To eliminate land use incompatibilities with installations, public land can be acquired through voluntary real estate transactions.

Public land acquisition programs can be used for acquisition of land to support the AICUZ Program. Land acquisitions are designed to eliminate land use incompatibilities through voluntary transactions in the real estate market and local development process. Acquisition strategies are particularly effective tools because they advance the complementary goals of shaping future growth away from the airfields, while protecting the environment, maintaining agriculture, and conserving open spaces and rural character. A vital part in implementing acquisition tools is to identify areas of conservation interest. Laying out protection priorities around airfields is important when exploring possible partnerships with non-profit conservation groups and in requesting future acquisition funds.

Special Planning Districts

Special Planning Districts are created by local governments and commissions to implement tailor-made policies, standards, and land uses that supersede existing zoning.

Special Planning Districts are established to implement tailor-made policies, development standards, design guidelines, and land uses that overlay the existing zoning for designated areas within jurisdictional boundaries. The districts regulations supersede the underlying zoning and may be either more or less restrictive. Local governments and commissions have the power to create Special Planning Districts, such as "military influence areas" or "airport overlay zones/districts" where local governments can either enact restrictions on land development or require notification for proposed development within the special planning area. Special Planning Districts can help mitigate the negative effects of certain projects or land use activities.

Annexation

Annexation adds urban land into an existing political unit, such as a city, so that the land will be under development regulations including zoning and building codes.

Annexation is the process of adding urbanized land and land appropriate for urbanization into an existing political unit, such as a city. This action provides the city and landowners with the option to include adjacent properties into the city's jurisdiction. With the proper authority, annexation can ensure the compatible and well-ordered development of the city by including the annexed areas into the land development regulations (i.e., zoning and building codes).

Real Estate Disclosure

Real estate disclosures should provide information to prospective clients regarding aviation noise and APZs so they can make informed decisions, thereby reducing frustration and criticism of an installation's mission.

Real estate disclosures allow prospective buyers, lessees, or renters of property in the vicinity of military operation areas to make informed decisions regarding the purchase or lease of property. Disclosure of noise and safety zones is a crucial tool in protecting and notifying the community about expected impacts of aviation noise and location of APZs, subsequently reducing frustration and anti-airport criticism by those who were not adequately informed prior to purchase of properties within impact areas.

7.3.2 Local Government Level Recommendations

Communication

Community decision makers should inform and request input from NAS Meridian regarding land use decisions that could affect the installation's mission and should provide an AICUZ Program website for the public.

While it is NAS Meridian's responsibility to inform and educate community decision makers about the AICUZ Program, community decision makers should continue to actively inform and request input from NAS Meridian regarding land use decisions that could affect the operational integrity of the installation. To communicate with the public, local government websites should update information on the AICUZ Program for NAS Meridian and provide a link to the NAS Meridian website for information on aircraft operations.

Land Use Plans and Regulations

County and city governments should update all applicable land use regulations and plans to reflect the 2012 AICUZ footprint and OPNAVINST 11010.36C.

It is vital that local governments currently within the AICUZ footprint recognize their responsibility in providing land use controls to protect the health, safety, and general welfare of the population. Kemper County and Lauderdale County governments should align future plans and update ordinances and any other applicable land use regulations to reflect the 2012 AICUZ footprint and OPNAVINST 11010.36C. The efforts of the local governments to strengthen and modify their guidelines should include an evaluation of the previously mentioned land use tools and focus on reducing and mitigating noise, accident potential, height obstructions, and land use incompatibility generated by aircraft operations to ensure compatibility with the recommendations of Navy land use compatibility guidelines shown in Appendix B.

Joint Land Use Study (JLUS) Planning Initiative

County and city governments should work with NAS Meridian to develop a framework for implementing compatible development and promoting public safety and the installation's mission.

The local counties and city governments (Kemper and Lauderdale Counties, and the City of Meridian) should work with NAS Meridian to develop a cooperative JLUS that presents a rational policy framework to support adoption and implementation of compatible development measures designed to prevent urban encroachment, safeguard the military mission, and protect the public health, safety, and welfare. Each time an AICUZ is updated, further engagement with the neighboring local communities is needed through the JLUS to preserve the operational utility of the air installation.

Decisions with Special Planning Districts

Local governments should work with NAS Meridian to revise and maintain their airport overlay districts.

Following the recommendations in the 1987 AICUZ Study, both Lauderdale and Kemper counties' Airport Zoning Commissions recommended an airport overlay district (AICUZ Ordinance) to regulate land use surrounding NAS Meridian and NOLF Joe Williams (Navy 2004); the Boards of Supervisors passed the AICUZ Ordinance in each county. However, local governments need to understand that the noise contours and APZs that makeup the AICUZ footprint are dynamic, and the potential exists for changes in the AICUZ footprint as operational needs to satisfy the military mission change over time. Due to this variability, the local governments should work with NAS Meridian to revise and maintain their airport overlay district for areas outside the established APZ that are most likely to present compatibility problems, given changes in operations at NAS Meridian and NOLF Joe Williams.

Capital Improvement

Capital improvement projects should be evaluated for impacts on the AICUZ Program.

All capital improvement projects in proximity to the installation should be evaluated and reviewed for potential direct and indirect impacts that such improvements may have on the ability to implement a successful AICUZ Program. The Mississippi Development Authority (MDA) requires that projects applying for MDA funding that are located within 15,000 feet of a military airfield obtain a letter from the installation commenting on the effects of the project on airfield operations.

Building Codes

Local governments should amend building codes to include noise attenuation techniques for all new construction within the AICUZ footprint.

Local governments should adopt building codes to require that noise attenuation techniques be incorporated in the construction of new structures and homes within the AICUZ footprint. Additional insulation and soundproofing should be included in the local building codes as required for all new single- and multi-family developments constructed within the footprint. If local legislative sanction of these methods is not possible, Navy officials should work with local developers to ensure that these techniques are included on a voluntary basis.

Real Estate Disclosures

Any property affected by noise and/or APZs requires a disclosure statement to be acknowledged by both buyer and seller.

Both Lauderdale and Kemper Counties' AICUZ ordinances require disclosure statements (in writing) with an acknowledgement by both buyer and seller that the property is affected by noise and/or APZs in the vicinity of NAS Meridian and NOLF Joe Williams. The local governments should continue to ensure that real estate disclosure requirements are adhered to by real estate professionals, buyers, and sellers.

Transfer of Development Rights (TDR) Program

Local governments should consider TDR within their comprehensive/master plans.

County governments should explore the TDR concept when forming comprehensive/master plans as an appropriate alternative to across-the-board restrictions of private property rights. The Navy should encourage the surrounding county officials to further pursue the necessary ordinances and record-keeping capabilities that are required to enact the TDR concept.

Annexation Plans

Annexation plans for land adjacent to the installations should consider how the annexation may impact the success of the AICUZ Program.

All annexation plans that include land adjacent to NAS Meridian should review the impacts that such actions may have on the ability to implement a successful AICUZ Program. The decision makers should become informed about the AICUZ Program and seek input from NAS Meridian regarding the annexation of adjacent properties. After annexation, the City's comprehensive/master plans and land development regulations should be amended to include the annexed areas to ensure the compatible development of those lands.

7.4 Business Development/Real Estate Professionals/Private Citizens, Tools and Recommendations

Local citizens and businesses should recognize their responsibility in adhering to and complying with land use controls in those areas encumbered by the 2012 AICUZ footprint in order to protect themselves and the health, safety, and general welfare of the community. The following are actions, procedures, and recommendations that private groups can use or consider to help control development within the 2012 AICUZ footprint.

7.4.1 Private Level Tools

Business Development and Construction Loans to Private Contractors

Lenders should review noise and accident potential to promote compatible development with the installations and protect investors.

This tool encourages review of noise and accident potential as part of a lender's investigation of potential loans to private interests for real estate acquisition and development. Diligent lending practices will promote the compatible development of the land in the vicinity of NAS Meridian and protect both lenders and developers. Local banking and finance institutions should be encouraged to incorporate a "Due Diligence Review" of all loan applications, including a determination of possible noise or APZ impacts on the mortgaged property. The Navy can play a role in this strategy by providing AICUZ seminars to lenders throughout the region, as well as providing the regional HUD office with the latest noise data to review before issuing FHA and U.S. Department of Veterans Affairs (VA) insurance on mortgage loans for homes scheduled for construction within the AICUZ footprint.

Real Estate Professionals Cooperation

Realtors should advise prospective clients about high noise zones and APZs, as the ethical practice of full disclosure is an important element of the AICUZ Program's success.

Real estate professionals should ensure that prospective buyers or lessees are fully aware of what it means to be within a high noise zone and/or APZ. Private citizens should be provided all the information available to make informed decisions when purchasing or leasing any property in proximity to an air station. The disclosure is supported by the local AICUZ Ordinance adopted by Lauderdale and Kemper counties that requires local real estate and rental agents to provide prospective purchasers and renters with current information concerning the noise environment and APZs surrounding the installations. Under the terms of the AICUZ Ordinance, notice in writing would be given to prospective purchasers. Real estate professionals also have the ability to show prospective buyers and lessees properties at a time when noise exposure is expected to be at its worst in order to provide full disclosure. The ethical practice of full disclosure is an important element in the future success of the AICUZ Program.

Private Citizens

Citizens can choose not to invest in property located within a high noise zone or APZ.

Citizens have the ability to choose not to purchase property and/or invest in construction projects on properties within high noise zones and/or APZs.

7.4.2 Private Level Recommendations

Business Development and Construction Loans to Private Contractors

To promote compatible development around installations, lenders can choose to limit financing for projects that are incompatible with the AICUZ Program.

Lending institutions should consider whether to limit financing for real estate purchases or construction incompatible with the AICUZ Program. This approach encourages evaluation of noise and APZ impacts as part of a lender's investigation of potential loans to private interests for real estate acquisition and development. Diligent lending practices will promote compatible development of the area surrounding NAS Meridian and protect lenders and developers alike. Local banking and financial institutions should be encouraged to incorporate a "Due Diligence Review" of all loan applications, to determine possible noise or APZ impacts on the mortgaged property. The Navy can play a role in this strategy by providing AICUZ seminars to lenders throughout the region.

Real Estate Professionals Cooperation

Real Estate professionals should educate themselves on the locations of the properties they are representing in relation to the AICUZ footprint, and should provide full disclosure of noise exposure and APZs to prospective clients.

The main goal of real estate professionals should be to make prospective buyers and lessees aware of the potential magnitude of noise exposures they might experience on the property. Therefore, real estate professionals should provide written disclosure to prospective purchasers, renters, or lessees when a property is located within an APZ or a noise zone pursuant to the local ACIUZ Ordinance. If this practice is not already being adhered to in the areas surrounding the NAS Meridian and NOLF Joe Williams, it should be initiated immediately. Real estate professionals should provide, on their websites, acknowledgement of the AICUZ Program for NAS Meridian and provide a link to the installation's website for information on aircraft operations and the AICUZ Program. Real estate professionals in the area should also use the NAS Meridian 2012 AICUZ brochure as a tool to assist themselves and prospective homebuyers in understanding the location of homes in the region relative to the AICUZ for the installations.

The AICUZ brochure is produced by Navy and is distributed by the Navy, as requested, to appropriate government agencies, organizations, businesses, and individuals. Brochures are available at the Public Affairs Office at NAS Meridian.

Properties listed on the real estate Multiple Listing Service (MLS) system that are within the AICUZ footprint for the installations should be identified as such.

Private Citizens

Citizens should educate themselves on the AICUZ Program and inquire about noise zones and APZs when considering an investment in property near an installation. In addition, noise complaints should provide thorough and accurate information.

The citizens of the local communities surrounding NAS Meridian and NOLF Joe Williams should become informed about the AICUZ Program and learn about the Program's goals and objectives, its value in protecting the health, safety, and welfare of the population, the limits of the program, and the positive community aspects of a successful AICUZ Program.

Citizens that are potential purchasers, renters, or lessees of properties near NAS Meridian and NOLF Joe Williams should inquire if the location is within an APZ and/or noise zone to local real estate professionals, lending institutions, and/or an NAS Meridian representative.

Citizens should also provide sufficient and accurate information when registering a noise compliant with the installation. The installation needs sufficient and accurate information to assess the potential causes resulting in the complaint and to assess any practical remedies for reducing future complaints.

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APPENDIX A

DISCUSSION OF NOISE AND ITS EFFECT ON THE ENVIRONMENT

Discussion of Noise and its Effects on the Environment

March 2012

Prepared for:
Ecology and Environment, Inc.

Authors:
Wyle Staff

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1 Basics of Sound

Noise is unwanted sound. Sound is all around us; sound becomes noise when it interferes with normal activities, such as sleep or conversation.

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., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. First, intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic of sound is frequency, which 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 third important characteristic of sound is duration or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. Because of this vast range, using a linear scale to represent the intensity of sound becomes very unwieldy. As a result, a logarithmic unit known as the decibel (abbreviated 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. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted 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. For example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

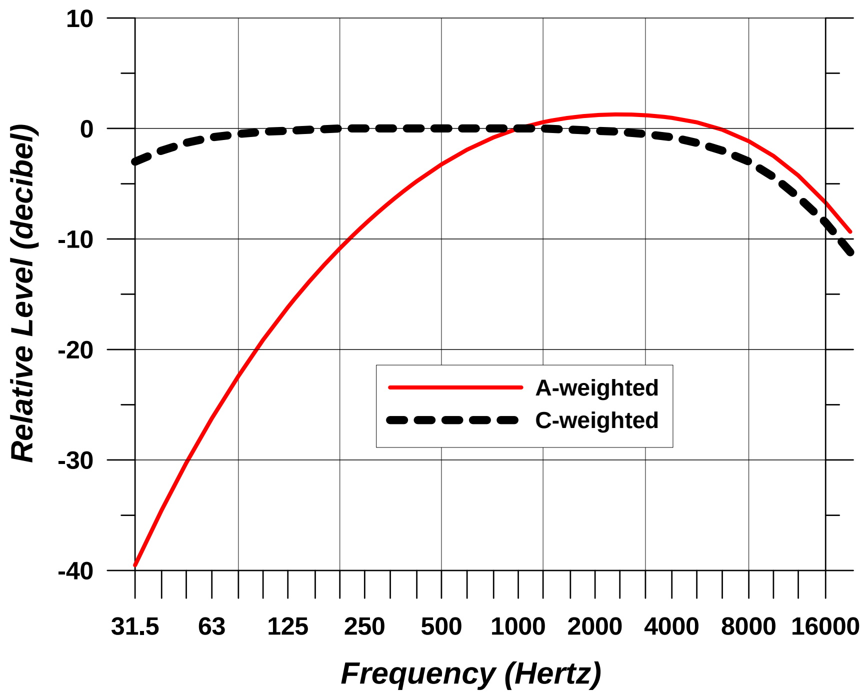
Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels is different than that of ordinary numbers, such addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what we are really doing when we add decibel values is first converting each decibel value to its corresponding acoustic energy, then adding the energies using the normal rules of addition, and finally converting the total energy back to its decibel equivalent.

The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness, and this relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90 percent decrease in sound intensity but only a 50 percent decrease in perceived loudness because of the nonlinear response of the human ear (similar to most human senses).

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the standard unit for cps. The normal human ear can detect sounds that range in frequency from about 20 Hz to about 15,000 Hz. All sounds in this wide range of frequencies, however, are not heard equally by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. C-weighting is nearly flat throughout the range of audible frequencies, hardly de-emphasizing the low frequency sound while approximating the human ear's sensitivity to higher intensity sounds. The two curves shown in Figure A-1 are also the most adequate to quantify environmental noises.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

Figure A-1. Frequency Response Characteristics of A- and C-Weighting Networks

1.1 A-weighted Sound Level

Sound levels that are measured using A-weighting, called A-weighted sound levels, are often denoted by the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the adjective "A-weighted" is often omitted and the measurements are expressed as dB. In this report (as in most environmental impact documents), dB units refer to A-weighted sound levels.

Noise potentially becomes an issue when its intensity exceeds the ambient or background sound pressures. Ambient background noise in metropolitan, urbanized areas typically varies from 60 to 70 dB and can be as high as 80 dB or greater; quiet suburban neighborhoods experience ambient noise levels of approximately 45-50 dB (U.S. Environmental Protection Agency (EPA) 1978).

Figure A-2 is a chart of A-weighted sound levels from typical sounds. Some noise sources (air conditioner, vacuum cleaner) are continuous sounds which levels are constant for some time. Some (automobile, heavy truck) are the maximum sound during a vehicle pass-by. Some (urban daytime, urban nighttime) are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Aircraft noise consists of two major types of sound events: aircraft takeoffs and landings, and engine maintenance operations. The former can be described as intermittent sounds and the latter as continuous. Noise levels from flight operations exceeding background noise typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contribution drops to lower levels, often becoming indistinguishable from the background.

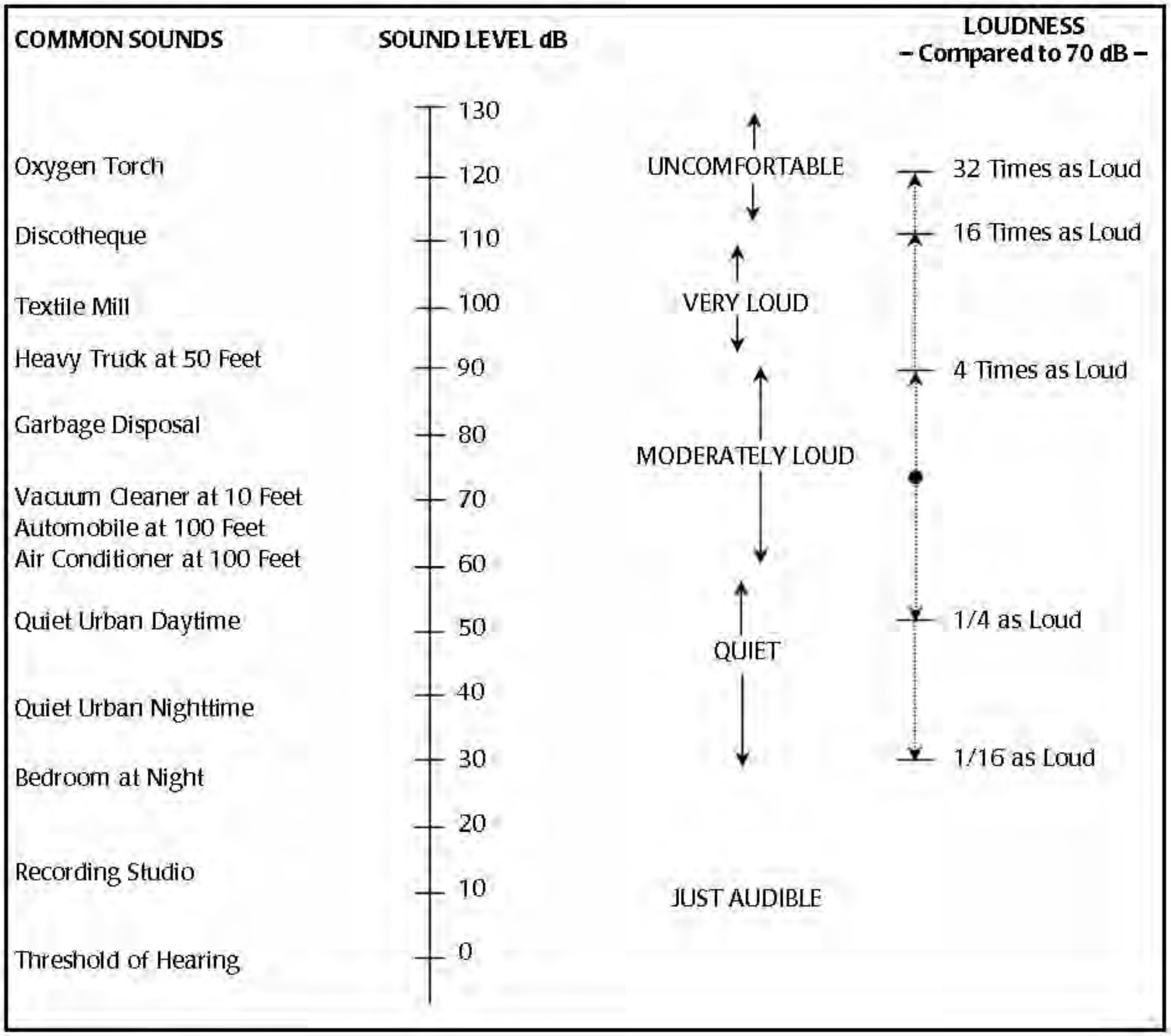
C-weighted Sound Level

Sound levels measured using a C-weighting are most appropriately called C-weighted sound levels (and denoted dBC). C-weighting is nearly flat throughout the audible frequency range, hardly de-emphasizing the low frequency. This weighting scale is generally used to describe impulsive sounds. Sounds that are characterized as impulsive generally contain low frequencies. Impulsive sounds may induce secondary effects, such as shaking of a structure, rattling of windows, inducing vibrations. These secondary effects can cause additional annoyance and complaints.

The following definitions in the American National Standard Institute (ANSI) Report S12.9, Part 4 provide general concepts helpful in understanding impulsive sounds (ANSI 1996).

Impulsive Sound: Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceeds the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second (ANSI 1996).

Highly Impulsive Sound: Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.



SOURCE: Handbook of Noise Control, *C.M. Harris, Editor McGraw-Hill Book Co., 1979, and FICAN 1997*

Figure A-2. Typical A-weighted Sound Levels of Common Sounds

High-energy Impulsive Sound: Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams.

2 Noise Metrics

In general, a metric is a statistic for measuring or quantifying. A noise metric quantifies the noise environment. There are three families of noise metrics described herein – one for single noise events such as an aircraft flyby, one for cumulative noise events such as a day's worth of aircraft activity and one which quantifies the events or time relative to single noise events.

Within the single noise event family, metrics described below include Peak Sound Pressure Level, Maximum Sound Level and Sound Exposure Level. Within the cumulative noise events family, metrics described below include Equivalent Sound Level, Day-Night Average Sound Level and several others. Within the events/time family, metrics described below include Number of Events Above a Threshold Level and Time Above a Specified Level.

2.1 Maximum Sound Level (L_{max})

The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or Maximum Sound Level.

During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. The L_{max} indicates the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally one-eighth of a second, and is denoted as "fast" response (ANSI 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted "slow" response. The L_{max} is important in judging the interference caused by a noise event with conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the period of time that the sound is heard.

2.2 Peak Sound Pressure Level (L_{pk})

The Peak Sound Pressure Level, is the highest instantaneous level obtained by a sound level measurement device. The L_{pk} is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

2.3 Sound Exposure Level (SEL)

Sound Exposure Level is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both the L_{max} and the lower noise levels produced during onset and recess periods of the overflight.

SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For sound from aircraft overflights, which typically lasts more than one second, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the L_{max} occurs instantaneously. SEL represents the best metric to compare noise levels from overflights.

2.4 Equivalent Sound Level (L_{eq})

A cumulative noise metric useful in describing noise is the Equivalent Sound Level. L_{eq} is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{eq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{eq} is defined as an average, it is effectively a sum over that time period and is, thus, a measure of the cumulative impact of noise. For example, the sum of all noise-generating events during the period of 7 a.m. to 4 p.m. could provide the relative impact of noise generating events for a school day.

2.5 Day-Night Average Sound Level (DNL or L_{dn}) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level and Community Noise Equivalent Level are composite metrics that account for all noise events in a 24-hour period. In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (10:00 p.m. to 7:00 a.m. time period). A variant of the DNL, the CNEL includes a 5 dB penalty on noise during the 7:00 a.m. to 10:00 p.m. time period, and a 10 dB penalty on noise during the 10:00 p.m. to 7:00 a.m. time period. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent.

Like L_{eq}, DNL and CNEL without their penalties are average quantities, mathematically representing the continuous A-weighted or C-weighted sound level that would be present if all of the variations in sound level that occur over a 24-hour period were smoothed out so as to contain the same total sound energy. These composite single-measure time-average metrics account for the SELs, L_{max}, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period but do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantifies the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The nighttime penalties in both DNL and CNEL account for 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. The evening penalty in CNEL accounts for the added intrusiveness of sounds during that period.

The inclusion of daytime, evening and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. They can, however, be applied over periods of multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average.

The logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average. A DNL of 65 dB could result from a very few noisy events or a large number of quieter events.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs during the daytime over 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 65.9 dB. Assume, as a second example that 10 such 30-second overflights occur during 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 75.5 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.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (EPA 1978 and Schultz 1978).

2.6 Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}) and Onset-Rate Adjusted Monthly Community Noise Equivalent Level ($CNEL_{mr}$)

Military aircraft utilizing Special Use Airspace (SUA) such as Military Training Routes (MTRs), Military Operating Areas (MOAs) and Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, flight activity in SUAs is highly sporadic and often seasonal ranging from ten per hour to less than one per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional SEL metric is adjusted to account for the "surprise" effect of the sudden onset of aircraft noise events on humans with an adjustment ranging up to 11 dB above the normal SEL (Stusnick, et al. 1992). Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted SEL is designated as the onset-rate adjusted sound exposure level (SEL_r).

Because of the sporadic characteristic of SUA activity and so as not to dilute the resultant noise exposure, the month with the most operations or sorties from a yearly tabulation for the given SUA is examined -- the so-called busiest month. The cumulative exposure to noise in these areas is computed by DNL over the busy month, but using SEL_r instead of SEL. This monthly average is denoted L_{dnmr}. If onset rate adjusted DNL is computed over a period other than a month, it would be designated L_{dnr} and the period must be specified. In the state of California, a variant of the L_{dnmr} includes a penalty for evening operations (7 p.m. to 10 p.m) and is denoted $CNEL_{mr}$.

2.7 Number-of-Events Above (NA) a Threshold Level (L)

The Number-of-events Above metric (NA) provides the total number of noise events that exceed the selected noise level threshold during a specified period of time. Combined with the selected threshold level (L), the NA metric is symbolized as NAL. The threshold L can be defined in terms of either the SEL or L_{max} metric, and it is important that this selection is reflected in the nomenclature. When labeling a contour line or point of interest (POI) on a map the NAL will be followed by the number of events in parentheses for that line or POI. For example, the noise environment at a location where 10 events exceed an SEL of 90 dB, over a given period of time, would be represented by the nomenclature NA90SEL(10). Similarly, for L_{max} it would be NA90L_{max}(10). The period of time can be an average 24-hour day, daytime, nighttime, school day, or any other time period appropriate to the nature and application of the analysis.

NA can be portrayed for single or multiple locations, or by means of noise contours on a map similar to the common DNL contours. A threshold level is selected that best meets the need for that situation. An L_{max} threshold is normally selected to analyze speech interference, whereas an SEL threshold is normally selected for analysis of sleep disturbance.

The NA metric is the only supplemental metric that has been developed that combines single-event noise levels with the number of aircraft operations. In essence, it answers the question of how many aircraft (or range of aircraft) fly over a given location or area at or above a selected threshold noise level.

2.8 Time Above (TA) a Specified Level (L)

The Time Above (TA) metric is a measure of the total time that the A-weighted aircraft noise level is at or above a defined sound level threshold. Combined with the selected threshold level (L), the TA metric is symbolized as TAL. TA is not a sound level, but rather a time expressed in minutes. TA values can be calculated over a full 24-hour annual average day, the 15-hour daytime and 9-hour nighttime periods, a school day, or any other time period of interest, provided there is operational data to define the time period of interest.

TA has application for describing the noise environment in schools, particularly when comparing the classroom or other noise sensitive environments for different operational scenarios. TA can be portrayed by means of noise contours on a map similar to the common DNL contours.

The TA metric is a useful descriptor of the noise impact of an individual event or for many events occurring over a certain time period. When computed for a full day, the TA can be compared alongside the DNL in order to determine the sound levels and total duration of events that contribute to the DNL. TA analysis is usually conducted along with NA analysis so the results show not only how many events occur above the selected threshold(s), but also the total duration of those events above those levels for the selected time period.

3 Noise Effects

This noise effects section includes discussions of annoyance, speech interference and sleep disturbance, and the effects of noise on hearing, health, performance, learning, animals, property values, terrain and archaeological sites.

3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance, defined by the Environmental Protection Agency (EPA) as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response because it attempts to account for all negative aspects of effects from noise, e.g., increased annoyance due to being awakened the previous night by aircraft and interference with everyday conversation.

Numerous laboratory studies and field surveys have been conducted to measure annoyance and to account for a number of variables, many of which are dependent on a person's individual circumstances and preferences. Laboratory studies of individual response to noise have helped isolate a number of the factors contributing to annoyance, such as the intensity level and spectral characteristics of the noise, duration, the presence of impulses, pitch, information content, and the degree of interference with activity. Social surveys of community response to noise have allowed the development of general dose-response relationships that can be used to estimate the proportion of people who will be highly annoyed by a given noise level. The results of these studies have formed the basis for criteria established to define areas of compatible land use.

A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, audio/video entertainment, and outdoor living; but the most useful metric for assessing peoples' responses to noise is the percentage of the population expected to be "highly annoyed." The concept of "percent highly annoyed" has provided the most consistent response of a community to a particular noise environment. In his synthesis of several different social surveys that employed different response scales, Schultz (1978) defined "highly annoyed" respondents as those respondents whose self-described annoyance fell within the upper 28 percent of the response scale where the scale was numerical or un-named. For surveys where the response scale was named, Schultz counted those who claimed to be highly annoyed, combining the responses of "very annoyed" and "extremely annoyed." Schultz's definition of "percent highly annoyed" (%HA) became the basis for the Federal policy on environmental noise. Daily average sound levels are typically used for the evaluation of community noise effects, such as long-term annoyance.

In general, scientific studies and social surveys have found a correlation between the percentages of groups of people highly annoyed and the level of average noise exposure. Thus, the results are expressed as the average %HA at various exposure levels measured in DNL. The classic analysis is Schultz's original 1978 study, whose results are shown in Figure A-3. This figure is commonly referred to as the Schultz curve. It represents the synthesis of a large number of social surveys (161 data points in all), that relates the long-term community response to various types of noise sources, measured using the DNL metric.

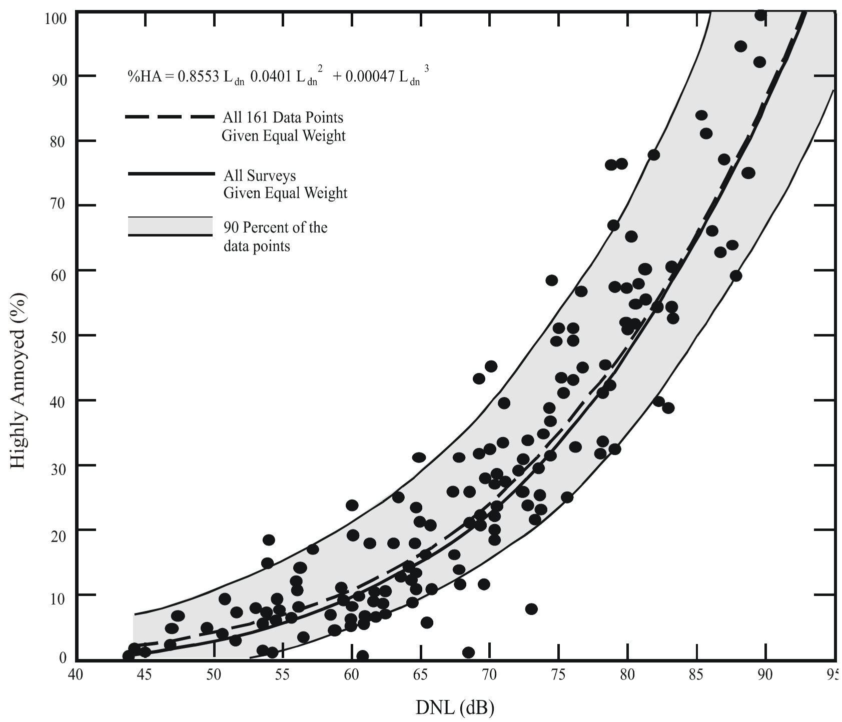
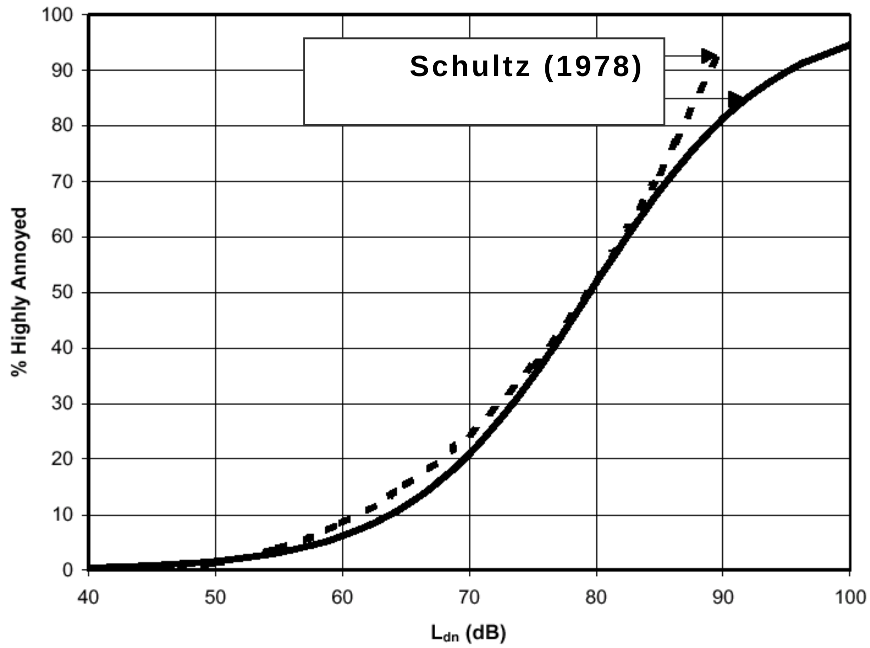


Figure A-3. Community Surveys of Noise Annoyance

An updated study of the original Schultz data based on the analysis of 400 data points collected through 1989 essentially reaffirmed this relationship. Figure A-4 shows an updated form of the curve fit in comparison with the original Schultz curve (Finegold 1994). The updated fit, which does not differ substantially from the original, is the preferred form in the U.S. The relationship between %HA and DNL is:

$$\%HA = 100/[1+ \exp(11.13 - 0.141L_{dn})]$$



SOURCE:(Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits

Figure A-4. Response of Communities to Noise; Comparison of Original

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. However, the correlation coefficients for the annoyance of individuals are relatively low, 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.

A number of non-acoustic factors have been identified that may influence the annoyance response of an individual. Newman and Beattie (1985) divided these factors into emotional and physical variables.

Emotional Variables:

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;
- General sensitivity to noise;
- Belief about the effect of noise on health; and
- Feeling of fear associated with the noise.
- Physical Variables:
- Type of neighborhood;
- Time of day;

- Season;
- Predictability of noise;
- Control over the noise source; and
- Length of time an individual is exposed to a noise.

The low correlation coefficients for individuals' reactions reflect the large amount of scatter among the data drawn from the various surveys and point to the substantial uncertainty associated with the equation representing the relationship between %HA and DNL. Based on the results of surveys it has been observed that noise exposure can explain less than 50 percent of the observed variance in annoyance, indicating that non-acoustical factors play a major role. As a result, it is not possible to accurately predict individual annoyance in any specific community based on the aircraft noise exposure. Nevertheless, changes in %HA can be useful in giving the decision maker more information about the relative effects that different alternatives may have on the community.

The original Schultz curve and the subsequent updates do not separate out the annoyance from aircraft noise and other transportation noise sources. This was an important element, in that it allowed Schultz to obtain some consensus among the various social surveys from the 1960s and 1970s that were synthesized in the analysis. In essence, the Schultz curve assumes that the effects of long-term annoyance on the general population are the same, regardless of whether the noise source is road, rail, or aircraft. In the years after the classical Schultz analysis, additional social surveys have been conducted to better understand the annoyance effects of various transportation sources.

Miedema & Vos (1998) present synthesis curves for the relationship between DNL and percentage "Annoyed" and percentage "Highly Annoyed" for three transportation noise sources. Separate, non-identical curves were found for aircraft, road traffic, and railway noise. Table A-1 illustrates that, for a DNL of 65 dB, the percent of the people forecasted to be Highly Annoyed is 28 percent for air traffic, 18 percent for road traffic, and 11 percent for railroad traffic. For an outdoor DNL of 55 dB, the percent highly annoyed would be close to 12 percent if the noise is generated by aircraft operations, but only 7 percent and 4 percent, respectively, if the noise is generated by road or rail traffic. Comparing the levels on the Miedema & Vos curve to those on the updated Schultz curve indicates that the percentage of people highly annoyed by aircraft noise may be higher than previously thought when the noise is solely generated by aircraft activity.

Table A-1. Percent Highly Annoyed for Different Transportation Noise Sources

DNL (dB)	Percent Hightly Annoyed (% HA)			
	Miedema and Vos			Schultz Combined
	Air	Road	Rail	
55	12	7	4	3
60	19	12	7	6
65	28	18	11	12
70	37	29	16	22
75	48	40	22	36

Source: Miedema & Vos 1998

As noted by the World Health Organization (WHO), even though aircraft noise seems to produce a stronger annoyance response than road traffic, caution should be exercised when interpreting synthesized data from different studies (WHO 2000). The WHO noted that five major parameters should be randomly distributed for the analyses to be valid: personal, demographic, and lifestyle factors, as well as the duration of noise exposure and the population experience with noise.

The FICON found that the updated Schultz curve remains the best available source of empirical dosage effect information to predict community response to transportation noise without any segregation by transportation source (FICON 1992); a position held by the FICAN in 1997 (FICAN 1997). However, FICON also recommended further research to investigate the differences in perceptions of aircraft noise, ground transportation noise (highways and railroads), and general background noise.

3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. 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 particularly important in classrooms and offices. In industrial settings it can cause fatigue and vocal strain in those who attempt to communicate over the noise.

The disruption of speech in the classroom is a primary concern, due to the potential for adverse effects on children's learning ability. There are two aspects to speech comprehension:

1. *Word Intelligibility* - the percent of words transmitted and received. This might be important for students in the lower grades who are learning the English language, and particularly for students who have English as a Second Language.
2. S*entence Intelligibility* – the percent of sentences transmitted and understood. This might be important for high-school students and adults who are familiar with the language, and who do not necessarily have to understand each word in order to understand sentences.

For teachers to be clearly understood by their students, it is important that regular voice communication is clear and uninterrupted. Not only does the background sound level have to be low enough for the teacher to be clearly heard, but intermittent outdoor noise events also need to be minimized. It is therefore important to evaluate the steady background level, the level of voice communication, and the single-event level due to aircraft overflights that might interfere with speech.

Several research studies have been conducted and guideline documents been developed resulting in a fairly consistent set of noise level criteria for speech interference. This section provides an overview of the results of these studies.

U.S. Federal Criteria for Interior Noise

In 1974, the EPA identified a goal of an indoor 24-hour average sound level $L_{eq(24)}$ of 45 dB to minimize speech interference based on the intelligibility of sentences in the presence of a steady background noise (EPA 1974). Intelligibility pertains to the percentage of speech units correctly understood out of those transmitted, and specifies the type of speech material used, i.e. sentences or words. The curve displayed in Figure A-5 shows the effect of steady indoor background sound levels on sentence intelligibility. For an average adult with normal hearing and fluency in the language, steady background sound levels indoors of less than 45 dB L_{eq} are expected to allow 100 percent intelligibility of sentences.

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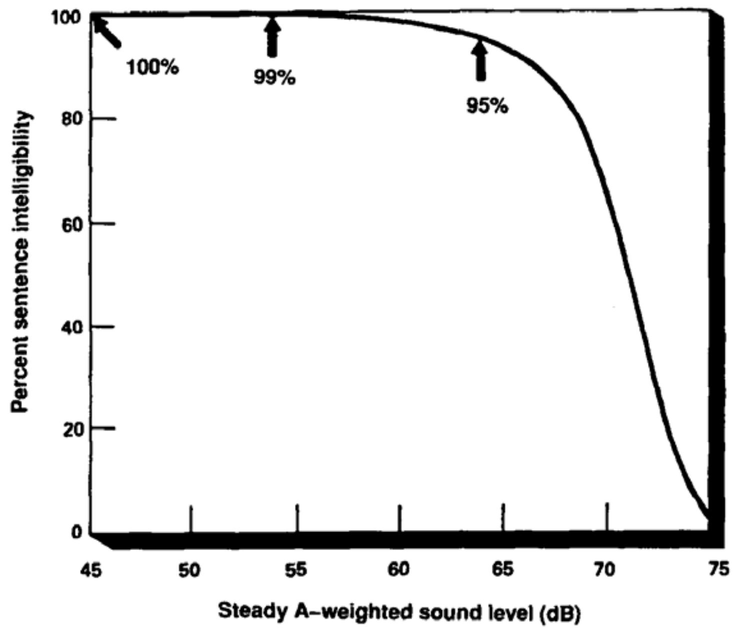

Source: EPA 1974

Figure A-5. Speech Intelligibility Curve

The curve shows 99 percent sentence intelligibility for background levels at a L_{eq} of 54 dB, and less than 10 percent intelligibility for background levels above a L_{eq} of 73 dB. Note that the curve is especially sensitive to changes in sound level between 65 dB and 75 dB - an increase of 1 dB in background sound level from 70 dB to 71 dB results in a 14 percent decrease in sentence intelligibility, whereas a 1 dB increase in background sound level from 60 dB to 61 dB results in less than 1 percent decrease in sentence intelligibility.

Classroom Criteria

For listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., the difference between the speech level and the level of the interfering noise) is in the range 15-18 dB (Lazarus 1990).

Both the ANSI and the American Speech-Language-Hearing Association (ASHLA) recommend at least a 15 dB signal-to-noise ratio in classrooms, to ensure that children with hearing impairments and language disabilities are able to enjoy high speech intelligibility (ANSI 2002; ASHLA 1995). As such, provided that the average adult male or female voice registers a minimum of 50 dB L_{max} in the rear of the classroom, the ANSI standard requires that the continuous background noise level indoors must not exceed a L_{eq} of 35 dB (assumed to apply for the duration of school hours).

The WHO reported for a speaker-to-listener distance of about 1 meter, empirical observations have shown that speech in relaxed conversations is 100 percent intelligible in background noise levels of about 35 dB, and speech can be fairly well understood in the presence of background levels of 45 dB. The WHO recommends a guideline value of 35 dB L_{eq} for continuous background levels in classrooms during school hours (WHO 2000).

Bradley suggests that in smaller rooms, where speech levels in the rear of the classroom are approximately 50 dB L_{max}, steady-state noise levels above 35 dB L_{eq} may interfere with the intelligibility of speech (Bradley 1993).

For the purposes of determining eligibility for noise insulation funding, the Federal Aviation Administration (FAA) guidelines state that the design objective for a classroom environment is 45 dB L_{eq} resulting from aircraft operations during normal school hours (FAA 1985).

However, most aircraft noise is not continuous and consists of individual events where the sound level exceeds the background level for a limited time period as the aircraft flies over. Since speech interference in the presence of aircraft noise is essentially determined by the magnitude and frequency of individual aircraft flyover events, a time-averaged metric alone, such as L_{eq}, is not necessarily appropriate when evaluating the overall effects. In addition to the background level criteria described above, single-event criteria, which account for those sporadic intermittent outdoor noisy events, are also essential to specifying speech interference criteria.

In 1984, a report to the Port Authority of New York and New Jersey recommended utilizing the Speech Interference Level (SIL) metric for classroom noise criteria (Sharp and Plotkin 1984). This metric is based on the maximum sound levels in the frequency range (approximately 500 Hz to 2,000 Hz) that directly affects speech communication. The study identified an SIL (the average of the sound levels in the 500, 1000, and 2000 Hz octave-bands) of 45 dB as the desirable goal, which was estimated to provide 90 percent word intelligibility for the short time periods during aircraft over-flights. Although early classroom level criteria were defined in terms of SIL, the use and measurement of L_{max} as the primary metric has since become more popular. Both metrics take into consideration the L_{max} associated with intermittent noise events and can be related to existing background levels when determining speech interference percentages. An SIL of 45 dB is approximately equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler 1986).

In 1998, a report also concluded that if an aircraft noise event's indoor L_{max} reached the speech level of 50 dB, 90 percent of the words would be understood by students seated throughout the classroom (Lind, Pearsons, and Fidell 1998). Since intermittent aircraft noise does not appreciably disrupt classroom communication at lower levels and other times, the authors also adopted an indoor L_{max} of 50 dB as the maximum single-event level permissible in classrooms. Note that this limit was set based on students with normal hearing and no special needs; at-risk students may be adversely affected at lower sound levels.

Bradley recommends SEL as a better indicator of indoor estimated speech interference in the presence of aircraft overflights (Bradley 1985). For acceptable speech communication using normal vocal efforts, Bradley suggests that the indoor SEL be no greater than 64 dB. He assumes a 26 dB outdoor-to-indoor noise reduction that equates to 90 dB SEL outdoors. Aircraft events producing outdoor SEL values greater than 90 dB would result in disruption to indoor speech communication. Bradley's work indicates that, for speakers talking with a casual vocal effort, 95 percent intelligibility would be achieved when indoor SEL values did not exceed 60 dB, which translates approximately to an L_{max} of 50 dB.

In the presence of intermittent noise events, ANSI states that the criteria for allowable background noise level can be relaxed since speech is impaired only for the short time when the aircraft noise is close to its maximum value. Consequently, they recommend when the background noise level of the noisiest hour is dominated by aircraft noise, the indoor criteria (35 dB L_{eq} for continuous background noise) can be increased by 5 dB to an Leq of 40 dB, as long as the noise level does not exceed 40 dB for more than 10 percent of the noisiest hour. (ANSI 2002).

The WHO does not recommend a specific indoor L_{max} criterion for single-event noise, but does place a guideline value at L_{eq} of 35 dB for overall background noise in the classroom. However, WHO does report that "for communication distances beyond a few meters, speech interference starts at sound pressure levels below 50 dB for octave bands centered on the main speech frequencies at 500 Hz, 1kHz, and 2 kHz." (WHO 2000). One can infer this can be approximated by an L_{max} value of 50 dB.

The United Kingdom Department for Education and Skills (UKDFES) established in its classroom acoustics guide a 30-minute time-averaged metric [$L_{eq(30min)}$] for background levels and $L_{A1,30}$ min for intermittent noises, at thresholds of 30-35 dB and 55 dB, respectively. $L_{A1,30}$ min represents the A-weighted sound level that is exceeded one percent of the time (in this case, during a 30 minute teaching session) and is generally equivalent to the L_{max} metric (UKDFES 2003).

Summary

As the previous section demonstrates, research indicates that it is not only important to consider the continuous background levels using time-averaged metrics, but also the intermittent events, using single-event metrics such as L_{max}. Table A-2 provides a summary of the noise level criteria recommended in the scientific literature.

Table A-2. Indoor Noise Level Criteria Based on Speech Intelligibility

Source	Metric/Level (dB)	Effects and Notes
U.S. FAA (1985)	L_{eq}(during school hours) = 45 dB	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used
Lind et al. (1998), Sharp and Plotkin (1984), Wesler (1986)	L_{max} = 50 dB / SIL 45	Single event level permissible in the classroom
WHO (1999)	L_{eq} = 35 dB L_{max} = 50 dB	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB
U.S. ANSI (2002)	L_{eq} = 40 dB, Based on Room Volume	Acceptable background level for continuous noise/ relaxed criteria for intermittent noise in the classroom
U.K. DFES (2003)	$L_{eq(30min)}$ = 30-35 dB L_{max} = 55 dB	Minimum acceptable in classroom and most other learning environs

When considering intermittent noise caused by aircraft overflights, a review of the relevant scientific literature and international guidelines indicates that an appropriate criteria is a limit on indoor background noise levels of 35 to 40 dB L_{eq} and a limit on single events of 50 dB L_{max}.

3.3 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. There have been numerous research studies that have attempted to quantify the complex effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies that have been conducted, with particular emphasis placed on those studies that have influenced U.S. federal noise policy. The studies have been separated into two groups:

1. Initial studies performed in the 1960s and 1970s, where the research was focused on laboratory sleep observations.
2. Later studies performed in the 1990s up to the present, where the research was focused on field observations, and correlations to laboratory research were sought.

Initial Studies

The relationship between noise levels and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep, but also on the previous exposure to aircraft noise, familiarity with the surroundings, the physiological and psychological condition of the recipient, and a host of other situational factors. The most readily measurable effect of noise on sleep is the number of arousals or awakenings, and so the body of scientific literature has focused on predicting the percentage of the population that will be awakened at various noise levels. Fundamentally, regardless of the tools used to measure the degree of sleep disturbance (awakenings, arousals, etc.), these studies have grouped the data points into bins to predict the percentage of the population likely to be disturbed at various sound level thresholds.

FICON produced a guidance document that provided an overview of the most pertinent sleep disturbance research that had been conducted throughout the 1970s (FICON 1992). Literature reviews and meta-analysis conducted between 1978 and 1989 made use of the existing datasets that indicated the effects of nighttime noise on various sleep-state changes and awakenings (Lukas 1978; Griefahn 1978; Peasons et. al. 1989). FICON noted that various indoor A-weighted sound levels – ranging from 25 to 50 dB were observed to be thresholds below which significant sleep effects were not expected. Due to the large variability in the data, FICON did not endorse the reliability of the results.

However, FICON did recommend the use of an interim dose-response curve—awaiting future research—which predicted the percent of the exposed population expected to be awakened as a function of the exposure to single event noise levels expressed in terms of SEL. This curve was based on the research conducted for the U.S. Air Force (Finegold 1994). The dataset included most of the research performed up to that point, and predicted that ten percent of the population would be awakened when exposed to an interior SEL of approximately 58 dB. The data utilized to derive this relationship were primarily the results of controlled laboratory studies.

Recent Sleep Disturbance Research – Field and Laboratory Studies

It was noted in the early sleep disturbance research that the controlled laboratory studies did not account for many factors that are important to sleep behavior, such as habituation to the environment and previous exposure to noise and awakenings from sources other than aircraft noise. In the early 1990s, field studies were conducted to validate the earlier laboratory work. The most significant finding from these studies was that an estimated 80 to 90 percent of sleep disturbances were not related to individual outdoor noise events, but were instead the result of indoor noise sources and other non-noise-related factors. The results showed that there was less of an effect of noise on sleep in real-life conditions than had been previously reported from laboratory studies.

FICAN

The interim FICON dose-response curve that was recommended for use in 1992 was based on the most pertinent sleep disturbance research that was conducted through the 1970s, primarily in laboratory settings. After that time, considerable field research was conducted to evaluate the sleep effects in peoples' normal, home environment. Laboratory sleep studies tend to show higher values of sleep disturbance than field studies because people who sleep in their own homes are habituated to their environment and, therefore, do not wake up as easily (FICAN 1997).

Based on the new information, FICAN updated its recommended dose-response curve in 1997, depicted as the lower curve in Figure A-6. This figure is based on the results of three field studies (Ollerhead 1992; Fidell et. al. 1994; Fidell et al. 1995a and 1995b), along with the datasets from six previous field studies.

The new relationship represents the higher end, or upper envelope, of the latest field data. It should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened" or the "maximum percent awakened" for a given residential population. According to this relationship, a maximum of 3 percent of people would be awakened at an indoor SEL of 58 dB, compared to 10 percent using the 1992 curve. An indoor SEL of 58 dB is equivalent to outdoor SEL's of 73 and 83 dB respectively assuming 15 and 25 dB noise level reduction from outdoor to indoor with windows open and closed, respectively.

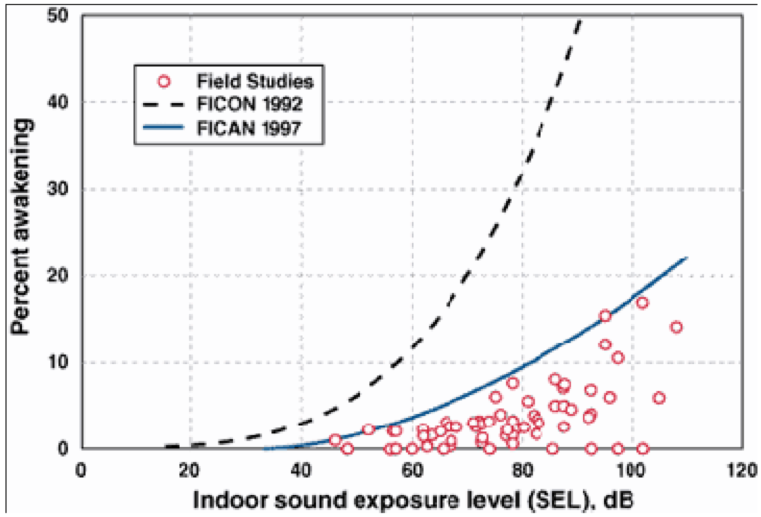

Figure A-6. FICAN's 1997 Recommended Sleep Disturbance Dose-Response Relationship

The FICAN 1997 curve is represented by the following equation:

$$\text{Percent Awakenings} = 0.0087 \times [SEL - 30]^{1.79}$$

Note the relatively low percentage of awakenings to fairly high noise levels. People think they are awakened by a noise event, but usually the reason for awakening is otherwise. For example, the 1992 UK CAA study found the average person was awakened about 18 times per night for reasons other than exposure to an aircraft noise – some of these awakenings are due to the biological rhythms of sleep and some to other reasons that were not correlated with specific aircraft events.

Number of Events and Awakenings

In recent years, there have been studies and one proposal that attempted to determine the effect of multiple aircraft events on the number of awakenings. The German Aerospace Center (DLR) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and other related human performance factors (Basner 2004). The DLR study was one of the largest studies to examine the link between aircraft noise and sleep disturbance and involved both laboratory and in-home field research phases. The DLR investigators developed a dose-effect curve that predicts the number of aircraft events at various values of L_{max} expected to produce one additional awakening over the course of a night. The dose-effect curve was based on the relationships found in the field studies.

In July 2008 ANSI and the Acoustical Society of America (ASA) published a method to estimate the percent of the exposed population that might be awakened by multiple aircraft noise events based on statistical assumptions about the probability of awakening (or not awakening) (ANSI 2008). This method relies on probability theory rather than direct field research/experimental data to account for multiple events.

Figure A-7 depicts the awakenings data that form the basis and equations of ANSI S12.9-2008. The curve labeled 'Eq. (B1)' is the relationship between noise and awakening endorsed by FICAN in 1997. The ANSI recommended curve labeled 'Eq. (1)' quantifies the probability of awakening for a population of sleepers who are exposed to an outdoor noise event as a function of the associated indoor SEL in the bedroom. This curve was derived from studies of behavioral awakenings associated with noise events in "steady state" situations where the population has been exposed to the noise long enough to be habituated. The data points in Figure A-7 come from these studies. Unlike the FICAN curve, the ANSI 2008 curve represents the average of the field research data points.

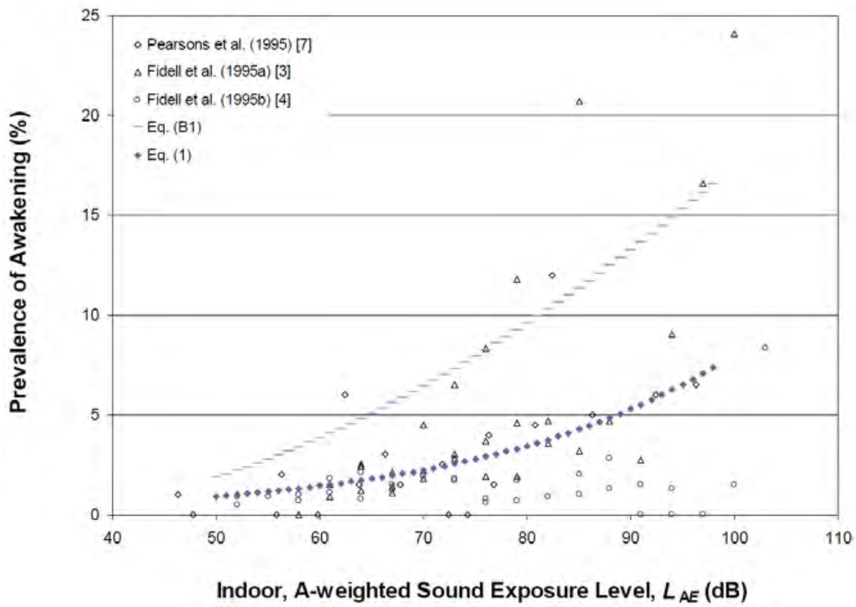

Figure A-7. Plot of Sleep Awakening Data versus Indoor SEL

In December 2008, FICAN recommended the use of this new estimation procedure for future analyses of behavioral awakenings from aircraft noise. In that statement, FICAN also recognized that additional sleep disturbance research is underway by various research organizations, and results of that work may result in additional changes to FICAN's position. Until that time, FICAN recommends the use of ANSI S12.9-2008.

3.4 Noise-Induced Hearing Impairment

Residents in surrounding communities express concerns regarding the effects of aircraft noise on hearing. This section provides a brief overview of hearing loss caused by noise exposure. The goal is to provide a sense of perspective as to how aircraft noise (as experienced on the ground) compares to other activities that are often linked with hearing loss.

Hearing Threshold Shifts

Hearing loss is generally interpreted as a decrease in the ear's sensitivity or acuity to perceive sound; i.e. a shift in the hearing threshold to a higher level. This change can either be a Temporary Threshold Shift (TTS), or a Permanent Threshold Shift (PTS) (Berger 1995).

TTS can result from exposure to loud noise over a given amount of time, yet the hearing loss is not necessarily permanent. An example of TTS might be a person attending a loud music concert. After the concert is over, the person may experience a threshold shift that may last several hours, depending upon the level and duration of exposure. While experiencing TTS, the person becomes less sensitive to low-level sounds, particularly at certain frequencies in the speech range (typically near 4,000 Hz). Normal hearing ability eventually returns, as long as the person has enough time to recover within a relatively quiet environment.

PTS usually results from repeated exposure to high noise levels, where the ears are not given adequate time to recover from the strain and fatigue of exposure. A common example of PTS is the result of working in a loud environment such as a factory. It is important to note that a temporary shift (TTS) can eventually become permanent (PTS) over time with continuous exposure to high noise levels. Thus, even if the ear is given time to recover from TTS, repeated occurrence of TTS may eventually lead to permanent hearing loss. The point at which a Temporary Threshold Shift results in a Permanent Threshold Shift is difficult to identify and varies with a person's sensitivity.

Criteria for Permanent Hearing Loss

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Considerable data on hearing loss have been collected and analyzed by the scientific/medical community. It has been well established that continuous exposure to high noise levels will damage human hearing (EPA 1978). The Occupational Safety and Health Administration (OSHA) regulation of 1971 standardizes the limits on workplace noise exposure for protection from hearing loss as an average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period (the average level is based on a 5 dB decrease per doubling of exposure time) (US Department of Labor 1970). Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is an average sound level of 70 dB over a 24-hour period.

The US EPA established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96 percent of the population from greater than a 5 dB PTS (EPA 1978). The National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics identified 75 dB as the minimum level at which hearing loss may occur (CHABA 1977). Finally, the WHO has concluded that environmental and leisure-time noise below an L_{eq24} value of 70 dB "will not cause hearing loss in the large majority of the population, even after a lifetime of exposure" (WHO 2000).

Hearing Loss and Aircraft Noise

The 1982 EPA Guidelines report specifically addresses the criteria and procedures for assessing the noise-induced hearing loss in terms of the Noise-Induced Permanent Threshold Shift (NIPTS), a quantity that defines the permanent change in hearing level, or threshold, caused by exposure to noise (EPA, 1982). Numerically, the NIPTS is the change in threshold averaged over the frequencies 0.5, 1, 2, and 4 kHz that can be expected from daily exposure to noise over a normal working lifetime of 40 years, with the exposure beginning at an age of 20 years. A grand average of the NIPTS over time (40 years) and hearing sensitivity (10 to 90 percentiles of the exposed population) is termed the Average NIPTS or Ave NIPTS for short. The Average Noise Induced Permanent Threshold Shift (Ave. NIPTS) that can be expected for noise exposure as measured by the DNL metric is given in Table A-3.

Table A-3. Ave. NIPTS and 10th Percentile NIPTS as a Function of DNL

DNL	Ave. NIPTS dB*	10th Percentile NIPTS dB*
75-76	1.0	4.0
76-77	1.0	4.5
77-78	1.6	5.0
78-79	2.0	5.5
79-80	2.5	6.0
80-81	3.0	7.0
81-82	3.5	8.0
82-83	4.0	9.0
83-84	4.5	10.0
84-85	5.5	11.0

* Rounded to the nearest 0.5 dB

For example, for a noise exposure of 80 dB DNL, the expected lifetime average value of NIPTS is 2.5 dB, or 6.0 dB for the 10th percentile. Characterizing the noise exposure in terms of DNL will usually overestimate the assessment of hearing loss risk as DNL includes a 10 dB weighting factor for aircraft operations occurring between 10 p.m. and 7 a.m. If, however, flight operations between the hours of 10 p.m. and 7 a.m. account for 5 percent or less of the total 24-hour operations, the overestimation is on the order of 1.5 dB.

From a civilian airport perspective, the scientific community has concluded that there is little likelihood that the resulting noise exposure from aircraft noise could result in either a temporary or permanent hearing loss. Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie 1985). The EPA criterion (L_{eq24} = 70 dBA) can be exceeded in some areas located near airports, but that is only the case outdoors. Inside a building, where people are more likely to spend most of their time, the average noise level will be much less than 70 dBA (Eldred and von Gierke 1993). Eldred and von Gierke also report that "several studies in the U.S., Japan, and the U.K. have confirmed the predictions that the possibility for permanent hearing loss in communities, even under the most intense commercial take-off and landing patterns, is remote."

With regard to military airbases, as individual aircraft noise levels are increasing with the introduction of new aircraft, a 2009 DoD policy directive requires that hearing loss risk be estimated for the at risk population, defined as the population exposed to DNL greater than or equal to 80 dB and higher (DoD 2009). Specifically, DoD components are directed to "*use the 80 Day-Night A-Weighted (DNL) noise contour to identify populations at the most risk of potential hearing loss*". This does not preclude populations outside the 80 DNL contour, i.e. at lower exposure levels, from being at some degree of risk of hearing loss. However, the analysis should be restricted to populations within this contour area, including residents of on-base housing. The exposure of workers inside the base boundary area should be considered occupational and evaluated using the appropriate DoD component regulations for occupational noise exposure.

With regard to military airspace activity, studies have shown conflicting results. A 1995 laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs (Nixon, et al. 1993). The potential effects of aircraft flying along MTRs is of particular concern because of maximum overflight noise levels can exceed 115 dB, with rapid increases in noise levels exceeding 30 dB per second. In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. Fifty percent of the subjects showed no change in hearing levels, 25 percent had a temporary 5 dB *increase* in sensitivity (the people could hear a 5 dB wider range of sound than before exposure), and 25 percent had a temporary 5 dB decrease in sensitivity (the people could hear a 5 dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds or until a temporary shift in hearing was observed. The temporary hearing threshold shifts showed an *increase* in sensitivity of up to 10 dB.

In another study of 115 test subjects between 18 and 50 years old in 1999, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight noise (Ising, et al. 1999). According to the authors, the results indicate that repeated exposure to military low-altitude flight noise with L_{max} greater than 114 dB, especially if the noise level increases rapidly, may have the potential to cause noise induced hearing loss in humans.

Summary

Aviation and typical community noise levels near airports are not comparable to the occupational or recreational noise exposures associated with hearing loss. Studies of aircraft noise levels associated with civilian airport activity have not definitively correlated permanent hearing impairment with aircraft activity. It is unlikely that airport neighbors will remain outside their homes 24 hours per day, so there is little likelihood of hearing loss below an average sound level of 75 dB DNL. Near military airbases, average noise levels above 75 dB may occur, and while new DoD policy dictates that NIPTS be evaluated, no research results to date have definitively related permanent hearing impairment to aviation noise.

3.5 Nonauditory Health Effects

Studies have been conducted to determine whether correlations exist between noise exposure and cardiovascular problems, birth weight, and mortality rates. The nonauditory effect of noise on humans is not as easily substantiated as the effect on hearing. The results of studies conducted in the United States, primarily concentrating on cardiovascular response to noise, have been contradictory (Cantrell 1974). Cantrell concluded that the results of human and animal experiments show that average or intrusive noise can act as a stress-provoking stimulus. Prolonged stress is known to be a contributor to a number of health disorders. Kryter and Poza (1980) state, "It is more likely that noise-related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body." Psychological stresses may cause a physiological stress reaction that could result in impaired health.

The National Institute for Occupational Safety and Health and EPA commissioned CHABA in 1981 to study whether established noise standards are adequate to protect against health disorders other than hearing defects. CHABA's conclusion was that:

Evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise. It seems prudent, therefore, in the absence of adequate knowledge as to whether or not noise can produce effects upon health other than damage to auditory system, either directly or mediated through stress, that insofar as feasible, an attempt should be made to obtain more critical evidence.

Since the CHABA report, there have been more recent studies that suggest that noise exposure may cause hypertension and other stress-related effects in adults. Near an airport in Stockholm, Sweden, the prevalence of hypertension was reportedly greater among nearby residents who were exposed to energy averaged noise levels exceeding 55 dB and maximum noise levels exceeding 72 dB, particularly older subjects and those not reporting impaired hearing ability (Rosenlund, et al. 2001). A study of elderly volunteers who were exposed to simulated military low-altitude flight noise reported that blood pressure was raised by L_{max} of 112 dB and high speed level increase (Michalak, et al. 1990). Yet another study of subjects exposed to varying levels of military aircraft or road noise found no significant relationship between noise level and blood pressure (Pulles, et al. 1990).

The U.S. Department of the Navy prepared a programmatic Environmental Assessment (EA) for the continued use of non-explosive ordnance on the Vieques Inner Range. Following the preparation of the EA, it was learned that research conducted by the University of Puerto Rico, Ponce School of Medicine, suggested that Vieques fishermen and their families were experiencing symptoms associated with vibroacoustic disease (VAD) (U.S. Department of the Navy 2002). The study alleged that exposure to noise and sound waves of large pressure amplitudes within lower frequency bands, associated with Navy training activities—specifically, air-to-ground bombing or naval fire support—was related to a larger prevalence of heart anomalies within the Vieques fishermen and their families. The Ponce School of Medicine study compared the Vieques group with a group from Ponce Playa. A 1999 study conducted on Portuguese aircraft-manufacturing workers from a single factory reported effects of jet aircraft noise exposure that involved a wide range of symptoms and disorders, including the cardiac issues on which the Ponce School of Medicine study focused. The 1999 study identified these effects as VAD.

Johns Hopkins University (JHU) conducted an independent review of the Ponce School of Medicine study, as well as the Portuguese aircraft workers study and other relevant scientific literature. Their findings concluded that VAD should not be accepted as a syndrome, given that exhaustive research across a number of populations has not yet been conducted. JHU also pointed out that the evidence supporting the existence of VAD comes largely from one group of investigators and that similar results would have to be replicated by other investigators. In short, JHU concluded that it had not been established that noise was the causal agent for the symptoms reported and no inference can be made as to the role of noise from naval gunfire in producing echocardiographic abnormalities (U.S. Department of the Navy 2002).

Most studies of nonauditory health effects of long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 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 8-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" (von Gierke 1990).

Although these findings were specifically directed at noise effects in the workplace, 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 that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, two UCLA researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport (LAX) and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Meacham and Shaw 1979). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Frerichs, et al. 1980).

As a second example, two other UCLA researchers used this same population near LAX to show a higher rate of birth defects for 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the Center for Disease Control performed a more thorough study of populations near Atlanta's Hartsfield International Airport (ATL) for 1970 to 1972 and found no relationship in their study of 17 identified categories of birth defects to aircraft noise levels above 65 dB (Edmonds, et al. 1979).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time-average sound levels below 75 dB.

The potential for noise to affect physiological health, such as the cardiovascular system, has been speculated; however, no unequivocal evidence exists to support such claims (Harris 1997). Conclusions drawn from a review of health effect studies involving military low-altitude flight noise with its unusually high maximum levels and rapid rise in sound level have shown no increase in cardiovascular disease (Schwartze and Thompson 1993). Additional claims that are unsupported include flyover noise producing increased mortality rates and increases in cardiovascular death, aggravation of post-traumatic stress syndrome, increased stress, increase in admissions to mental hospitals, and adverse effects on pregnant women and the unborn fetus (Harris 1997).

3.6 Performance Effects

The effect of noise on the performance of activities or tasks has been the subject of many studies. Some of these studies have established links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies employing noise levels in excess of 85 dB. Little change has been found in low-noise cases. It has been cited that moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task.

While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

- A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.
- Noise is more inclined to affect the quality than the quantity of work.
- Noise is more likely to impair the performance of tasks that place extreme demands on the worker.

3.7 Noise Effects on Children

In response to noise-specific and other environmental studies, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997), requires federal agencies to ensure that policies, programs, and activities address environmental health and safety risks to identify any disproportionate risks to children.

A review of the scientific literature indicates that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including noise effects on learning and cognitive abilities, and reports of various noise-related physiological changes.

3.7.1 Effects on Learning and Cognitive Abilities

In 2002 ANSI refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children (ANSI 2002). ANSI provides discussion on the relationships between noise and learning, and stipulates design requirements and acoustical performance criteria for outdoor-to-indoor noise isolation. School design is directed to be cognizant of, and responsive to surrounding land uses and the shielding of outdoor noise from the indoor environment. The ANSI acoustical performance criteria for schools include the requirement that the one-hour-average background noise level shall not exceed 35 dBA in core learning spaces smaller than 20,000 cubic-feet and 40 dBA in core learning spaces with enclosed volumes exceeding 20,000 cubic-feet. This would require schools be constructed such that, in quiet neighborhoods indoor noise levels are lowered by 15 to 20 dBA relative to outdoor levels. In schools near airports, indoor noise levels would have to be lowered by 35 to 45 dBA relative to outdoor levels (ANSI 2002).

The studies referenced by ANSI to support the new standard are not specific to jet aircraft noise and the potential effects on children. However, there are references to studies that have shown that children in noisier classrooms scored lower on a variety of tests. Excessive background noise or reverberation within schools causes interferences of communication and can therefore create an acoustical barrier to learning (ANSI 2002). Studies have been performed that contribute to the body of evidence emphasizing the importance of communication by way of the spoken language to the development of cognitive skills. The ability to read, write, comprehend, and maintain attentiveness, are, in part, based upon whether teacher communication is consistently intelligible (ANSI 2002).

Numerous studies have shown varying degrees of effects of noise on the reading comprehension, attentiveness, puzzle-solving, and memory/recall ability of children. It is generally accepted that young children are more susceptible than adults to the effects of background noise. Because of the developmental status of young children (linguistic, cognitive, and proficiency), barriers to hearing can cause interferences or disruptions in developmental evolution.

Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Although many factors could contribute to learning deficits in school-aged children (e.g., socioeconomic level, home environment, diet, sleep patterns), evidence exists that suggests that chronic exposure to high aircraft noise levels can impair learning.

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green, et al. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans, et al. 1998). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell (1997) study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children. Other studies found that children residing near the Los Angeles International Airport had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen, et al. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines, et al. 2001a, and 2001b). Similarly, a 1994 study found that students exposed to aircraft noise of approximately 76 dBA scored 20% lower on recall ability tests than students exposed to ambient noise of 42-44 dBA (Hygge 1994). Similar studies involving the testing of attention, memory, and reading comprehension of school children located near airports showed that their tests exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans, et al. 1998; Haines, et al. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure, as one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines, et al. 2001a, and 2001b). In contrast, a 2002 study found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed. (Hygge, et al. 2002).

Finally, although it is recognized that there are many factors that could contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led the World Health Organization and a North Atlantic Treaty Organization working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (World Health Organization 2000; North Atlantic Treaty Organization 2000).

3.7.2 Health Effects

Physiological effects in children exposed to aircraft noise and the potential for health effects have also been the focus of limited investigation. Studies in the literature include examination of blood pressure levels, hormonal secretions, and hearing loss.

As a measure of stress response to aircraft noise, authors have looked at blood pressure readings to monitor children's health. Children who were chronically exposed to aircraft noise from a new airport near Munich, Germany, had modest (although significant) increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans, et al. 1998). Children attending noisy schools had statistically significant average systolic and diastolic blood pressure ($p<0.03$). Systolic blood pressure means were 89.68 mm for children attending schools located in noisier environments compared to 86.77 mm for a control group. Similarly, diastolic blood pressure means for the noisier environment group were 47.84 mm and 45.16 for the control group (Cohen, et al. 1980).

Although the literature appears limited, studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group. Specifically, two studies analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise (Haines, et al. 2001b and 2001c). In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Other studies have reported hearing losses from exposure to aircraft noise. Noise-induced hearing loss was reportedly higher in children who attended a school located under a flight path near a Taiwan airport, as compared to children at another school far away (Chen, et al. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was reportedly uniform, with DNL greater than 75 dB and maximum noise levels of about 87 dB during overflights. Conversely, several other studies that were reviewed reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Fisch 1977; Andrus, et al. 1975; Wu, et al. 1995).

3.8 Effects on Domestic Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci, et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns is vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci, et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci, et al. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on 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. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights. Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith, et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci, et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Apparently, animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith, et al. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the 1988 Manci, et al., literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci, et al. (1988), reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

3.8.1 Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci, et al. 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

Some reviewers have indicated that earlier studies, and claims by farmers linking adverse effects of aircraft noise on livestock, did not necessarily provide clear-cut evidence of cause and effect (Cottereau 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that summarizes the literature on the impacts of low-altitude flights on livestock (and poultry) and includes specific case studies conducted in numerous airspaces across the country. Adverse effects have been found in a few studies but have not been reproduced in other similar studies. One such study, conducted in 1983, suggested that 2 of 10 cows in late pregnancy aborted after showing rising estrogen and falling progesterone levels. These increased hormonal levels were reported as being linked to 59 aircraft overflights. The remaining eight cows showed no changes in their blood concentrations and calved normally (U.S. Air Force 1994b). A similar study reported abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft (U.S. Air Force 1994b). Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994b).

A majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Studies presenting adverse effects to domestic animals have been limited. A number of studies (Parker and Bayley 1960; Casady and Lehmann 1967; Kovalcik and Sottnik 1971) investigated the effects of jet aircraft noise and sonic booms on the milk production of dairy cows. Through the compilation and examination of milk production data from areas exposed to jet aircraft noise and sonic boom events, it was determined that milk yields were not affected. This was particularly evident in those cows that had been previously exposed to jet aircraft noise.

A study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a one-year time period and none were associated with aircraft disturbances (U.S. Air Force 1993). In 1987, Anderson contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Three out of 43 cattle previously exposed to low-altitude flights showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level and 400 knots by running less than 10 meters. They resumed normal activity within one minute (U.S. Air Force 1994b). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30 to 60 feet overhead did not affect milk production and pregnancies of 44 cows and heifers in a 1964 study (U.S. Air Force 1994b).

Additionally, Beyer reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or disturb their pregnancies after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights (U.S. Air Force 1994b). A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994b).

In a report to Congress, the U. S. Forest Service concluded that "evidence both from field studies of wild ungulates and laboratory studies of domestic stock indicate that the risks of damage are small (from aircraft approaches of 50 to 100 meters), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50 to 100 meters, there is no evidence that mothers and young are separated, that animals collide with obstructions (unless confined) or that they traverse dangerous ground at too high a rate." These varied study results suggest that, although the confining of cattle could magnify animal response to aircraft overflight, there is no proven cause-and-effect link between startling cattle from aircraft overflights and abortion rates or lower milk production.

Horses

Horses have also been observed to react to overflights of jet aircraft. Several of the studies reviewed reported a varied response of horses to low-altitude aircraft overflights. Observations made in 1966 and 1968 noted that horses galloped in response to jet flyovers (U.S. Air Force 1993). Bowles (1995) cites Kruger and Erath as observing horses exhibiting intensive flight reactions, random movements, and biting/kicking behavior. However, no injuries or abortions occurred, and there was evidence that the mares adapted somewhat to the flyovers over the course of a month (U.S. Air Force 1994b). Although horses were observed noticing the overflights, it did not appear to affect either survivability or reproductive success. There was also some indication that habituation to these types of disturbances was occurring.

LeBlanc, et al. (1991), studied the effects of F-14 jet aircraft noise on pregnant mares. They specifically focused on any changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation. Their findings reported observations of "flight-fright" reactions, which caused increases in heart rates and serum cortisol concentrations. The mares, however, did habituate to the noise. Levels of anxiety and mass body movements were the highest after initial exposure, with intensities of responses decreasing thereafter. There were no differences in pregnancy success when compared to a control group.

Swine

Generally, the literature findings for swine appear to be similar to those reported for cows and horses. While there are some effects from aircraft noise reported in the literature, these effects are minor. Studies of continuous noise exposure (i.e., 6 hours, 72 hours of constant exposure) reported influences on short-term hormonal production and release. Additional constant exposure studies indicated the observation of stress reactions, hypertension, and electrolyte imbalances (Dufour 1980). A study by Bond, et al. (1963), demonstrated no adverse effects on the feeding efficiency, weight gain, ear physiology, or thyroid and adrenal gland condition of pigs subjected to observed aircraft noise. Observations of heart rate increase were recorded, noting that cessation of the noise resulted in the return to normal heart rates. Conception rates and offspring survivorship did not appear to be influenced by exposure to aircraft noise.

Similarly, simulated aircraft noise at levels of 100 dB to 135 dB had only minor effects on the rate of feed utilization, weight gain, food intake, or reproduction rates of boars and sows exposed, and there were no injuries or inner ear changes observed (Manci, et al. 1988; Gladwin, et al. 1988).

Domestic Fowl

According to a 1994 position paper by the U.S. Air Force on effects of low-altitude overflights (below 1,000 ft) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994a). The paper did recognize that given certain circumstances, adverse effects can be serious. Some of the effects can be panic reactions, reduced productivity, and effects on marketability (e.g., bruising of the meat caused during "pile-up" situations).

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds, and birds not previously exposed, are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994a). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994a). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s (U.S. Air Force 1994a). Many of the claims were disproved or did not have sufficient supporting evidence. The claims were filed for the following alleged damages: 55% for panic reactions, 31% for decreased production, 6% for reduced hatchability, 6% for weight loss, and less than 1% for reduced fertility (U.S. Air Force 1994a).

Turkeys

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles, et al. 1990a). Findings from the study suggested that turkeys habituated to jet aircraft noise quickly, that there were no growth rate differences between the experimental and control groups, and that there were some behavioral differences that increased the difficulty in handling individuals within the experimental group.

Low-altitude overflights were shown to cause turkey flocks that were kept inside turkey houses to occasionally pile up and experience high mortality rates due to the aircraft noise and a variety of disturbances unrelated to aircraft (U.S. Air Force 1994a).

3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci, et al. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci, et al. 1988).

3.8.2.1 MAMMALS

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals' ears, and levels at 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger, et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kg animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, is not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci, et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci, et al. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaska Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America, 1980). Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci, et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci, et al. 1988).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater "disturbance level" exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis, et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson, et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock, et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson, et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles, et al. 1991b).

3.8.2.2 BIRDS

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of one to five kHz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis, et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis, et al. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant (Branta bernicla nigricans) (Ward and Stehn 1990) to 85 dB for crested tern (Sterna bergii) (Brown 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by "raucous discordant cries." There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci, et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci, et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A recent study, conducted cooperatively between the DoD and the USFWS, assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater, et al. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater, et al. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey (Meleagris gallopavo silvestris) in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

3.8.2.2.1 RAPTORS

In a literature review of raptor responses to aircraft noise, Manci, et al. (1988), found that most raptors did not show a negative response to overflights. When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis, et al. (1991), performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest.

Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Reoccupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or reoccupancy. Due to the locations of some of the nests, some birds may have been habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation.

Manci, et al. (1988), noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises. The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated the greatest reaction to overflights (approximately 98 dBA) was "watching the aircraft fly by." No detrimental impacts to distribution, breeding success, or behavior were noted.

Bald Eagle

A study by Grubb and King (1991) on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances. The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 meters away caused reactions similar to other disturbance types. Ellis, et al. (1991), showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 meters, rather than the noise level. Fleischner and Weisberg (1986) stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less. They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane.

The USFWS advised Cannon AFB that flights at or below 2,000 feet AGL from October 1 through March 1 could result in adverse impacts to wintering bald eagles (U.S. Fish and Wildlife Serice 1998). However, Fraser, et al. (1985), suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less.

Osprey

A study by Trimper, et al. (1998), in Goose Bay, Labrador, Canada, focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until they grew to 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences.

The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

Red-tailed Hawk

Anderson, et al. (1989), conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests. Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (nine of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

3.8.2.2.2 MIGRATORY WATERFOWL

A study of caged American black ducks was conducted by Fleming, et al. in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy, et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward, et al. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci, et al. 1988 reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards, et al. 1979).

3.8.2.2.3 WADING AND SHORE BIRDS

Black, et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75 percent of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the Concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1970, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin, et al. 1970). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, Sooties were observed to react to sonic booms by rising in a “panic flight,” circling over the island, then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed normally. A colony of Noddies on the same island hatched successfully in 1969, the year of the Sooty hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Bowles, et al. 1991a; Bowles, et al. 1994; Cottereau 1972; Cogger and Zegarra 1980) failed to show adverse effects on hatching of eggs. A structural analysis (Ting, et al. 2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger (1981) observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport. The Concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin, et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci, et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the “startle” or “fright” response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 dB DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 dB DNL noise zone and the greater than 75 dB DNL noise zone. HUD's position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy's and Air Force's Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Newman and Beattie (1985) reviewed the literature to assess the effect of aircraft noise on property values. One paper by Nelson (1978), reviewed by Newman and Beattie, suggested a 1.8 to 2.3 percent decrease in property value per decibel at three separate airports, while at another period of time, they found only a 0.8 percent devaluation per decibel change in DNL. However, Nelson also noted a decline in noise depreciation over time which he theorized could be due to either noise sensitive people being replaced by less sensitive people or the increase in commercial value of the property near airports; both ideas were supported by Crowley (1978). Ultimately, Newman and Beattie summarized that while an effect of noise was observed, noise is only one of the many factors that is part of a decision to move close to, or away from, an airport, but which is sometimes considered an advantage due to increased opportunities for employment or ready access to the airport itself. With all the issues associated with determining property values, their reviews found that decreases in property values usually range from 0.5 to 2 percent per decibel increase of cumulative noise exposure.

More recently Fidell, et al. (1996) studied the influences of aircraft noise on actual sale prices of residential properties in the vicinity of two military facilities and found that equations developed for one area to predict residential sale prices in areas unaffected by aircraft noise worked equally well when applied to predicting sale prices of homes in areas with aircraft noise in excess of 65 dB DNL. Thus, the model worked equally well in predicting sale prices in areas with and without aircraft noise exposure. This indicates that aircraft noise had no meaningful effect on residential property values. In some cases, the average sale prices of noise exposed properties were somewhat higher than those elsewhere in the same area. In the vicinity of Davis-Monthan AFB in Tucson, AZ, Fidell found the homes near the AFB were much older, smaller and in poorer condition than homes elsewhere. These factors caused the equations developed for predicting sale prices in areas further away from the base to be inapplicable with those nearer the AFB. However, again Fidell found that, similar to other researchers, differences in sale prices between homes with and without aircraft noise were frequently due to factors other than noise itself.

3.10 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, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects would result from routine, subsonic aircraft operations.

3.11 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. Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson, et al. 1991). 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 Concorde airplane at Dulles (Wesler 1977). There was 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 conventional structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

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APPENDIX B

LAND USE COMPATIBILITY RECOMMENDATIONS

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Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
10	Residential							
11	Household units	NA	NA	NA	N[26]	N[26]	N	N
11.11	Single units; detached	N	N	Y[2]	N[26]	N[26]	N	N
11.12	Single units; semidetached	N	N	N	N[26]	N[26]	N	N
11.13	Single units; attached row	N	N	N	N[26]	N[26]	N	N
11.21	Two units; side-by-side	N	N	N	N[26]	N[26]	N	N
11.22	Two units; one above the other	N	N	N	N[26]	N[26]	N	N
11.31	Apartments; walk up	N	N	N	N[26]	N[26]	N	N
11.32	Apartments; elevator	N	N	N	N[26]	N[26]	N	N
12	Group quarters	N	N	N	N[26]	N[26]	N	N
13	Residential hotels	N	N	N	N[26]	N[26]	N	N
14	Mobile home parks or courts	N	N	N	N	N	N	N
15	Transient lodgings	N	N	N	N[26]	N[26]	N[26]	N
16	Other residential	N	N	N	N[26]	N[26]	N	N
20	Manufacturing [3]							
21	Food and kindred products; manufacturing	N	N	Y[4]	Y	Y[27]	Y[22]	Y[29]
22	Textile mill products; manufacturing	N	N	Y[4]	Y	Y[27]	Y[28]	Y[29]
23	Apparel and other finished products made from fabrics, leather, and similar materials; manufacturing	N	N	N	Y	Y[27]	Y[28]	Y[29]

Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
24	Lumber and wood products (except furniture); manufacturing	N	Y[5]	Y[5]	Y	Y[27]	Y[28]	Y[29]
25	Furniture and fixtures; manufacturing	N	Y[5]	Y[5]	Y	Y[27]	Y[28]	Y[29]
26	Paper and allied products; manufacturing	N	Y[5]	Y[5]	Y	Y[27]	Y[28]	Y[29]
27	Printing, publishing, and allied industries	N	Y[5]	Y[5]	Y	Y[27]	Y[28]	Y[29]
28	Chemicals and allied products; manufacturing	N	N	N	Y	Y[27]	Y[28]	Y[29]
29	Petroleum refining and related industries	N	N	N	Y	Y[27]	Y[28]	Y[29]
30	Manufacturing (cont'd) [3]							Y[29]
31	Rubber and misc. plastic products; manufacturing	N	N	N	Y	Y[27]	Y[28]	Y[29]
32	Stone, clay, and glass products; manufacturing	N	N	Y[5]	Y	Y[27]	Y[28]	Y[29]
33	Primary metal products; manufacturing	N	N	Y[5]	Y	Y[27]	Y[28]	Y[29]
34	Fabricated metal products; manufacturing	N	N	Y[5]	Y	Y[27]	Y[28]	Y[29]
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks; manufacturing	N	N	N	Y	25	30	N
39	Miscellaneous manufacturing	N	Y[6]	Y[6]	Y	Y[27]	Y[28]	Y[29]
40	Transportation, communication and utilities [3,6]					Y[27]		
41	Railroad, rapid rail transit, and street railway transportation	N	Y [3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
42	Motor vehicle transportation	N	Y [3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]

Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
43	Aircraft transportation	N	Y[3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
44	Marine craft transportation	N	Y[3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
45	Highway and street right-of-way	N	Y[3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
46	Automobile parking	N	Y[3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
47	Communication	N	Y[3,7]	Y[3]	Y	25,30	30,30	N
48	Utilities	N	Y[3,7]	Y[3]	Y	Y[27]	Y[28]	Y[29]
485	Solid waste disposal (landfills, incineration, etc.)	N	N	N	NA	NA	NA	NA
49	Other transportation, communication, and utilities	N	Y[3,7]	Y[3]	Y	25,30	30,30	N
50	Trade							
51	Wholesale trade	N	Y[5]	Y[5]	Y	Y[27]	Y[28]	Y[29]
52	Retail trade – building materials, hardware, and farm equipment	N	Y[8]	Y[8]	Y	Y[27]	Y[28]	Y[29]
53	Retail trade – shopping centers	N	N[9]	Y[9]	Y	25	30	N
54	Retail trade – food	N	N	Y[10]	Y	25	30	N
55	Retail trade – automotive, marine craft, aircraft, and accessories	N	Y[8]	Y[8]	Y	25	30	N
56	Retail trade – apparel and accessories	N	N	Y[11]	Y	25	30	N
57	Retail trade – furniture, home furnishings, and equipment	N	N	Y[11]	Y	25	30	N
58	Retail trade – eating and drinking establishments	N	N	N	Y	25	30	N

Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
59	Other retail trade	N	N	Y[9]	Y	25	30	N
60	Services [12]							
61	Finance, insurance, and real estate services	N	N	Y[13]	Y	25	30	N
62	Personal services	N	N	Y[14]	Y	25	30	N
62.4	Cemeteries	N	Y[15]	Y[15]	Y	Y[27]	Y[28]	Y [29,24]
63	Business services	N	N	Y[16]	Y	25	30	N
63.7	Warehousing and storage	N	Y[17]	Y[17]	Y	Y[27]	Y[28]	Y[29]
64	Repair services	N	Y[18]	Y[18]	Y	Y[27]	Y[28]	Y[29]
65	Professional services	N	N	Y[9]	Y	25	30	N
65.1	Hospitals, other medical facilities	N	N	N	25	30	N	N
65.16	Nursing homes	N	N	N	N[26]	N[26]	N	N
66	Contract construction services	N	Y[18]	Y[18]	Y	25	30	N
67	Governmental services	N	N	Y[10]	Y[26]	25	30	N
68	Educational services	N	N	N	25	30	N	N
69	Miscellaneous services	N	N	Y[9]	Y	25	30	N
70	Cultural, entertainment and recreational							
71	Cultural activities (including churches)	N	N	N	25	30	N	N
71.2	Nature exhibits	N	Y[19]	Y[19]	Y[26]	N	N	N

Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
72	Public assembly	N	N	N	Y	N	N	N
72.1	Auditoriums, concert halls	N	N	N	25	30	N	N
72.11	Outdoor music shells, amphitheaters	N	N	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	N	N	N	Y[31]	Y[31]	N	N
73	Amusements (including fairgrounds, miniature golf, driving ranges, amusement parks)	N	N	Y	Y	Y	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y[18,19]	Y[18,19]	Y[26]	25	30	N
75	Resorts and group camps	N	N	N	Y[26]	Y[26]	N	N
76	Parks	N	Y[18,19]	Y[18,19]	Y[26]	Y[26]	N	N
79	Other cultural, entertainment and recreation	N	Y[18,19]	Y[18,19]	Y[26]	Y[26]	N	N
80	Resource production and extraction							
81	Agriculture (except livestock)	Y[6]	Y[20]	Y[20]	Y[32]	Y[33]	Y[34]	Y[34,35]
81.5, 81.7	Livestock farming and animal breeding	N	Y[20,21]	Y[20,21]	Y[32]	Y[33]	N	N
82	Agricultural related activities	N	Y[20,22]	Y[20,22]	Y[32]	Y[33]	Y[34]	Y[34,35]
83	Forestry activities and related services [23]	N	Y[22]	Y[22]	Y[32]	Y[33]	Y[34]	Y[34,35]
84	Fishing activities and related services [24]	N[24]	Y[22]	Y[22]	Y	Y	Y	Y
85	Mining activities and related services	N	Y[22]	Y[22]	Y	Y	Y	Y
89	Other resource production and extraction	N	Y[22]	Y[22]	Y	Y	Y	Y

Land Use Compatibility Recommendations

Land Use		Accident Potential Areas[1]			Noise Levels			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65 to 70 DNL	70 to 75 DNL	75 to 80 DNL	80 to 85 DNL
90	Other							
91	Undeveloped land	Y	Y	Y	NA	NA	NA	NA
93	Water areas	N[25]	N[25]	N[25]	NA	NA	NA	NA

Source: U.S. Department of the Navy 2008.

Notes:

1. A "Yes" or a "No" designation for compatible land use is to be used only for general comparison. Within each, uses exist where further evaluation may be needed in each category as to whether it is clearly compatible, normally compatible, or not compatible due to the variation of densities of people and structures. In order to assist installations and local governments, general suggestions as to floor/area ratios (FAR) are provided in OPNAVINST 11010.36C as a guide to density in some categories. In general, land use restrictions that limit commercial, services, or industrial buildings or structure occupants to 25 per acre in APZ I and 50 per acre in APZ II are the range of occupancy levels considered to be low density. Outside events should normally be limited to assemblies of not more than 25 people per acre in APZ I, and maximum assemblies of 50 people per acre in APZ II.
2. The suggested maximum density for detached single-family housing is 1 to 2 dwelling units per acre (Du/Ac). In a Planned Unit Development (PUD) of single-family detached units where clustered housing development results in large open areas, this density could possibly be increased, provided the amount of surface area covered by structures does not exceed 20% of the PUD total area. PUD encourages clustered development that leaves large open areas.
3. Other factors to be considered: Labor intensity, structural coverage, explosive characteristics, air pollution, electronic interference with aircraft, height of structures, and potential glare.
4. Maximum FAR of 0.56.
5. Maximum FAR of 0.28 in APZ I and 0.56 in APZ II.
6. No structures (except airfield lighting), buildings or aboveground utility/communications lines should normally be located in clear zone areas on or off the installation. The clear zone is subject to severe restrictions. See NAVFAC P-80.3 or Tri-Service Manual AFM 32-1123(I); TM 5-803-7, NAVFAC P-971 "Airfield and Heliport Planning & Design" dated 17 November 2008 for specific design details.
7. No passenger terminals and no major aboveground transmission lines in APZ I.
8. Maximum FAR of 0.14 in APZ I and 0.28 in APZ II.
9. Maximum FAR of 0.22.
10. Maximum FAR of 0.24.
11. Maximum FAR of 0.28.

12. Low intensity office uses only. Accessory uses such as meeting places, auditoriums, etc., are not recommended.
13. Maximum FAR of 0.22 for "General Office/Office Park."
14. Office uses only. Maximum FAR of 0.22.
15. No chapels are allowed within APZ I or APZ II.
16. Maximum FAR of 0.22 in APZ II.
17. Maximum FAR of 1.0 in APZ I and 2.0 in APZ II.
18. Maximum FAR of 0.11 in APZ I and 0.22 in APZ II.
19. Facilities must be low intensity and provide no tot lots, etc. Facilities such as clubhouses, meeting places, auditoriums, large classes, etc., are not recommended.
20. Includes livestock grazing but excludes feedlots and intensive animal husbandry. Activities that attract concentrations of birds creating a hazard to aircraft operations should be excluded.
21. Includes feedlots and intensive animal husbandry.
22. Maximum FAR of 0.28 in APZ I and 0.56 in APZ II. No activity that produces smoke or glare or involves explosives.
23. Lumber and timber products removed due to establishment, expansion, or maintenance of clear zones will be disposed of in accordance with appropriate DoD Natural Resources Instructions.
24. Controlled hunting and fishing may be permitted for the purpose of wildlife management.
25. Naturally occurring water features (e.g., rivers, lakes, streams, wetlands) are compatible.
26. a. Although local conditions regarding the need for housing may require residential use in these zones, residential use is discouraged in DNL 65-69 and strongly discouraged in DNL 70-74. The absence of viable alternative development options should be determined and an evaluation should be conducted prior to approvals indicating that a demonstrated community need for the residential use would not be met if development were prohibited in these zones.
    b. Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor noise level reduction (NLR) of at least 25 dB (DNL 65-69) and 30 dB (DNL 70-74) should be incorporated into building codes and be considered in individual approvals; for transient housing a NLR of at least 35 dB should be incorporated in DNL 75-79.
    c. Normal permanent construction can be expected to provide an NLR of 20 dB; thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation, upgraded Sound Transmission Class (STC) ratings in windows and doors and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels or vibrations.
    d. NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design, and use of berms and barriers can help mitigate outdoor exposure, particularly from ground level sources. Measures that reduce noise at a site should be used wherever practical in preference to measures which only protect interior spaces.
27. Measures to achieve an NLR of 25 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.
28. Measures to achieve an NLR of 30 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.
29. Measures to achieve an NLR of 35 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.
30. If the project or proposed development is noise sensitive, use indicated NLR; if not, land use is compatible without NLR.

31. Land use compatible, provided special sound reinforcement systems are installed.
32. Residential buildings require an NLR of 25.
33. Residential buildings require an NLR of 30.
34. Residential buildings not permitted.
35. Land use not recommended, but if the community decides use is necessary, hearing protection devices should be worn by personnel.

Key:

Y (Yes) = Land use and related structures compatible without restrictions.

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

Y^x (Yes with restrictions) = The land use and related structures are generally compatible. However, see notes indicated by superscript.

N^x (No with restrictions) = The land use and related structures are generally incompatible. However, see notes indicated by superscript.

SLUCM = Standard Land Use Coding Manual.

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

DNL = Day-night average sound level.

NA = Not Applicable (no data available for that category).

25, 30, or 35 = Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 must be incorporated into design and construction of structure.